CITY OF NANAIMO

MANUAL OF ENGINEERING STANDARDS & SPECIFICATIONS

Edition No. 13
May 2020

ENGINEERING STANDARDS & SPECIFICATIONS
INTRODUCTION

(REVISED MAY 2020)

APPENDIX

INTRODUCTION

.1 This Manual of Engineering Standards and Specifications has been compiled to reflect the design requirements, material specifications, and installation requirements for Municipal Works constructed in the City of Nanaimo. For a list of acceptable products for installation within the City of Nanaimo, refer to the City of Nanaimo Approved Products List.

.2 This Manual is intended for use by City Engineering, Public Works, Parks and Recreation Department employees; Consulting Engineers working for the City of Nanaimo; private developers and others doing work in the City.

.3 The Manual is divided into fourteen (14) sections.

(a) Section 1 covers General Drafting Requirements and provides standards for design drawings, as-built drawings, certification of installed works and design in statutory rights-of-way, etc.
(b) Section 2 covers the General Definitions and References for the manual, followed by General Requirements covered in Section 3.
(c) Excavation, trenching and backfill are dealt with Section 4 as it applies to the installation of underground utilities such as water, sanitary sewer and storm sewer lines, and private utilities installed within statutory and road rights-of-way. ***(REVISED MAY 2020)***
(d) Sections 5, 6 and 7 deal with standards for water, sanitary sewer, storm sewer.
(e) Section 8 deals with standards for transportation infrastructure. Section 9 covers standards for the roadway structure, the aggregates and granular materials required. Section 10 deals with standards for roadway lighting and traffic signals. ***(REVISED MAY 2020)***
(f) Sections 11 and 12 deal with information on requirements for cast in place concrete works as well as asphaltic concrete paving. ***(REVISED MAY 2020)***
(g) Section 13 deals with surface treatments, for use in road rights-of-way. ***(REVISED MAY 2020)***
(h) Section 14 covers standards for landscaping in City streets, including required maintenance.

.4 The sections on water, sanitary sewer, storm sewer, transportation, roadway lighting and traffic signals are divided into three basic parts under the following sub-headings: ***(REVISED MAY 2020)***

(a) Design Criteria.
(b) Specifications.
(c) Installation.

.5 Individually, these sub-headings have a numbering sequence common to each section. Each sub-section or sub-heading has a block of numbers reserved and applied to it.

.6 The numbers which have been reserved for each sub-section and which would be preceded by the applicable section number are as follows:

(a) Design Criteria .00 to .19
(b) Specifications .20 to .39
(c) Installation .40 to .69

.7 With this method of numbering, the numbering sequence is not continuous from sub-section to sub-section. Some sub-sections do not use all the numbers allotted to them.

APPLICATION OF THE STANDARDS

.1 The Manual of Engineering Standards and Specifications shall apply to City of Nanaimo capital projects, works within statutory and road rights-of-way and works taken over by the City of Nanaimo related to private development (i.e., subdivision, etc.). There are sections of the Manual which are not applicable to all the various users. However, contracts, designs and construction of works within the scope of the manual shall comply with the intent of the Manual and adhere to the Design, Specification and Installation Requirements.

.2 For the definition of terms used within the Manual, please refer to Section 2.01 – DEFINITION OF TERMS.

.3 For the list of products acceptable for the design within the scope of the Manual, please refer to the City of Nanaimo Approved Products List.

(a) The Approved Product List does not imply automatic approval as a product substitution for a contract specified product. Product substitution is subject to the Design Engineer's approval.

.4 For a list of specifications and other references by the Manual, please refer to Section 2.01B – Reference.

.5 No departure from the requirements of the Manual shall be permitted without the prior approval of the City Engineer.

.6 Where the users of this Manual have any doubt as to the meaning or interpretation of any part of the Manual, they are advised to contact the Engineering, Municipal Infrastructure division for clarification. ***(REVISED MAY 2020)***

.7 Where "approval" is requested by the Manual, it shall mean approval by the City Engineer unless otherwise stated. For "approval", all requests shall be submitted by a Professional Engineer complete with any supporting documentation to the City Engineer.

.8 For proposed works not covered by the requirements of the Manual, supplementary specifications, product information or other supporting documentation shall be submitted by a Professional Engineer for approval.

REQUESTS FOR CHANGES TO THE STANDARDS

.1 Suggestions for changes to the Manual of Engineering Standards and Specifications are welcomed and should be directed to the Engineering, Municipal Infrastructure division using the standard Revision Request Summary Sheet form included in Appendix A of this document. ***(REVISED MAY 2020)***

.2 Requests for change should include the number of the section and clause for which a change is requested; suggested new wording and an explanation of the reason for the requested change.

.3 Requests for change should include red lined mark-ups of the written specifications or standard drawings that are relevant to the suggested change.

.4 Changes which are made will be implemented at the discretion of the Engineering Services Division.

AMENDMENTS TO STANDARDS

.1 The Manual of Engineering Standards and Specifications will be reviewed approximately every three years and amendments issued accordingly. When required, interim amendments will be issued.

.2 Amendments and interim amendments will be issued based on the current list of copy holders. It shall be the responsibility of copy holders to ensure they have all the amendments that are issued. The City of Nanaimo's website will also be updated with the issued changes.

.3 For the use of the copy holder, an Amendment Record Sheet has been included at the back of the Manual.

(REVISED MAY 2020)

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DESIGN DRAWING STANDARDS

DESIGN DRAWINGS STANDARDS

1.01 GENERAL REQUIREMENTS

.1 A complete set of construction drawings shall consist of separate drawings of some or all of the following as determined by the City Engineer:

(a) Site plan and key plan
(b) Plan and profile for roads, drainage and storm sewers
(c) Plan and profile for sanitary sewers and watermains
(d) Plan and profile for sanitary and storm sewers for common trench designs
(e) Plan of proposed street lighting, hydro, telephone, cablevision and gas
(f) Plan of proposed signage and pavement markings
(g) Plan of proposed landscaping and irrigation
(h) Plan of proposed sanitary sewer tributary area plan
(i) Plan of proposed storm sewer tributary area plan
(j) Tree Management Plan ***(REVISED MAY 2020)***
(k) Additional plans showing the proposed site grading plan, stormwater management plan
(l) Additional plans showing any special details and cross sections

.2 Maximum drawing size shall be Arch D (24” x 36”; 610 mm x 915 mm).

.3 All drawings shall be metric. Drawing scales shall be shown on all drawings with scale bars shown for every unique plan.

.4 The drawings shall be neat and legible with adequate clearance margins between the drawing information and the title block border. Notes and text shall locate and describe the proposed work in sufficient detail to facilitate construction. Limits of construction and match lines shall be clearly marked on the drawing.

.5 North arrow shall be shown for every plan on a drawing, and shall be located at the upper left or right of the corresponding plan.

.6 All text to be vertical upper case lettering. The minimum height of lettering for proposed work is 2.5-mm and for existing structures is 1.80-mm. Conflicts between linework, symbols, dimensioning or text shall not occur.

.7 Construction notes shall be boxed and located around the perimeter of the drawing, tagged to the drawing feature.

.8 All elevations shown on drawings shall be metric geodetic datum. The source and location of the datum shall be clearly noted on each drawing in the general notes. Refer to Section 1.42, Co-ordinate System.

.9 The drawing title block shall be completed with the following information:

(a) Project Name
(b) Project Location
(c) Drawing Title
(d) Consulting Company Name or Logo
(e) City of Nanaimo Logo
(f) Drawing Scale
(g) City of Nanaimo Engineering File Number
(h) BP Number, DP Number and SUB Number
(i) City of Nanaimo Drawing Number
(j) Revision
(k) Engineer's Name
(l) Engineer's Seal, Signature and Date

.10 Standard details such as manholes, catch basins, hydrants, etc., that are shown and described in the City of Nanaimo Standard Drawings need not be shown in detail on the drawings; the Standard Drawing No. shall be quoted on the plan for reference. Standard symbols for the various utilities as shown on Standard Drawing No.'s G-4 to G-4I, and Standard Drawing No. G-3 - Standard Materials and Hatch Patterns, shall be used and may be shown in a legend on the drawings.

.11 All drawings shall bear the dated stamp/seal and signature of the professional engineer responsible for the design.

.12 Numerical values shown on the Construction drawings shall be shown to two (2) decimal places unless accuracy warrants otherwise.

1.02 SITE PLAN AND KEY PLAN

.1 The Site Plan of the construction works shall be to a scale of not less than 1:1000.

.2 The site plan shall include but is not limited to the following:

(a) existing watercourses
(b) pavement, curbs
(c) ditches, culverts, storm sewers, manholes, temporary cleanouts, inlet/outlet structures and catch basins
(d) sanitary sewers, manholes, temporary cleanouts
(e) watermains, valves, hydrants, PRV stations, air valves, flushouts
(f) all pertinent property, right-of-way and easement lines
(g) road allowance and easement dimensions
(h) lot numbers and existing legal plan numbers
(i) street addresses
(j) one metre contour lines for slopes greater than 10% existing and proposed
(k) power and telephone and street light poles
(l) plan and profile drawings reference numbers

(m) gas mains, underground hydro, telephone, street lights and cable and their related appurtenances
(n) survey control monuments
(o) routing of all major storm flow including the 100 year storm

.3 A Key Plan to a small sale, (e.g., 1:10000), showing the location of the works in relation to major streets, shall be provided in the upper right-hand section of the drawing sheet.

.4 A drawing index shall be provided and include the drawings titles, sheet numbers, and the City of Nanaimo drawing number.

.5 The following notes shall be shown on either the site plan or the first drawing of the set:

(a) "All work and materials are as described in the City of Nanaimo manual of 'Engineering Standards and Specifications' or as otherwise approved by the City Engineer."
(b) "Connection to, or alteration of, existing City-owned utilities, requires authorization by the City Engineer."
(c) "A 'Permit to Install Works Within Streets, Lanes and City Property Areas', will be required where construction is to be undertaken in City of Nanaimo right-of-ways and/or on City of Nanaimo owned utilities or properties."
(d) "Upon approval of the permit the City of Nanaimo's Engineering Construction Branch shall be notified forty-eight (48) hours prior to commencement of work."
(e) "Contractor is to comply with all applicable Ministry of Forests, Lands, Natural Resource Operations and Rural Development and Fisheries and Oceans Canada requirements at all times during construction.

1.03 PLAN AND PROFILE DRAWINGS - GENERAL

Each Plan and Profile drawings shall show but not be limited to the following information:

.1 Drawings shall be to the following scales unless otherwise approved:

Horizontal - 1:250 for all drawings except;
1:500 for single utility drawings only

Vertical - 1:50 for drawings with plan view scale of 1:250
1:100 for drawings with plan view scale of 1:500

Note: In areas of steep slope, the standard 5x vertical shall be reduced to 2x exaggeration for clarity.

.2 All cadastral information including property, right-of-way and easement lines and dimensions in sufficient detail to relate design to surrounding and adjacent properties. To be included on all drawing submissions.

.3 Legal descriptions and civic addresses of existing properties.

.4 Road allowance dimensions.

.5 Existing pavement, curbs, sidewalks, ditches, driveways, lanes, retaining walls, buildings, trees and shrubs within the right-of-way. Note significant trees on and within 5 metres of the right-of-way.

.6 All existing underground and surface utilities and services shall be labeled with (material type and elevation) including but not limited to the following:

(a) sanitary sewers, storm sewers, watermains and appurtenances
(b) street light poles, conduit and appurtenances
(c) hydro poles and underground wiring ducts and appurtenances
(d) telephone poles, underground wiring ducts and appurtenances and fibre optic cables
(e) gas mains and appurtenances
(f) cable television ducts and appurtenances
(g) traffic control devices, poles, conduits, signs and painting
(h) irrigation systems

.7 All relevant topographic information. For slopes greater than 10 percent, one (1) meter contour lines are required.

.8 Right-of-way and/or road centerline stationing shall be to metric standards (0+000) at 20 metre intervals and shall be related geometrically to legal property lines or survey monuments. Stationing shall run left to right where possible and upstream on gravity pipes.

.9 Plan and Profile drawings shall be drawn with the profile on the bottom of the drawing sheet and shall be lined up under the plan. Utility and road stationing, inverts, diameter, material type, class and grade information shall be located across the bottom of the profile.

.10 Profile elevations shall be placed at both sides of the profile. Split profiles must show elevations on both sides of the break.

1.04 <u>ROADS</u>

The following shall be shown in addition to the information required in section 1.03:

.1 All proposed roadworks, complete with existing elevation tie-in points and offsets from road centerline, including: pavement, curbs, sidewalks and poles.

.2 Stations of the BC & EC of road centerline and curb return horizontal curves together with the curve information including delta angle, radius, tangent length and arc length.

.3 Details of intersections with spot elevations at all critical points including grades and elevations of curb returns.

.4 Catch basin rim elevations and locations related to road centerline stationing.

.5 Existing ground profile and finished pavement profile along the pavement centerline with elevations at 20 metre intervals.

.6 Crossfall or crown information with gutter elevations at change points.

.7 Proposed road centerline grade.

.8 Stations and elevations of BVC, EVC, and VPI.

.9 Vertical curve information including the radius, length of curve and sag or crest K value.

.10 Elevations along the vertical curve at ten (10) metre intervals.

.11 Elevation and station of low and high spots of vertical curves.

.12 Where the slope of existing ground is greater than 10% across the right-of-way, cross-sections shall be shown at intervals not exceeding twenty (20) metres.

.13 Where there is an elevation difference of more than 1.2 m from the design road centre line to a suitable building site on the adjacent parcel, driveway grades and profile shall be shown the drawings.

.14 Where only half road is being constructed, full width design cross-sections shall be provided as required to ensure the design suits the future development of adjacent properties.

.15 Typical road cross-section showing right-of-way width, proposed road design structure, pavement width, sidewalks, curbs, underground utilities, hydro, power and street light poles, hydrants and their related offsets.

.16 Additional design details as required.

1.05 STORM AND SANITARY SEWERS

The following shall be shown in addition to the information required in section 1.03:

.1 Include common trench designs on the same construction drawing.

.2 All proposed storm and sanitary works including manholes, drop pipes, temporary cleanouts, catch basins, inlet/outlet structures, pipe work, ditches, culverts, inspection chambers, services and wyes, complete with offsets for mains, rim elevations, stations related to the road centerline, and pipe inverts at manholes and pipe grad breaks.

.3 Existing ground profile and finished ground profile along the centerline of the proposed sewer.

.4 Distance between manholes with proposed grade of pipe.

.5 Stations and elevations of the BC, and EC of all horizontal curves with the curve information including radius and arc length.

.6 Stations and elevations of the BVC, EVC, and VPI of all vertical curves with the curve information including the length of vertical and maximum pipe deflection. Elevations along vertical curves at then (10) metre intervals.

.7 Existing and proposed pipe crossings to be shown in in profile and to include pipe size, type and invert. (example: EX 200 dia. AC WTR; INV:101.11)

.8 For proposed service connections, the offset location referenced to property line and invert elevation at the property line. Offset distance to include prefix “S” for sanitary and “D” for storm, (i.e. S 2.4m or D 3.0m). Reference Standard Drawing No. T-7, Section 4.0. Service inverts shall be in a table.

.9 Location of existing buildings on properties served by storm and sanitary sewers.

.10 Basement elevations for existing buildings.

.11 Routing of all major storm flows including the 100 year storm with minimum basement floor elevations provided for properties with the potential to be affected by the major storm flows.

.12 The design flow rate and return period shall be noted on each storm drawing.

.13 Material, type, size, inverts and flow direction to be shown for all proposed and existing culverts.

.14 Additional design details as required.

1.06 <u>WATERWORKS</u>

The following shall be shown in addition to the information required in section 1.03:

.1 For new construction, all proposed waterworks attributes including size, type and class of pipe, hydrants, valves, joint restraints, fittings and all related appurtenances with offsets and stationing related to road centerline. For all rehabilitation all proposed waterworks as stated above shall be with offsets and stationing related to the centerline of pipe alignment.

.2 Locations of proposed service connections including an offset distance from an iron pin or lot corner. Offset distance to include the prefix “W”, (i.e. W 1.2m).

.3 Existing ground profile and finished ground profile, and invert profile along the centerline of the proposed watermain.

.4 All other pertinent service crossings to be shown in profile (e.g., sewer mains, gas mains, etc.).

.5 Extent of work required in making the connection to existing watermains.

.6 If the proposed watermain alignment or profile varies from the road centerline, the following shall be provided:

(a) stations of the BC and EC of horizontal curves together with curve information including delta angle, radius, tangent length and arc length.
(b) stations and elevations of the BVC, EVC, AND VPI of vertical curves together with curve information including curve length and maximum pipe deflection required.
(c) elevations along vertical curves at (10) metre intervals.
(d) proposed grades.

.7 Pipes requiring joint restraints shall be shaded, labeled and dimensioned from adjacent fitting showing the length of pipe requiring restraint.

.8 Additional design details as required.

1.07 ORNAMENTAL STREET LIGHTING, TRAFFIC CONTROL SIGNALS, HYDRO, PHONE, GAS AND CABLEVISION FIBRE OPTICS (COMMERCIAL AND PRIVATE)

.1 The following information shall be shown in addition to the information required for the plan view in section 1.03:

(a) pole, conduit and appurtenances locations with offsets and stationing related to road centerline.
(b) size, type, class of conduits.
(c) schematics of wiring details for street lights and traffic signals.
(d) details of detector loops, the location of the power source and all other wiring circuits on traffic signals.

.2 Street lights shall be numbered and pertinent information, (i.e. wattage, lamp type, pole height and location including co-ordinates as per Section 1.42 - Co-ordinate System) shall be shown as per Standard Drawing No. G-7.

.3 The plan shall be to scale of 1:1000, 1:500, or 1:250.

.4 Traffic signal drawings shall generally conform to Section 10.02 - Traffic Signals.

1.08 SIGNAGE AND PAVEMENT MARKINGS

.1 A separate plan shall be prepared in all cases for signage and pavement markings. This plan shall detail all eradications, alterations, additions and new regulatory and advisory signage and line painting. The design shall conform to the Manual of Standard Traffic Signs and Pavement Markings by MoTI or the Manual on Uniform Traffic Control Devices (MUTCD) or City of Nanaimo Traffic and Highway Installation Guidelines. The following information shall be shown:

(a) Lane widths, median radii and taper ratios.

(b) Dimensioned location and type of new or relocated signs.
(c) Completed Traffic Sign Table as per Standard Drawing No. G-7.

.2 The plan shall be to a scale of 1:500 or 1:250.

.3 For drawing clarity, show curb locations only. Do not show utilities, legal information or addresses.

1.09 DETAIL SHEETS

.1 Where there is not a sufficient room on the plan and profile drawings, design details for the particular drawing may be provided on a separate sheet.

.2 Scale shall be determined by the designer to suit the design detail, and shall be included for each detail.

.3 Where road cross-sections are required they may be provided on a separate sheet.

1.10 CROSS-SECTIONS

.1 Cross-sections shall be to a scale of 1:100 horizontal to 1:20 vertical (5:1 vertical exaggeration) or 1:100 horizontal to 1:50 vertical (2:1 vertical exaggeration) in steep slope situations.

.2 Starting at the lower left hand corner of the drawing sheet, cross-sections shall be placed up the sheet in order of increasing stationing. Grid elevations shall be shown at the left hand side of each cross-section and stationing shall be shown above each cross-section. Adequate space shall be left between cross-sections so as to ensure clarity.

.3 Cross-sections shall include:

(a) Design road cross-section within the right-of-way.
(b) Existing ground cross-section extending into the adjacent properties as required.

1.11 <u>LANDSCAPE AND IRRIGATION PLAN PREPARATION</u>

.1 All landscape related construction drawings and inspections required under this Section shall be undertaken by a Landscape Architect registered with the British Columbia Society of Landscape Architects (BCSLA).

.2 The landscape architect shall coordinate the landscape design within the street right-of-way with existing or proposed landscape on private property fronting the road, so as avoid over planting or conflicts with sight distance, existing trees or buildings.

.3 The following information shall be shown in addition to the information required for the plan view in Section 1.03:

(a) Sight distance triangles at intersections.
(b) Proposed slopes steeper than 3:1 to be indicated with slope direction arrow and slope ratio, contours and/or top and bottom of slope lines and elevations.
(c) Proposed tree locations showing trunk center and approximate canopy spread at 15 years age.
(d) Location of all shrub, groundcover beds, grass areas and replacement trees required as per the Management and Protection of Trees Bylaw. ***(REVISED MAY 2020)***
(e) Extent of proposed decorative paving and/or street furnishings.
(f) Plant labels and an associated plant list which indicates quantity, scientific name, common name, plant size, condition (e.g. container or B&B), spacing, and comments.
(g) Identify any replacement trees required as per the Management and Protection of Trees Bylaw. ***(REVISED MAY 2020)***

.4 A typical R.O.W. cross section drawing indicating the relationship of all plantings to overhead, above-ground and below-ground utilities, and pavement and other structures shall be referenced and shown on the landscape plan or, if there is insufficient room, on a details and cross-section sheet.

.5 Typical tree, shrub and groundcover cross section planting details shall be referenced to specific City of Nanaimo standard details Section 14.0, or if alternate details are proposed, these shall be included on the landscape construction drawings.

.6 An irrigation plan shall be produced, using the same base information, which shows:

(a) Location of all heads, emitter devices and driplines; lateral and mainline pipe locations and sizes; sleeves, valve sizes and locations; and location of backflow prevention device and water service connection;
(b) An irrigation equipment legend, and schedule of hydraulic data in metric to include flow and precipitation rate for each valve zone; and
(c) Water service/backflow prevention connection detail, valve and head installation details including all equipment, fittings and related valve boxes, by reference to City of Nanaimo standard details Section 14.0 or if an alternative is proposed, by details shown on the landscape construction drawings.

1.11A TREE MANAGEMENT PLAN ***(REVISED MAY 2020)***

.1 All Tree Management Plan drawings are to be prepared in consultation with a qualified arborist. ***(REVISED MAY 2020)***

.2 The following information shall be shown on the Tree Management Plan: ***(REVISED MAY 2020)***

(a) Existing and proposed works and legal property lines, right-of-way, easement and covenant areas. ***(REVISED MAY 2020)***
(b) Existing trees (including trees within 5 m of right-of-way and/or property lines. ***(REVISED MAY 2020)***
(c) Trees to be protected and trees to be removed. ***(REVISED MAY 2020)***
(d) Location and details of tree protection fencing as per Section 3.27. ***(REVISED MAY 2020)***
(e) Table itemizing tree removal and replacement requirement as per the Management and Protection of Trees Bylaw including size and species. ***(REVISED MAY 2020)***
(f) Summary of tree removal, tree bylaw replacement requirements, proposed tree replacement sand/or contribution toward tree replacement as per the Management and Protection of Trees Bylaw. ***(REVISED MAY 2020)***
(g) Legend to identify trees to be removed, trees to be retained and the tree replacements. ***(REVISED MAY 2020)***

1.12 STORMWATER MANAGEMENT

.1 Refer to Section 1.03 for the general required information.

.2 Refer to Section 7.01.6(b) for the information that shall be shown on Stormwater Management Plans.

1.13 CERTIFICATION OF WORKS

.1 A certification of design conforming to Appendix G1 and signed and sealed by a Professional Engineer shall be submitted with the design drawings.

OTHER GENERAL REQUIREMENTS

1.15 -NOT USED-

1.16 SURVEY CONTROL MONUMENTS

.1 Survey control monuments shall be installed in accordance with Specifications for Control Surveys as prepared by the Province of British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development. The brass plugs are to be accurately drilled by a registered British Columbia Land Surveyor, by City forces, as development growth requires.

RECORD DRAWING STANDARDS

1.20 GENERAL REQUIREMENTS

.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.

.2 Removed utilities shall not be shown on the record drawings. Abandoned utilities shall be displayed and labeled as abandoned on the record drawings.

.3 Line work for all constructed works shown on the drawings shall retain the thicker line density. Proposed construction for future phases of the project shall not be shown on the record drawings.

.4 All dimensions, elevations and inverts shown shall reflect the post construction conditions of the site and all references to 'Proposed' shall be removed. The revision table within the title block shall be completed indicating the drawings are the record drawings.

.5 The record drawing shall reflect the true elevation and location of all constructed features in both the plan and profile views. It is not acceptable to only revise the elevation or dimension labels.

.6 The City of Nanaimo's Engineering and Public Works Department administers a Geographic Information System (GIS) to manage location and attribute data related to underground utilities, roads, pedestrian facilities, traffic signage and street lighting. The GIS data is primarily derived from post construction record drawings. To ensure accuracy and completeness, the following information shall be clearly labeled or identified on the record drawing:

(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 the restrainers are installed.
(e) The In Service Date block for all post construction infrastructure shall be included on the record drawings. Refer to Standard Drawing No. G-4I.

(f) Sanitary Sewer System Plan shall include:

(i) Diameter and material of sanitary mains and service connections
(ii) Identification of forcemains
(iii) Flow direction arrows
(iv) Service lateral inspection chamber locations c/w invert elevation
(v) Identification of water tight or locking manhole covers

Sanitary Sewer System Profile shall include:

(vi) Length, diameter, material and grade of sanitary mains
(vii) Upstream and downstream manhole rim and invert elevations
(viii) Identification of drop manhole structures

(g) Stormwater System Plan shall include:

(i) Diameter and material of storm mains, service connections, catch basin leads and culverts
(ii) Flow direction arrows
(iii) Service lateral inspection chamber locations c/w invert elevation
(iv) Identification of perforated 'French' drains
(v) Identification of catch basin type as per Section 7.0 Stormwater Management
(vi) Identification of inlet/outlet material and type as per Section 7.0 Stormwater Management

Stormwater System Profile shall include:

(vii) Length, diameter, material and grade of storm mains
(viii) Pipe inlet and outlet invert elevations at manholes
(ix) Upstream and downstream manhole rim and invert elevations
(x) Invert elevations of inlet and outlet structures

(h) Water Distribution System Plan shall include:

(i) Diameter and material of watermains and service connections
(ii) Water meter type
(iii) Identification of flushouts as above-ground or below-grade
(iv) Identification of firelines

Water Distribution System Profile shall include:

(v) Diameter and material of watermains
(vi) Invert elevations at pipe tie-in and hydrant locations

(i) Fibre Optic Utility Plan shall include:

(i) Conduct size and type
(ii) Access type

(j) Streets, Street Lighting, Traffic Signs and Markings Plan shall include:

(i) Road classification as per Section 8.0 Transportation. ***(REVISED MAY 2020)***
(ii) Sidewalk material and width
(iii) Crosswalk design type
(iv) Street Light Table as per Standard Drawing G-7 that shall include wattage, lamp type, pole height, pole type, luminaire type, luminaire make
(v) Traffic Sign Table as per Standard Drawing G-7 that shall include UTCD number as per the Transportation Association of Canada's Manual of Uniform Traffic Control Devices for Canada.
(vi) Street marking material and MUTCD number as per the Transportation Association of Canada's Manual of Uniform Traffic Control Devices for Canada
(vii) Pole type

(k) Landscape and Irrigation Plan shall include:

(i) Diameter and material or irrigation main, valve locations and all lateral and sprinkler heads
(ii) Manufacturer's name, the model name and the catalogue number for all controllers
(iii) The as-planted location, species and size of all trees
(iv) The as-planted location, species, size and quantity of shrubs and ground cover shown in a plant list

1.21 RECORD DRAWING SUBMISSION

.1 The record drawings shall be submitted on 3 mil mylar. Drawings must be sealed and signed by the Design Engineer. Three prints of the site plan shall be provided.

.2 The following information shall be submitted with the record drawing submission:

(a) Appendix E, Substantial Completion Statistics Record.
(b) A completed City of Nanaimo Service Sheet in accordance with Appendix F1 or Appendix F2 shall be submitted for each lot showing the as constructed location of all service connections.
(c) Approved and registered statutory right-of-way drawings, if required.
(d) All required testing results including an interpretation and summary of the results by a Professional Engineer.
(e) A copy of the final inspection deficiency list.
(f) Certification of the works that include the following:

(i) A certification of Installed Works conforming to Appendix G2 and signed and sealed by a Professional Engineer
(ii) A Certification of Street Light Installation conforming to Appendix G3 and signed and sealed by a Professional Electrical Engineer
(iii) A Province of British Columbia Electrical Inspectors certification of the street lighting
(iv) A Certification of Landscape Installation conforming to Appendix G4 and signed and sealed by the Landscape Architect.

(g) A Water Meter Information Sheet in accordance with Appendix F3 for all developer installed water meters and detector check valves.
(h) Revised storm drainage calculations, if required, to reflect changes during the storm sewer construction.
(i) Revised sanitary sewer calculations, if required, to reflect changes during the sanitary sewer construction.
(j) Revised street light calculations, if required, to reflect changes during the street light installation.
(k) Operating and maintenance manuals and product information, if required, for sanitary sewer pump stations, water booster pumps, pressure reducing stations, traffic signal controllers, irrigation controllers and other products.

1.22 DIGITAL SUBMISSION OF RECORD DRAWINGS

.1 A copy of the record drawing data as per Section 1.20 General Requirements shall be submitted in the most current version of AutoCAD or Civil 3D (C3D). Refer to Section 1.40.6. No formats prior to 2013 shall be accepted. ***(REVISED MAY 2020)***

.2 All as constructed features shall be surveyed and survey points imported into the digital drawing. ***(REVISED MAY 2020)***

.3 The digital drawing shall contain all works removed or abandoned during construction. The following layers shall be used:

(a) ABD-GAS Gas Infrastructure
(b) ABD-SAN Sanitary Infrastructure
(c) ABD-STM Storm Infrastructure
(d) ABD-WAT Water Infrastructure
(e) REMOVED-CURB Curbs
(f) REMOVED-EP Edges of Pavement
(g) REMOVED-PAINTLINE Paintlines
(h) REMOVED-SAN Sanitary Infrastructure ***(REVISED MAY 2020)***
(i) REMOVED-SIGN Signs ***(REVISED MAY 2020)***
(j) REMOVED-STM Storm Infrastructure
(k) REMOVED-SW Sidewalks
(l) REMOVED-WAT Water Infrastructure

.4 Refer to the MoESS CAD Standards and Section 1.40 Computer Aided Drafting Standards Overview for direction.

CAD STANDARDS

1.40 COMPUTER AIDED DRAFTING STANDARDS OVERVIEW

.1 All infrastructure and land development engineering drawings for projects completed in the City of Nanaimo shall use the City of Nanaimo CAD standard.

.2 The use of a consistent standard is required for the following reasons:

(a) Consistency in the appearance of engineering drawing to facilitate design reviews and construction.
(b) Consistency in the internal drawing structure to facilitate data hand off and usability.
(c) Consistency in the appearance and internal drawing structure to facilitate post construction record drawing submissions.
(d) Consistency in the digital format for automated data collection and import into the City GIS. ***(REVISED MAY 2020)***

.3 Standards were developed for use in C3D. All City of Nanaimo standard files and drawings are based on the 2018 version or newer of AutoDesk software. The CAD standard incorporates both AutoCAD standardized elements and C3D standardized elements. C3D is the model based design tool adopted by the City of Nanaimo. ***(REVISED MAY 2020)***

.4 For the most current City of Nanaimo Drawing Template version, refer to the City of Nanaimo website or contact the Engineering Projects Division.

.5 The City considers C3D as the industry standard software application for the design of civil infrastructure projects and the production of engineering drawings. C3D pipe networks allow designers to input physical properties for sanitary, storm, and watermain models. ***(REVISED MAY 2020)***

.6 The City encourages the submission of C3D files. The object based program includes design components such as points, surfaces, alignments, profiles, corridors, pipe networks and sections that are drawing objects with “intelligence”. With software such as FME, these objects can be converted with attributes intact and imported to the City GIS At some point in the future, the City may require all submissions to be C3D files to take advantage of the attribute opportunities within the C3D and automate the CAD to GIS conversion. ***(REVISED MAY 2020)***

1.41 TEMPLATE DRAWINGS

.1 City of Nanaimo drawing template, (AutoCAD file extension .dwt) is available to engineering and survey consultants for the creation of survey and design drawings. In addition to the drawing template, a pipe catalog is available which adheres to the common pipe materials and sizes approved by the City. This catalog may be utilized with the City template through the “SetNetworkCatalog” command within the C3D software. ***(REVISED MAY 2020)***

(a) C3D Template. ***(REVISED MAY 2020)***
(b) C3D Pipe Catalog. ***(REVISED MAY 2020)***

.2 *Template drawings* contain standard layer definitions and scale-dependent paper space layout definitions with standard title blocks, text styles and dimension styles.

1.42 CO-ORDINATE SYSTEM

.1 All drawings shall be based on a ground coordinate system that is related to the Universal Transverse Mercator (U.T.M.) Projection that is tied to City of Nanaimo's integrated survey monument network. To convert the published NAD83 (Zone 10) grid coordinates of City monuments to the required ground coordinate system suitable for topographic ground surveys, and eventual record drawings, grid coordinates are multiplied by the city wide calculated combined scale factor of 1.00035012254, about coordinate base (0,0). All digital drawing files submitted to the City of Nanaimo must use this common ground coordinate system within the borders of Nanaimo.

.2 If the consultant obtains cadastral and other digital files form the City's GIS, these will be provided in NAD83 (Zone 10) grid coordinates. To shift to the above mentioned ground coordinate system in CAD, all horizontal features must be scaled by 1.00035012254, about coordinate base (0,0).

.3 The vertical datum is the Canadian Vertical Datum of CVD28BC. The integrated survey monument and published elevation used plus the approximate location of the monument (i.e. street intersection or address location) is to be indicated on each record sheet.

.4 All drawings submitted to the City of Nanaimo must use ground level coordinates. To convert to UTM NAD83 (CSRS) coordinates, multiply by combined scale factor of 0.99965.

1.43 LAYER NAMING CONVENTIONS

.1 Layer naming conventions for existing and proposed conditions shall be adhered to. In the event that new layers are required, the consultant shall create the layer name using the standard City of Nanaimo layer naming convention and notify the project manager.

.2 The City of Nanaimo incorporates a categorized CAT layer naming convention used to represent existing and proposed conditions. The naming convention is as follows:

CAT1-CAT2-CAT3

(a) CAT1 represents the feature stage - e.g. EX (for existing), PR (for proposed), REM (for Removed) or ABD (for Abandoned).
(b) CAT2 is used to describe the major feature such as STM (storm), SAN (sanitary), WAT (water), RD (road), etc.
(c) CAT3 is an additional identifier such as TXT (text), PROF (profile), PNTS (points), etc.
(d) For clarity, each category is delimited by a dash. (eg. PR-WAT-TXT)

.3 Refer to Standard Drawings G-1 to G1B for the list of standard layer names and properties, (linetypes, colours, pen weights) used in the City of Nanaimo design drawings.

1.44 STANDARD SYMBOLS AND ABBREVIATIONS

.1 The City of Nanaimo requires that engineering and construction consultants use City of Nanaimo approved standard symbols and abbreviations for the preparation of the design drawings.

.2 The standard abbreviations for both existing and proposed conditions are shown on Standard Drawing G-2.

.3 The standard symbols for both existing and proposed conditions are shown in Standard Drawings G-4A to G-4I.

.4 Standard materials and their representative AutoCAD hatch patterns are shown in Drawing G-3.

G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 1 DWGS\G-1

LAYER LIST

Name	Description	Colour	Linetype
0	*	white	Continuous
ABD-GAS	ABANDONED GAS	8	CoN-Gas
ABD-SAN	ABANDONED SANITARY	8	CoN-Sanitary
ABD-STM	ABANDONED STORM	8	CoN-Storm
ABD-WAT	ABANDONED WATER	8	CoN-Water
AS-BUILT	AS-BUILT INFORMATION LAYER	yellow	Continuous
AS-BUILT-PNTS	AS-BUILT SURVEY POINTS	yellow	Continuous
CITY	CITY OF NANAIMO LOGO	152	Continuous
CITY1	CITY OF NANAIMO LOGO	white	Continuous
CITY2	CITY OF NANAIMO LOGO	140	Continuous
CONST-NOTES	CONSTRUCTION NOTES	yellow	Continuous
CONT-LBL	CONTOUR LINES - LABEL	magenta	Continuous
CONT-MJR	CONTOUR LINES - MAJOR	yellow	Continuous
CONT-MNR	CONTOUR LINES - MINOR	red	Continuous
Defpoints	Defpoints	white	Continuous
DETAILS	DETAILS	white	Continuous
EX-BUILDING	EXISTING BUILDING	173	Continuous
EX-GRID-PROF	EXISTING GRID - PROFILE	9	Continuous
EX-GROUND-PROF	EXISTING GROUND - PROFILE	red	HIDDEN2
EX-INVERTS	EXISTING WATER, STORM & SEWER INVERTS, FLR. ELEVS (INFO LAYER)	240	Continuous
EX-LEG	EXISTING MON, OIP, OIB, ETC. BLOCKS	red	Continuous
EX-LEG-PL	EXISTING LEGAL PROPERTY LINE	252	Continuous
EX-LEG-RD	EXISTING LEGAL ROAD RIGHT OF WAY LINES	13	Continuous
EX-LEG-ROW	EXISTING LEGAL EASEMENT AND RIGHT OF WAY LINES	red	DASHED
EX-LEG-TXT	EXISTING LEGAL TEXT	red	Continuous
EX-NOTES	EXISTING NOTES	yellow	Continuous
EX-RD-MARK	EXISTING TRAFFIC PAINT MARKINGS	151	Continuous
EX-RD-TXT	EXISTING ROAD NAMES	12	Continuous
EX-SAN	EXISTING SANITARY SEWER MAINS	22	CoN-Sanitary
EX-SAN-FlowDir	EXISTING SANITARY SEWER PIPE FLOW DIRECTION	22	Continuous
EX-SAN-PROF	EXISTING SANITARY SEWER AND SERVICES - PROFILE	22	Continuous
EX-SAN-SRVC	EXISTING SANITARY SEWER SERVICES	22	DASHED
EX-SAN-STRC	EXISTING SANITARY SEWER STRUCTURES	22	Continuous
EX-ST-LITE	EXISTING STREET LIGHTS AND SIGNALS	210	CoN-StreetliteDuct
EX-ST-LITE-PROF	EXISTING STREET LIGHTS AND SIGNALS - PROFILE	210	DASHDOT2
EX-STM	EXISTING STORM DRAIN MAIN	100	CoN-Storm
EX-STM-CULV	EXISTING STORM CULVERTS	100	CoN-Storm
EX-STM-DITCH	EXISTING STORM DITCHES	100	DOT2
EX-STM-FlowDir	EXISTING STORM PIPE FLOW DIRECTION	100	Continuous
EX-STM-PROF	EXISTING STORM DRAIN AND SERVICES - PROFILE	100	Continuous
EX-STM-SRVC	EXISTING STORM DRAIN SERVICES	100	DASHED
EX-STM-STRC	EXISTING STORM STRUCTURES	100	Continuous
EX-SURV-COMM	SURVEYED COMM PNTS	210	Continuous
EX-SURV-ELEC	SURVEYED ELEC PNTS	210	Continuous
EX-SURV-GAS	SURVEYED GAS PNTS	240	Continuous
EX-SURV-LEG	SURVEYED LEGAL PNTS	red	Continuous
EX-SURV-LOCT	SURVEYED LOCATED UTILITY	21	Continuous
EX-SURV-MON	SURVEY MONUMENTS	white	Continuous
EX-SURV-PNTS	EXISTING SURVEY PNTS	red	Continuous
EX-SURV-SAN	SURVEYED SANITARY PNTS	22	Continuous
EX-SURV-STM	SURVEYED STORM PNTS	100	Continuous
EX-SURV-TRAV-LINE	EXISTING SURVEY TRAVERSE LINES	green	Continuous
EX-SURV-TRAV-PNTS	EXISTING SURVEY TRAVERSE PNTS	green	Continuous
EX-SURV-WAT	SURVEYED WATER PNTS	150	Continuous
EX-TOPO	EXISTING TOPOGRAPHY NOT LISTED BELOW	cyan	Continuous
EX-TOPO-AC	EXISTING ASPHALT CURB	cyan	Continuous
EX-TOPO-BB	EXISTING BOTTOM OF BANK	cyan	CoN-BotBank
EX-TOPO-CC	EXISTING CONCRETE CURB	cyan	Continuous
EX-TOPO-CCG	EXISTING CONCRETE CURB AND GUTTER	cyan	Continuous
EX-TOPO-DITCH	EXISTING DITCH	cyan	CoN-DitchEx
EX-TOPO-EC	EXISTING EDGE OF CONCRETE	cyan	Continuous
EX-TOPO-EG	EXISTING GROUND - SURFACE	red	Continuous
EX-TOPO-EP	EXISTING EDGE OF PAVEMENT	cyan	CoN-EP
EX-TOPO-FENCE	EXISTING FENCE	cyan	CoN-Fence
EX-TOPO-FL	EXISTING TOPOGRAPHY - FEATURE LINES	94	Continuous
EX-TOPO-GRAVEL	EXISTING GRAVEL	cyan	Continuous
EX-TOPO-HEDGE	EXISTING HEDGE LINE	cyan	CoN-Hedge
EX-TOPO-HW	EXISTING HEADWALL	cyan	Continuous

2.13.2020

CITY OF NANAIMO
THE HARBOUR CITY

STANDARD LAYER NAMES
SHEET 1 OF 3

Scale:	NTS
Created:	NOV 2015
Rev Date:	NOV 2016
Dwg No:	G-1

LAYER LIST			
Name	Description	Colour	Linetype
EX-TOPO-LNDSCP	EXISTING LANDSCAPING	cyan	Continuous
EX-TOPO-NoPost	EXISTING NO POST BARRIER	cyan	Continuous
EX-TOPO-RAILWAY	EXISTING RAILWAY	cyan	Continuous
EX-TOPO-ROCK	EXISTING ROCK OR RIP RAP	cyan	Continuous
EX-TOPO-SHLD	EXISTING SHOULDER	cyan	Continuous
EX-TOPO-TB	EXISTING TOP OF BANK	cyan	CoN-TopBank
EX-TOPO-TRAFFIC	EXISTING TRAFFIC CONTROL (LOOPS, CONDUITS, etc)	cyan	Continuous
EX-TOPO-TREE	EXISTING TREE	green	Continuous
EX-TOPO-TREE-TEXT	EXISTING TREE TEXT	green	Continuous
EX-TOPO-TREELINE	EXISTING TREE LINE	cyan	CoN-TreeLine
EX-TOPO-WALL	EXISTING WALL	cyan	Continuous
EX-UTIL-COMM	EXISTING UNDERGROUND COMMUNICATIONS	210	CoN-Communication
EX-UTIL-COMM-PROF	EXISTING UNDERGROUND COMMUNICATIONS - PROFILE	210	Continuous
EX-UTIL-FIBOPT	EXISTING UNDERGROUND FIBRE OPTIC A	240	CoN-FibreOptic
EX-UTIL-FIBOPT-PROF	EXISTING UNDERGROUND FIBRE OPTIC - PROFILE	240	Continuous
EX-UTIL-GAS	EXISTING GAS MAIN AND SERVICES	240	CoN-Gas
EX-UTIL-GAS-PROF	EXISTING GAS MAIN AND SERVICES - PROFILE	240	HIDDEN
EX-UTIL-HYD	EXISTING UNDERGROUND HYDRO	210	CoN-Hydro
EX-UTIL-HYD-PROF	EXISTING UNDERGROUND HYDRO AND SERVICES - PROFILE	210	DASHDOT2
EX-UTIL-OVERHEAD	EXISTING HYDRO OVERHEAD LINES	210	CoN-OverheadHydro
EX-UTIL-TEL	EXISTING UNDERGROUND TELUS	210	CoN-TelephoneLine
EX-UTIL-TEL-PROF	EXISTING UNDERGROUND TELUS - PROFILE	210	Continuous
EX-WAT	EXISTING WATERMAINS	150	CoN-Water
EX-WAT-PROF	EXISTING WATERMAINS AND SERVICES - PROFILE	150	Continuous
EX-WAT-SRVC	EXISTING WATER SERVICES	150	DASHED
EX-WAT-STRC	EXISTING WATERMAIN STRUCTURES	150	Continuous
EX-WATERBODY	EX-WATERBODY	142	Continuous
EX-WATERCOURSE	EX-WATERCOURSE	142	Continuous
FUT-LEG-PL	FUTURE LEGAL PROPERTY LINE	56	BORDER2
FUT-LEG-ROW	FUTURE LEGAL RIGHT-OF-WAY, EASEMENTS	56	DASHED2
FUT-LEG-TXT	FUTURE LEGAL TEXT	56	Continuous
FUT-RD	FUTURE ROAD (ADD -CAT3 LAYER IF DESIRED)	56	DASHEDX2
FUT-RD-SW	FUTURE SIDEWALK	56	HIDDEN2
FUTURE	FUTURE DESIGN WORKS TEXT (ADD - CAT2)	56	PHANTOM2
FUTURE-TXT	FUTURE TEXT	56	Continuous
IMAGE	Images - Underlaid No Print	white	Continuous
LAYOUT	CONSTRUCTION LAYOUT LINES	red	Continuous
LAYOUT-PNTS	CONSTRUCTION LAYOUT POINTS	yellow	Continuous
ORTHO	ORTHO PHOTO	white	Continuous
PR-BUILDING	PROPOSED BUILDINGS AND STRUCTURES	214	Continuous
PR-DETAILS	PROPOSED CONSTRUCTION DETAILS AND NOTES	green	Continuous
PR-FG	PR-FG	white	Continuous
PR-GRADING	PROPOSED GRADING LINES	white	Continuous
PR-GRADING-PROF	PROPOSED GRADING LINES-PROFILE	white	Continuous
PR-LEG-PL	PROPOSED LEGAL PROPERTY LINES	yellow	PHANTOM2
PR-LEG-ROW	PROPOSED LEGAL RIGHT OF WAY AND ROAD WIDENINGS	yellow	DASHED
PR-LEG-TXT	PROPOSED LEGAL TEXT	yellow	Continuous
PR-NOTES	PROPOSED CONSTRUCTION NOTES AND LEADER LINES	yellow	Continuous
PR-RD-AC	PROPOSED ASPHALT CURB	110	Continuous
PR-RD-ASSM	PROPOSED ROAD ASSEMBLY	white	Continuous
PR-RD-CB	PROPOSED CATCHBASINS AND INFO	yellow	Continuous
PR-RD-CC	PROPOSED CONCRETE CURB	110	Continuous
PR-RD-CCG	PROPOSED CONCRETE CURB AND GUTTER	110	Continuous
PR-RD-CL	PROPOSED ROAD CENTRE LINE	yellow	CENTER
PR-RD-CL-PROF	PROPOSED ROAD CENTRE LINE - PROFILE	yellow	Continuous
PR-RD-CL-PROF-VIEW	PROPOSED ROAD CL PROFILE VIEW	white	Continuous
PR-RD-CL-XS-VIEW	PR-RD-CL-XS-VIEW	white	Continuous
PR-RD-CORR	PROPOSED ROAD CORRIDOR	white	Continuous
PR-RD-CORR-CUT	PROPOSED ROAD CORRIDOR - SHOWN IN CUT	237,38,2	Continuous
PR-RD-CORR-FILL	PROPOSED ROAD CORRIDOR - SHOWN IN FILL	53,237,2	Continuous
PR-RD-DES	SECTION LINES AND TEMPLATE ALIGNMENTS	white	Continuous
PR-RD-DIM	PROPOSED ROAD DIMENSIONS	yellow	Continuous
PR-RD-EP	PROPOSED EDGE OF PAVEMENT	110	Continuous
PR-RD-FURNITURE	PROPOSED STREET FURNITURE (BENCHES, PLANTERS....)	red	Continuous
PR-RD-GRADES	PROPOSED ROAD ELEVATIONS	yellow	Continuous
PR-RD-HATCH	PROPOSED ROAD SHADING FOR PAVING	254	Continuous
PR-RD-INTERSECTION	PR-RD-INTERSECTION	white	Continuous
PR-RD-LANDSCAPE	PROPOSED STREET LANDSCAPING	114	Continuous

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CITY OF NANAIMO
THE HARBOUR CITY

STANDARD LAYER NAMES
SHEET 2 OF 3

Scale: NTS
Created: NOV 2015
Rev Date: NOV 2016
Dwg No: G-1A

LAYER LIST

Name	Description	Colour	Linetype
PR-RD-MARK	PROPOSED TRAFFIC PAINT MARKINGS	191	Continuous
PR-RD-MASSHAUL	MASSHAUL DIAGRAM	white	Continuous
PR-RD-PROF	PROPOSED ROAD - PROFILE	yellow	Continuous
PR-RD-SAMPLE	SECTION SAMPLE LINES AND TEXT	red	Continuous
PR-RD-SHLD	PROPOSED ROAD SHOULDER	red	Continuous
PR-RD-SIGN	PROPOSED ROAD SIGN	yellow	Continuous
PR-RD-STA	PROPOSED ROAD STATION LABELS	yellow	Continuous
PR-RD-SW	PROPOSED SIDEWALKS	40	Continuous
PR-RD-TEXT	PROPOSED ROAD TEXT	white	Continuous
PR-RD-TRAFFIC	PROPOSED ROAD TRAFFIC CONTROL (LOOPS, CONDUITS, etc)	yellow	Continuous
PR-RD-XS-VIEW	PROPOSED ROAD CROSS SECTION VIEW	white	Continuous
PR-SAN	PROPOSED SANITARY SEWER MAINS	11	Continuous
PR-SAN-PROF	PROPOSED SANITARY SEWER AND SERVICES - PROFILE	11	Continuous
PR-SAN-SRVC	PROPOSED SANITARY SEWER SERVICES	11	Continuous
PR-SAN-STRC	PROPOSED SANITARY SEWER STRUCTURES (MANHOLES, COs...)	11	Continuous
PR-ST-LITE	PROPOSED STREETLIGHTS, SIGNALS AND DUCTS	yellow	Continuous
PR-STM	PROPOSED STORM DRAIN MAINS	93	Continuous
PR-STM-CULV	PROPOSED STORM DRAIN CULVERTS	93	Continuous
PR-STM-PROF	PROPOSED STORM DRAIN AND SERVICES - PROFILE	93	Continuous
PR-STM-SRVC	PROPOSED STORM DRAIN SERVICES	93	Continuous
PR-STM-STRC	PROPOSED STORM DRAIN STRUCTURES (MANHOLES, CBs....)	93	Continuous
PR-TABLE-FILL	PROPOSED TABLE - IN FILL	8	Continuous
PR-TABLE-GRID	PROPOSED TABLE - GRID	253	Continuous
PR-TABLE-LINES	PROPOSED TABLE - LINES	red	Continuous
PR-TABLE-TEXT	PROPOSED TABLE - TEXT	yellow	Continuous
PR-TOPO-DITCH	PROPOSED DITCHLINE	red	CoN-DitchNew
PR-TOPO-FG	PROPOSED FINISHED GRADE	40	Continuous
PR-TOPO-GRAD	Topography: grading	94	Continuous
PR-TOPO-GRAD-CUT	Topography: grading cut material	red	Continuous
PR-TOPO-GRAD-FILL	Topography: grading fill material	94	Continuous
PR-UTIL-COMM	PROPOSED UNDERGROUND COMM LINES	231	BORDER2
PR-UTIL-COMM-PROF	PROPOSED UNDERGROUND COMM LINES - PROFILE	231	Continuous
PR-UTIL-FIBOPT	PROPOSED UNDERGROUND FIBRE OPTIC CABLE/DUCT	231	BORDER2
PR-UTIL-GAS	PROPOSED GAS MAIN AND SERVICES	231	BORDER2
PR-UTIL-GAS-PROF	PROPOSED GAS MAIN AND SERVICES - PROFILE	231	Continuous
PR-UTIL-HYD	PROPOSED UNDERGROUND HYDRO	231	BORDER2
PR-UTIL-TEL	PROPOSED UNDERGROUND TELEPHONE	231	BORDER2
PR-WALL	PROPOSED WALL	230	Continuous
PR-WAT	PROPOSED WATERMAINS	161	Continuous
PR-WAT-PROF	PROPOSED WATERMAIN AND SERVICES - PROFILE	161	Continuous
PR-WAT-SRVC	PROPOSED WATER SERVICES	161	Continuous
PR-WAT-STRC	PROPOSED WATER STRUCTURES (AIRVALVES, FLUSHOUT....)	161	Continuous
RED-LINE-CITY	RED LINE MARKUP BY CITY	red	Continuous
RED-LINE-CONSULT	RED LINE MARKUP BY CONSULTANTS	red	Continuous
REMOVED-CURB	REMOVED CURBS	201	Continuous
REMOVED-EP	REMOVED EDGE OF ASPHALT	201	CoN-EP
REMOVED-PAINTLINE	REMOVED PAINTLINES	201	Continuous
REMOVED-SAN	REMOVED SANITARY	201	CoN-Sanitary
REMOVED-SIGN	REMOVED SIGNS	201	Continuous
REMOVED-STM	REMOVED STORM	201	CoN-Storm
REMOVED-SW	REMOVED SIDEWALK	201	Continuous
REMOVED-WAT	REMOVED WATER	201	CoN-Water
SRF-BOUNDARY	SURFACE BOUNDARIES (No Plot)	24	Continuous
SRF-BREAKLINES	SURFACE BREAKLINES	54	Continuous
SRF-EXISTING GROUND	SURFACE VIEW	115	Continuous
TITLE BLOCK	TITLE BLOCK LAYER	white	Continuous
VIEWPORT	VIEWPORT LAYER - NO PRINT	247	Continuous
Waterdrop	WATERDROP ANALYSIS - NO PRINT	140	Continuous
WIPEOUT	WIPEOUT	white	Continuous
WORKING LOCATES	BLOCKS FOR LOCATES TO DRAW IN PROFILE - NO PRINT	35	Continuous
WORKING NO PRINT	SCRATCH LAYER - NO PRINT	35	Continuous
XREF	XREFS ATTACHED TO DRAWING	white	Continuous

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CITY OF NANAIMO
THE HARBOUR CITY

STANDARD LAYER NAMES
SHEET 3 OF 3

Scale: NTS
Created: NOV 2015
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Dwg No: G-1B

STANDARD ABBREVIATIONS

PIPE MATERIAL ABBREVIATIONS

AC	ASBESTOS CONCRETE
CMP	CORRUGATED METAL PIPE
CI	CAST IRON
CP	CONCRETE PIPE
CU	COPPER
DI	DUCTILE IRON
HDPE	HIGH DENSITY POLYETHYLENE
PVC	POLYVINYL CHLORIDE
RC	REINFORCED CONCRETE
ST	STEEL
VC	VITRIFIED CLAY

GENERAL ABBREVIATIONS

ASP	ASPHALT
CONC	CONCRETE
NTS	NOT TO SCALE
REQ'D	REQUIRED
TYP	TYPICAL
UNO	UNLESS NOTED OTHERWISE

PIPING ABBREVIATIONS

COMPR	COMPRESSION FITTING
F	FLANGE
FIPT	FEMALE IRON PIPE THREAD
H	HUB
MIPT	MALE PIPE PIPE THREAD

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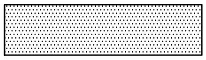
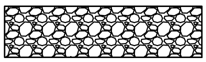
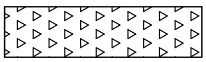
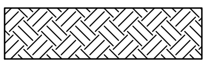
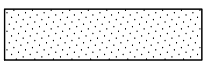
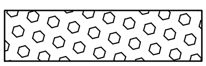
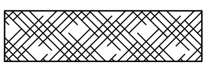
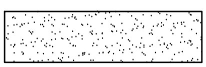
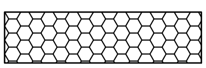
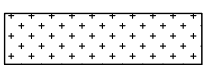
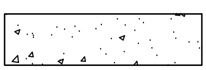
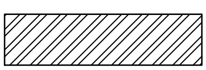
2.13.2020

CITY OF NANAIMO
THE HARBOUR CITY

STANDARD ABBREVIATIONS

Scale:	NTS
Created:	NOV 2015
Rev Date:	NOV 2016
Dwg No:	G-2

SYMBOL	MATERIAL	AutoCAD PATTERN
	PROPOSED ASPHALT PAVEMENT	DOTS
	EXISTING ASPHALT PAVEMENT	NO HATCH
	GRANULAR BASE	GRAVEL
	GRANULAR SUB-BASE	TRIANG
	UNDISTURBED EXISTING GROUND	EARTH
	GRANULAR PIPE BEDDING	DOTS
	IMPORTED GRANULAR BACKFILL	HEX
	APPROVED NATIVE BACKFILL	HOUND
	PIT RUN SAND	AR-SAND
	DRAIN ROCK	HONEY
	IMPORTED TOP SOIL	CROSS
	CONCRETE	AR-CONC
	METAL	ANSI 32

CITY OF NANAIMO
THE HARBOUR CITY

STANDARD MATERIALS
AND HATCH PATTERNS

Scale:	NTS
Created:	NOV 2015
Rev Date:	NOV 2016
Dwg No:	G-3

Existing Topographical Features

Layers

LAYER	Description	Colour	Linetype
EX-BUILDING	Existing Building	173	
EX-GROUND-PROF	Existing Ground in Profile	Red	
EX-TOPO	Existing Topo not listed elsewhere	Cyan	
EX-TOPO-BB	Existing Bottom of Bank	Cyan	
EX-TOPO-DITCH	Existing Ditch	Cyan	
EX-TOPO-EC	Existing Edge of Concrete	Cyan	
EX-TOPO-EG	Existing Ground - Surface	Red	
EX-TOPO-FENCE	Existing Fence	Cyan	X X X
EX-TOPO-FL	Existing Feature Line	94	
EX-TOPO-GRAVEL	Existing Gravel	Cyan	
EX-TOPO-HEDGE	Existing Hedge	Cyan	
EX-TOPO-HW	Existing Headwall	Cyan	
EX-TOPO-LNDSCP	Existing Landscaping	Cyan	
EX-TOPO-RAILWAY	Existing Railway	Cyan	
EX-TOPO-ROCK	Existing Rock	Cyan	
EX-TOPO-TB	Existing Top of Bank	Cyan	
EX-TOPO-TREE	Existing Tree	Green	
EX-TOPO-TREELINE	Existing Tree Line	Cyan	
EX-TOPO-WALL	Existing Wall	Cyan	
EX-WATERBODY	Existing Waterbody	142	
EX-WATERCOURSE	Existing Watercourse	142	

Point Descriptions and Styles

Point Style	Field Code	Point Style	Label Style	Block Name	Layer
BOL	bol	Bollard	Con-Label	EX-BOL	EX-TOPO
BH	bh	Borehole	Con-Label	EX-BH	EX-TOPO
GATE	gp	Post	Con-Label	EX-POST	EX-TOPO
LAMP	lamp	Lamp	Con-Label	EX-LAMP	EX-TOPO
MW	mw	Monitor Well	Con-Label	EX-MW	EX-TOPO
POST	post	Post	Con-Label	EX-POST	EX-TOPO
PIL LAMP	pil	Pillar Lamp	Con-Label	EX-PIL-LAMP	EX-TOPO
PILLAR	pi	Pillar	Con-Label	EX-PIL	EX-TOPO
	sh	Shrub	Con-No Desc	EX-SHRUB	EX-TOPO
*	tr	Tree	Con-No Desc	EX-TREE	EX-TOPO-TREE
*	tr2	Tree2	Con-No Desc	EX-TREE2	EX-TOPO-TREE
*	tr3	Tree3	Con-No Desc	EX-TREE3	EX-TOPO-TREE
*	tr2	Tree4	Con-No Desc	EX-TREE4	EX-TOPO-TREE

For Survey codes that do not display a symbol, see Dwg No G-8

* Survey codes allows for scaling of symbol, see Dwg No G-8

CITY OF NANAIMO
THE HARBOUR CITY

STANDARD SYMBOLS
SHEET 1 OF 10

Scale:	NTS
Created:	NOV 2015
Rev Date:	NOV 2016
Dwg No:	G-4

Existing Roadway Features (including Traffic Control)

Layers

LAYER	Description	Colour	Linetype
EX-RD-MARK	Existing Traffic Paint Markings	151	
EX-RD-TEXT	Existing Road Names	12	
EX-ST-LITE	Existing Streetlight Ducts	210	E E
EX-ST-LITE-PROF	Existing Streetlight - Profile	210	
EX-TOPO-AC	Existing Asphalt Curb	Cyan	
EX-TOPO-CC	Existing Concrete Curb	Cyan	
EX-TOPO-CCG	Existing Concrete Curb & Gutter	Cyan	
EX-TOPO-EP	Existing Edge of Pavement	Cyan	/// /// /// ///
EX-TOPO-NoPost	Existing No Post Barrier	Cyan	
EX-TOPO-SHLD	Existing Shoulder	Cyan	
EX-TOPO-TRAFFIC	Existing Traffic Control (Loops, Conduits, etc)	Cyan	

Point Descriptions and Styles

Point Style	Field Code	Point Style	Label Style	Block Name	Layer
LS	ls	Lamp Standard	Con-Label	EX-LS	EX-TOPO
SIGN	sign	Sign	Con-Label	EX-SIGN	EX-TOPO
SIGN	sign2	Sign2	Con-Label	EX-SIGN2	EX-TOPO
TS	ts	Traffic Signal	Con-Label	EX-TSP1	EX-TOPO-TRAFFIC
TS	ts2	Traffic Signal2	Con-Label	EX-TSP2	EX-TOPO-TRAFFIC
TSB	tsb	Junction Box	Con-Label	EX-JB	EX-TOPO-TRAFFIC

For Survey codes that do not display a Symbol, see Dwg No G-8

CITY OF NANAIMO
THE HARBOUR CITY

STANDARD SYMBOLS
SHEET 2 OF 10

Scale: NTS
Created: NOV 2015
Rev Date: NOV 2016
Dwg No: G-4A

Existing Legal Features

Layers

LAYER	Description	Colour	Linetype
EX-LEG	Existing Monuments, OIPs, etc	Red	
EX-LEG-PL	Existing Legal Property Lines	252	
EX-LEG-RD	Existing Legal Road ROW's	13	
EX-LEG-ROW	Existing Legal Easements and Right of Way Lines	Red	
EX-LEG-TXT	Existing Legal Text	Red	
EX-SURV-LEG	Existing Legal Pnts	Red	
EX-LEG-MON	Existing Monuments	Red	

Point Descriptions and Styles

Point Style	Field Code	Point Style	Label Style	Block Name	Layer
MON	mon*	Monument	Con-Label	mon	EX-LEG
ocm	ocm*	Trav Hub	Con-Label	EX-TRAVHUB	EX-SURV-LEG
OIB	oib	OIP	Con-Label	oip	EX-LEG
OIP	oip	OIP	Con-Label	oip	EX-LEG
OLP	olp	OIP	Con-Label	oip	EX-LEG
85 100.000 th	th*	Trav Hub	Nanaimo-Pt-Elev-Desc	oip	EX-SURV-TRAV-PNTS

For Survey codes that do not display a Symbol, see Dwg No G-8

Existing Infrastructure Features (Sanitary, Storm and Water)

Layers

LAYER	Description	Colour	Linetype
ABD-SAN	Abandoned Sanitary	8	S S
ABD-STM	Abandoned Storm	8	D D
ABD-WAT	Abandoned Water	8	W W
EX-SAN	Existing Sanitary Sewer Mains	22	S S FM FM
EX-SAN-FlowDir	Existing San Pipe Flow Direction	22	
EX-SAN-PROF	Existing Sanitary Sewer - Profile	22	
EX-SAN-SRVC	Existing Sanitary Sewer Services	22	
EX-SAN-STRC	Existing San Sewer Structures	22	
EX-STM	Existing Storm Drain Mains	100	D D
EX-STM- CULV	Existing Storm Culverts	100	D D
EX-STM- DITCH	Existing Storm Ditches	100	
EX-STM- FlowDir	Existing Storm Pipe Flow Direction	100	
EX-STM- PROF	Existing Storm Drain - Profile	100	
EX-STM- SRVC	Existing Storm Drain Services	100	
EX-STM- STRC	Existing Storm Structures	100	
EX-SURV- SAN	Surveyed Sanitary Points	22	
EX-SURV- STM	Surveyed Storm Points	100	
EX-SURV- WAT	Surveyed Water Points	150	
EX- WAT	Existing Watermains	150	W W
EX- WAT-PROF	Existing Watermains - Profile	150	
EX- WAT-SRVC	Existing Water Services	150	
EX- WAT-STRC	Existing Water Structures	150	

Point Descriptions and Styles

Point Style	Field Code	Point Style	Label Style	Block Name	Layer
CB	cb	Catch Basin	Con-Label	EX-CB	EX-SURV-STM
CBG	cb	Catch Basin Gutter	Con-Label	EX-CBG	EX-SURV-STM
CBMH	cbmh	Manhole	Con-Label	EX-CB	EX-SURV-STM
CBR	cbr	Catch Basin Round	Con-Label	EX-CBR	EX-SURV-STM
	inv	Invert	Con-No Desc	EX-INV	EX-SURV-STM
DCO	sdco	Cleanout	Con-Label	EX-CO	EX-SURV-STM
DIC	sdic	Inspection Chamber	Con-Label	EX-IC	EX-SURV-STM
DMH	sdmh	Manhole	Con-Label	EX-MH	EX-SURV-STM
SCO	ssco	Cleanout	Con-Label	EX-CO	EX-SURV-SAN
SIC	ssic	Manhole	Con-Label	EX-MH	EX-SURV-SAN
SMH	ssmh	Manhole	Con-Label	EX-MH	EX-SURV-SAN

See next sheet for Existing Watermain

G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 1 DWGS\G-4

2.13.2020

CITY OF NANAIMO
THE HARBOUR CITY

STANDARD SYMBOLS
SHEET 4 OF 10

Scale: NTS
Created: NOV 2015
Rev Date: NOV 2016
Dwg No: G-4C

Existing Infrastructure Features (Sanitary, Storm and Water)

Point Descriptions and Styles

Point Style	Field Code	Point Style	Label Style	Block Name	Layer
AV	av	Air Valve	Con-No Desc	EX-AV	EX-SURV-WAT
FH	fh	Hydrant	Con-Label	EX-FH	EX-SURV-WAT
IRR	irg	Junction Box Round	Con-Label	EX-JB	EX-SURV-WAT
FO	stdp	Flushout	Con-Label	EX-FO	EX-SURV-WAT
VENT	vent	Vent	Con-Label	EX-VENT	EX-SURV-WAT
WM	wme	Water Meter	Con-Label	EX-WME	EX-SURV-WAT
WMH	wmh	Manhole	Con-Label	EX-MH	EX-SURV-WAT
WV	wv	Water Valve	Con-Label	EX-WGV	EX-SURV-WAT

Existing Blocks displayed in GIS drawing or not displayed in Survey Points

Block	Block Name	Description
	EX-CAP	Existing Cap
	EX-Cathodic	Existing Cathodic Protection Station
	EX-DCB	Existing Double Catch Basin
	EX-DrainValve	Existing Drain Valve
	EX-HWALL	Existing Headwall Structure
	EX-PP-Lease	Existing PowerPole with Lease Light
	EX-PigLoader	Existing Pig Loader
P	EX-PUMP	Existing Water Pump
	EX-PumpStation	Existing Sanitary Pump Station
	EX-Red	Existing Reducer
SRV	EX-SRV	Existing Surge Relief Valve
SP	EX-StandPipe	Existing Standpipe for Fire Fighting
	EX-SurgeRelief	Existing Surge Relief Tank
M	EX-WatChamber	Existing Watermeter Chamber
NC	EX-WGV-NC	Existing Water Gate Valve, Normally Closed
PRV	EX-WPRV	Existing Water Pressure Reducing Station
	EX-WV-BFLY	Existing Water Butterfly Valve
	EX-WV-CHK	Existing Water Check Valve

CITY OF NANAIMO
THE HARBOUR CITY

STANDARD SYMBOLS
SHEET 5 OF 10

Scale:	NTS
Created:	NOV 2015
Rev Date:	NOV 2016
Dwg No:	G-4D

Existing Utilities (Hydro, Telephone, Cable, Gas, Fibre Optic)

Layers

LAYER	Description	Colour	Linetype
ABD-GAS	Abandoned Gas	8	G G
EX-SURV-COMM	Surveyed Communication Pnts	210	
EX-SURV-ELEC	Surveyed Electrical Pnts	210	
EX-SURV-GAS	Surveyed Gas Pnts	240	
EX-UTIL-COMM	Existing Underground Communications	210	C C
EX-UTIL-COMM-PROF	Existing Underground Communications - Profile	210	
EX-UTIL-FIBOPT	Existing Underground Fibre Optic	240	F/O F/O
EX-UTIL-FIBOPT-PROF	Existing Underground Fibre Optic	240	
EX-UTIL-GAS	Existing Underground Gas	240	G G
EX-UTIL-GAS-PROF	Existing Underground Gas-Profile	240	
EX-UTIL-HYD	Existing Underground Hydro	210	H H
EX-UTIL-HYD-PROF	Existing Underground Hydro - Profile	210	
EX-UTIL-OVERHEAD	Existing Overhead Lines	210	O/H O/H
EX-UTIL-TEL	Existing Underground Telus	210	T T
EX-UTIL-TEL-PROF	Existing Underground Telus-Profile	210	

Point Descriptions and Styles

Point Style	Field Code	Point Style	Label Style	Block Name	Layer
A	a	Anchor	Con-Label	EX-ANCH	EX-SURV-COMM
AP	ap	Anchor Pole	Con-Label	EX-ANCH	EX-SURV-COMM
BCHMH	bchmh	Manhole	Con-Label	EX-MH	EX-SURV-COMM
EB	eb	Junction Box	Con-Label	EX-JB	EX-SURV-ELEC
GAS	gv	Gas Valve	Con-Label	EX-WGV	EX-SURV-GAS
JB	jb	Junction Box	Con-Label	EX-JB	EX-SURV-ELEC
JBR	jbr	Junction Box Round	Con-Label	EX-JBR	EX-SURV-ELEC
PP	pp	Power Pole	Con-Label	EX-PP	EX-SURV-COMM
TELBOX	telbox	Junction Box	Con-Label	EX-JB	EX-SURV-COMM
TELMH	Telus Manhole	Manhole	Con-Label	EX-MH	EX-SURV-COMM

For Survey codes that do not display a Symbol, see Dwg No G-8

CITY OF NANAIMO
THE HARBOUR CITY

STANDARD SYMBOLS
SHEET 6 OF 10

Scale:	NTS
Created:	NOV 2015
Rev Date:	NOV 2016
Dwg No:	G-4E

Proposed Topographical Features

Layers

LAYER	Description	Colour	Linetype
PR-BUILDING	Proposed Building and Structures	214	
PR-GRADING	Proposed Grading	White	
PR-GRADING-PROF	Proposed Grading - Profile	White	
PR-TOPO-DITCH	Proposed Ditchline	Red	
PR-TOPO-FG	Proposed Finished Grade	Red	
PR-TOPO-GRAD	Proposed Grading	94	
PR-TOPO-GRAD-CUT	Proposed Grading Cut	Red	
PR-TOPO-GRAD-FILL	Proposed Grading Fill	94	
PR-WALL	Proposed Wall	230	

Proposed Legal Features

Layers

LAYER	Description	Colour	Linetype
PR-LEG-PL	Proposed Property Line	Yellow	
PR-LEG-ROW	Proposed Right of Ways and Easements	Yellow	
PR-LEG-TXT	Proposed Legal Text	Yellow	

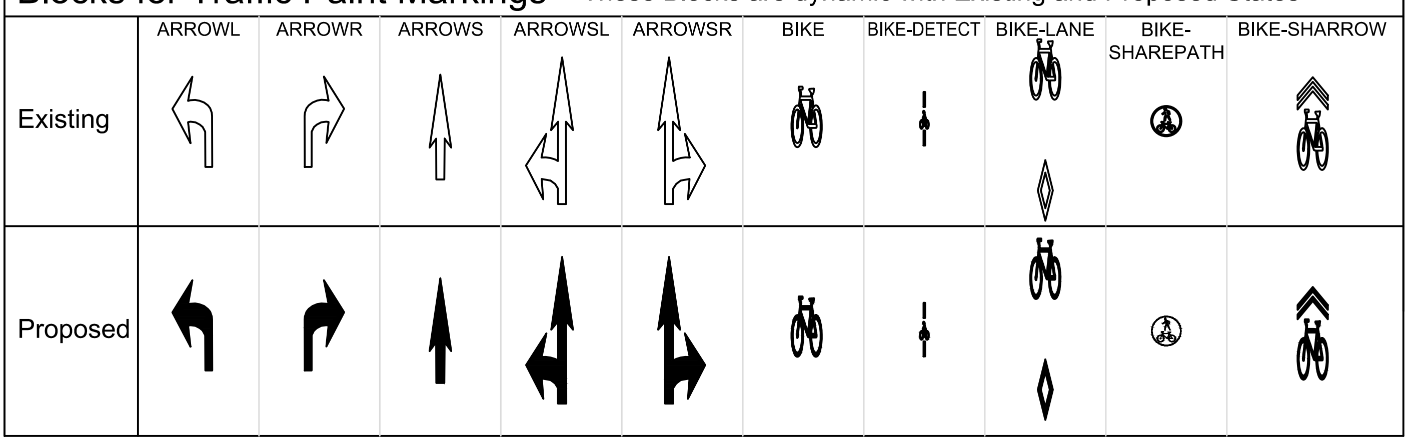
Future Features

Layers

LAYER	Description	Colour	Linetype
FUTURE	Future Works (add CAT 2)	56	
FUT-LEG-PL	Future Legal Property Line	56	
FUT-LEG-ROW	Future Right of Ways, Easements	56	
FUT-LEG-TEXT	Future Legal Text	56	
FUT-RD	Future Road	56	
FUT-RD-SW	Future Sidewalk	56	
FUTURE-TXT	Future Text (add CAT 3)	56	

Blocks for Traffic Paint Markings

These Blocks are dynamic with Existing and Proposed States



CITY OF NANAIMO
THE HARBOUR CITY

STANDARD SYMBOLS
SHEET 7 OF 10

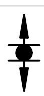
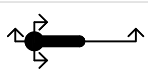
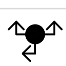
Scale: NTS
Created: NOV 2015
Rev Date: NOV 2016
Dwg No: G-4F

Proposed Roadway Features (including Traffic Control)

Layers

LAYER	Description	Colour	Linetype
PR-RD-AC	Proposed Asphalt Curb	110	
PR-RD-CB	Proposed Catch Basin and Info	Yellow	
PR-RD-CC	Proposed Concrete Curb	110	
PR-RD-CCG	Proposed Concrete Curb & Gutter	110	
PR-RD-CL	Proposed Road Centreline	Yellow	
PR-RD-CL-PROF	Proposed Road Centreline-Profile	Yellow	
PR-RD-DIM	Proposed Road Dimensions	Yellow	
PR-RD-EP	Proposed Edge of Pavement	110	
PR-RD-FURNITURE	Proposed Street Furniture	Red	
PR-RD-GRADES	Proposed Road Grading Text	Yellow	
PR-RD-HATCHING	Proposed Asphalt Hatching	254	
PR-RD-LANDSCAPE	Proposed Roadway Landscaping	114	
PR-RD-MARK	Proposed Traffic Paint Markings	191	
PR-RD-PROF	Proposed Road-Profile	Yellow	
PR-RD-SHLD	Proposed Road Shoulder	Red	
PR-RD-SIGN	Proposed Road Sign	Yellow	
PR-RD-SW	Proposed Sidewalk	40	
PR-RD-TEXT	Proposed Road Text	White	
PR-RD-TRAFFIC	Proposed Traffic Control (Loops, Conduits, etc)	Cyan	
PR-ST-LITE	Proposed Streetlights and Ducts	White	

Blocks for Proposed Roadway Features (including Traffic Control)

Block	Block Name	Description
	PR-BOLLARD	Proposed Bollard
	PR-LS	Proposed Lamp Standard
	PR-SIGN	Proposed Sign, 1 sided
	PR-SIGN2	Proposed Sign, 2 sided
	PR-TSP-1	Proposed Traffic Signal Pole with Arm
	PR-TSP-2	Proposed Traffic Signal Pole without Arm

CITY OF NANAIMO
THE HARBOUR CITY

STANDARD SYMBOLS
SHEET 8 OF 10

Scale: NTS
Created: NOV 2015
Rev Date: NOV 2016
Dwg No: G-4G

Proposed Infrastructure Features (Sanitary, Storm and Water)

Layers

LAYER	Description	Colour	Linetype
PR-SAN	Proposed Sanitary Sewer Mains	11	
PR-SAN-PROFILE	Proposed Sanitary Sewer-Profile	11	
PR-SAN-SRVC	Proposed San Sewer Services	11	
PR-SAN-STRC	Proposed San Sewer Structures	11	
PR-STM	Proposed Storm Mains	93	
PR-STM-CULV	Proposed Storm Culverts	93	
PR-STM-PROFILE	Proposed Storm Sewer-Profile	93	
PR-STM-SRVC	Proposed Storm Sewer Services	93	
PR-STM-STRC	Proposed Storm Sewer Structures	93	
PR-WAT	Proposed Watermains	161	
PR-WAT-PROFILE	Proposed Water-Profile	93	
PR-WAT-SRVC	Proposed Water Services	93	
PR-WAT-STRC	Proposed Water Structures	93	

Blocks for Proposed Infrastructure Features (Sanitary, Storm and Water)

Block	Block Name	Description	Block	Block Name	Description
	PR-5	5° Bend, Pipe Fitting		PR-DCB	Double Catch Basin
	PR-11	11.25° Bend, Pipe Fitting		PR-FH	Fire Hydrant
	PR-22	22.5° Bend, Pipe Fitting	FO	PR-FLO	Flush-out
	PR-45	45° Bend, Pipe Fitting		PR-HWALL	Headwall Structure
	PR-90	90° Bend, Pipe Fitting		PR-IC	Inspection Chamber (Service Box)
	PR-CROSS	Cross, Pipe Fitting		PR-MH	Manhole
	PR-CUP	Coupling, Pipe Fitting		PR-RED	Reducer, Pipe Fitting
	PR-TEE	Tee, Pipe Fitting	SRV	PR-SRV	Surge Relief Valve
	PR-VERT	Vertical Bend Shown in Plan		PR-WV-CHK	Check Valve
	THRUSTBLOCK			PR-WGV	Water Valve, Gate
AV	PR-AIR	Air Valve	NC	PR-WGV-NC	Water Valve, Normally Closed
	PR-CAP	Cap, Pipe Fitting		PR-WM	Water meter only, Residential
	PR-CB	Catch Basin, Rectangular		PR-WServBox	Water Meter Service Box only
	PR-CBG	Catch Basin at Curb, Rectangular		PR-WMWBOX	Water Meter and Service Box
	PR-CBR	Catch Basin Manhole or Round	PRV	PR-WPRV	Pressure Reducing Valve
	PR-CO	Clean-out			

CITY OF NANAIMO
THE HARBOUR CITY

STANDARD SYMBOLS
SHEET 9 OF 10

Scale: NTS
Created: NOV 2015
Rev Date: NOV 2016
Dwg No: G-4H

Proposed Utilities (Hydro, Telephone, Cable, Gas, Fibre Optic)

Layers

LAYER	Description	Colour	Linetype
PR-UTIL-COMM	Proposed Underground Communications	230	
PR-UTIL-COMM-PROF	Proposed Underground Communications - Profile	230	
PR-UTIL-FIBOPT	Proposed Underground Fibre Optics	230	
PR-UTIL-GAS	Proposed Underground Gas	230	
PR-UTIL-GAS-PROF	Proposed Underground Gas - Profile	230	
PR-UTIL-HYD	Proposed Underground Hydro	230	
PR-UTIL-TEL	Proposed Underground Telephone	230	

Blocks for Proposed Utilities and Miscellaneous

Block	Block Name	Description	Block	Block Name	Description
	PR-ANCH	Anchor for Utility Pole			
	PR-JB	Electrical Junction Box, Square			
	PR-JBR	Electrical Junction Box, Round			
	PR-PP	Utility Pole			
	PR-PIL	Pilaster, Pillar			
	TESTHOLE	Test Pit, Bore Hole			
RECORD DRAWING REVIEWED BY: SUPERINTENDENT/ INSPECTOR: ________ DATE: ________ DESIGNER/ ENGINEER OF RECORD: ________ DATE: ________ IN SERVICE DATE: ________				PS-STAMP	This stamp is to be on every "RECORD DRAWING" submission.

POLE TYPE - FIELDS
COG - Cobra / Galvanized
COP - Cobra / Painted
HCP - Heritage Cobra / Painted
HPP - Heritage Post top / Painted
MSP - Marine Style / Painted
POG - Post top / Galvanized
POT - Post top / Painted

FUSE TYPE - FIELDS
Gould Shawmut model OTM 10A
Buss model BAN-10, 10A

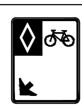
			POLE				LUMINAIRE					COORDINATES	
POLE ID	WATTAGE	LAMP TYPE	HEIGHT	TYPE	INSTALL DATE	FUSE TYPE	TYPE	MAKE	COLOUR TEMP (k)	INSTALL DATE	WIRING COVER INSTALL DATE	NORTHING	EASTING

LAMP TYPE - FIELDS
HPS - High Pressure Sodium
I - Incandescent
L - LED
MH - Metal Halide
MV - Mercury Vapour

LUMINAIRE TYPE - FIELDS
DGC - Drop Glass / Cobra
FGC - Flat Glass / Cobra
GLO - Globe
HER - Heritage
LAN - Lantern
MSP - Marine Style
TOP - Top Hat

STREET LIGHT TABLE TO APPEAR ON STREET LIGHT OR ROAD DRAWINGS

SIGN SCHEDULE

SIGN	QTY	LOCATION
 WA-36L	4	• 1 - NW CORNER VANCOUVER/TOWNSITE • 2 - SW CORNER TOWNSITE/VANCOUVER • 1 - SOUTHEND OF BUST RAMP
 WC-19 & WC-19S	1	STA 1+145
 BACK TO BACK  RB-4L RB-4R	2	STA 0+065 STA 1+011
  RB-91 & WB-36L	1	NW CORNER OF TOWNSITE/VANCOUVER

TRAFFIC SIGN TABLE TO APPEAR ON TRAFFIC SIGNAGE AND PAINT MARKING DRAWINGS

CITY OF NANAIMO
THE HARBOUR CITY

STREET LIGHT TABLE AND TRAFFIC SIGN TABLE

Scale:	NTS
Created:	NOV 2015
Rev Date:	NOV 2019
Dwg No:	G-7

CITY OF NANAIMO SURVEY CODES & DESCRIPTION KEY SETS

FIELD CODE	DESCRIPTION	STYLE	POINT LABEL STYLE	FORMAT (label)	LAYER	LINKED BLOCK
a	Anchor	Anchor	CoN-Label	A	EX-SURV-COMM	EX-ANCH
abm	Abutment	<default>	<default>	$*	EX-SURV-PNTS	<default>
ac	Asphalt Curb	<default>	<default>	$*	EX-SURV-PNTS	<default>
ap	Anchor Pole	Anchor Pole	CoN-Label	AP	EX-SURV-COMM	EX-AP
av	Air Valve	Air Valve	CoN-No Desc	$*	EX-SURV-WAT	EX-AV
bb	Bottom of Bank	<default>	<default>	$*	EX-SURV-PNTS	<default>
bchmh	BCHydro Manhole	Manhole	CoN-Label	BCHMH	EX-SURV-COMM	EX-MH
bh	Borehole	Borehole	CoN-Label	BH	EX-TOPO	EX-BH
bldg	Building Corner (commercial)	<default>	<default>	$*	EX-SURV-PNTS	<default>
bol	Bollard	Bollard	CoN-Label	BOL	EX-TOPO	EX-BOL
br	Bridge	<default>	<default>	$*	EX-SURV-PNTS	<default>
c	Concrete	<default>	<default>	$*	EX-SURV-PNTS	<default>
cb	Catch Basin	Catch Basin	CoN-Label	CB	EX-SURV-STM	EX-CB
cbg	Catch Basin Gutter	Catch Basin Gutter	CoN-Label	CBG	EX-SURV-STM	EX-CBG
cbmh	Catch Basin Manhole	Manhole	CoN-Label	CBMH	EX-SURV-STM	EX-MH
cbr	Catch Basin Round	Catch Basin Round	CoN-Label	CBR	EX-SURV-STM	EX-CBR
cc	Concrete Curb	<default>	<default>	$*	EX-SURV-PNTS	<default>
ccg	Concrete Curb Gutter	<default>	<default>	$*	EX-SURV-PNTS	<default>
d	Ditch	<default>	<default>	$*	EX-SURV-PNTS	<default>
dck	Bridge Deck	<default>	<default>	$*	EX-SURV-PNTS	<default>
dyl	Double Yellow Line	<default>	<default>	$*	EX-SURV-PNTS	<default>
eb	Electric Box	Junction Box	CoN-Label	EB	EX-SURV-ELEC	EX-JB
ec	Edge of Concrete	<default>	<default>	$*	EX-SURV-PNTS	<default>
egr	Edge of Gravel	<default>	<default>	$*	EX-SURV-PNTS	<default>
ep	Edge of Pavement	<default>	<default>	$*	EX-SURV-PNTS	<default>
ew	Edge of Water	<default>	<default>	$*	EX-SURV-PNTS	<default>
fe	Fence	<default>	<default>	$*	EX-SURV-PNTS	<default>
fh	Fire Hydrant	Hydrant	CoN-Label	FH	EX-SURV-WAT	EX-FH
g	Gas	<default>	<default>	$*	EX-SURV-GAS	<default>
gas *	Gas (appurtenance)	<default>	<default>	$*	EX-SURV-GAS	<default>
gp	Gate Post	Post	CoN-Label	GATE	EX-TOPO	EX-POST
gr	Guard Rail	<default>	<default>	$*	EX-SURV-PNTS	<default>
grvl	Gravel	<default>	<default>	$*	EX-SURV-PNTS	<default>
gv	Gas Valve	Gas Valve	CoN-Label	GAS	EX-UTIL-GAS	EX-WGV
hc	House Corner	<default>	<default>	$*	EX-SURV-PNTS	<default>
he	Hedge	<default>	<default>	$*	EX-SURV-PNTS	<default>
hw	Headwall	<default>	<default>	$*	EX-SURV-PNTS	<default>
hwm	Highwater Mark	<default>	<default>	$*	EX-SURV-PNTS	<default>

G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 1 DWGS\G-8

2.13.2020

CITY OF NANAIMO
THE HARBOUR CITY

SURVEY CODE DESCRIPTIONS
AND DESCRIPTION KEY SETS
SHEET 1 OF 3

Scale: NTS
Created: NOV 2015
Rev Date: NOV 2016
Dwg No: G-8

CITY OF NANAIMO SURVEY CODES & DESCRIPTION KEY SETS						
FIELD CODE	**DESCRIPTION**	**STYLE**	**POINT LABEL STYLE**	**FORMAT (label)**	**LAYER**	**LINKED BLOCK**
inv	Invert	Invert	CoN-No Desc	$*	EX-SURV-STM	EX-INV
irg	Irrigation Valve or Box	Junction Box Round	CoN-Label	IRR	EX-SURV-WAT	EX-JBR
jb	Junction Box	Junction Box	CoN-Label	JB	EX-SURV-ELEC	EX-JB
jbr	Junction Box Round	Junction Box Round	CoN-Label	JBR	EX-SURV-ELEC	EX-JBR
ksk	Electrical Kiosk (corner)	<default>	<default>	$*	EX-SURV-PNTS	<default>
lamp	Lamp	Lamp	CoN-Label	LAMP	EX-TOPO	EX-LAMP
lndscp	Landscaping	<default>	<default>	$*	EX-SURV-PNTS	<default>
loc*	Locate of pipe or utility	<default>	<default>	$*	EX-SURV-LOCT	<default>
ls	Light Standard	Lamp Standard	CoN-Label	LS	EX-TOPO	EX-LAMP
mb	Mailbox	<default>	<default>	$*	EX-SURV-PNTS	<default>
mfe	Minimum Floor Elevation	<default>	<default>	$*	EX-SURV-PNTS	<default>
mon*	Monument	Monument	CoN-Label	$*	EX-LEG	mon
mw	Monitor Well	Monitor Well	CoN-Label	MW	EX-TOPO	EX-MW
np	No Post Barries	<default>	<default>	$*	EX-SURV-PNTS	<default>
ocm*	Old Control Monument	Trav Hub	CoN-Label	$*	EX-SURV-LEG	EX-TRAVHUB
oib	Old Iron Bar	OIP	CoN-Label	OIB	EX-LEG	oip
oip	Old Iron Pin	OIP	CoN-Label	OIP	EX-LEG	oip
olp	Old Lead Plug	OIP	CoN-Label	OLP	EX-LEG	oip
p	Pavement Shot	<default>	<default>	$*	EX-SURV-PNTS	<default>
path	Edge of Path	<default>	<default>	$*	EX-SURV-PNTS	<default>
pb	Park Bench	<default>	<default>	$*	EX-SURV-PNTS	<default>
pi	Pillar (no lamp)	Pillar	CoN-Label	PILLAR	EX-TOPO	EX-PIL
pil	Pillar with Lamp	Pillar Lamp	CoN-Label	PIL LAMP	EX-TOPO	EX-PIL-LAMP
pnb	Present Natural Boundary	<default>	<default>	$*	EX-SURV-LEG	<default>
post	Post	Post	CoN-Label	POST	EX-TOPO	EX-POST
pp	Power Pole	Power Pole	CoN-Label	PP	EX-SURV-COMM	EX-PP
rck	Rock	<default>	<default>	$*	EX-SURV-PNTS	<default>
rr	Rip Rap	<default>	<default>	$*	EX-SURV-PNTS	<default>
sb	Stop Bar	<default>	<default>	$*	EX-SURV-PNTS	<default>
sdco	Storm CleanOut	Cleanout	CoN-Label	DCO	EX-SURV-STM	EX-CO
sdic	Storm Inspection Chamber	Inspection Chamber	CoN-Label	DIC	EX-SURV-STM	EX-IC
sdmh	Storm Manhole	Manhole	CoN-Label	DMH	EX-SURV-STM	EX-MH
sdr	Shoulder	<default>	<default>	$*	EX-SURV-PNTS	<default>
sh	Shrub	Shrub	CoN-No Desc	SHRUB	EX-TOPO	EX-SHRUB
sign	Sign	Sign	CoN-Label	SIGN	EX-TOPO	EX-SIGN
sign2	Sign 2 sided	Sign2	CoN-Label	SIGN	EX-TOPO	EX-SIGN2

CITY OF NANAIMO
THE HARBOUR CITY

SURVEY CODE DESCRIPTIONS
AND DESCRIPTION KEY SETS
SHEET 2 OF 3

Scale: NTS
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CITY OF NANAIMO SURVEY CODES & DESCRIPTION KEY SETS						
FIELD CODE	DESCRIPTION	STYLE	POINT LABEL STYLE	FORMAT (label)	LAYER	LINKED BLOCK
ssco	Sanitary CleanOut	Cleanout	CoN-Label	SCO	EX-SURV-SAN	EX-CO
ssic	Sanitary Inspection Chamber	Inspection Chamber	CoN-Label	SIC	EX-SURV-SAN	EX-IC
ssmh	Sanitary Manhole	Manhole	CoN-Label	SMH	EX-SURV-SAN	EX-MH
stdp	Standpipe	Flushout	CoN-No Desc	$*	EX-SURV-WAT	EX-FLO
str	Stairs	<default>	<default>	$*	EX-SURV-PNTS	<default>
sw	Swale	<default>	<default>	$*	EX-SURV-PNTS	<default>
t	Topo Shot	<default>	<default>	$*	EX-SURV-PNTS	<default>
tb	Top of Bank	<default>	<default>	$*	EX-SURV-PNTS	<default>
telbox	Telus Box	Junction Box	CoN-Label	TELBOX	EX-SURV-COMM	<default>
telmh	Telus Manhole	Manhole	CoN-Label	TELMH	EX-SURV-COMM	EX-MH
th*	Traverse Hub	Trav Hub	Nanaimo Pt-El-Desc	$*	EX-SURV-TRAV-PNTS	EX-TRAVHUB
toe	Toe of Slope	<default>	<default>	$*	EX-SURV-PNTS	<default>
tor	Top of Rail	<default>	<default>	$*	EX-SURV-PNTS	<default>
tr	Tree	Tree	CoN-No Desc	$1m%%c $2 Tree	EX-TOPO-TREE	EX-TREE
tr2	2 Tree Close Together	Tree2	CoN-No Desc	$1m%%c $2 Tree2	EX-TOPO-TREE	EX-TREE2
tr3	3 Tree Close Together	Tree3	CoN-No Desc	$1m%%c $2 Tree3	EX-TOPO-TREE	EX-TREE3
tr4	4 Tree Close Together	Tree4	CoN-No Desc	$1m%%c $2 Tree4	EX-TOPO-TREE	EX-TREE4
trdrip	Tree Dripline	<default>	<default>	$*	EX-SURV-PNTS	<default>
trl	Treeline	<default>	<default>	$*	EX-SURV-PNTS	<default>
ts	Traffic Signal with arm	Traffic Signal	CoN-Label	TS	EX-TOPO-TRAFFIC	EX-TSP1
ts2	Traffic Signal without arm	Traffic Signal2	CoN-Label	TS	EX-TOPO-TRAFFIC	EX-TSP2
tsb	Traffic Signal Box	Junction Box	CoN-Label	TSB	EX-TOPO-TRAFFIC	EX-JB
vac*	Vactor location	<default>	<default>	$*	EX-SURV-LOCT	
vent	Vent (Air Valve)	Vent	CoN-Label	VENT	EX-SURV-WAT	EX-VENT
wb	Wall Bottom	<default>	<default>	$*	EX-SURV-PNTS	<default>
wc	Wood Curb	<default>	<default>	$*	EX-SURV-PNTS	<default>
wl	White Line	<default>	<default>	$*	EX-SURV-PNTS	<default>
wme	Water Meter	Water Meter	CoN-Label	WM	EX-SURV-WAT	EX-WME
wmh	Water Manhole	Manhole	CoN-Label	WMH	EX-SURV-WAT	EX-MH
wt	Wall Top	<default>	<default>	$*	EX-SURV-PNTS	<default>
wv	Water Valve	Water Valve	CoN-Label	WV	EX-SURV-WAT	EX-WGV
xw	Cross Walk	<default>	<default>	$*	EX-SURV-PNTS	<default>
yl	Yellow Line	<default>	<default>	$*	EX-SURV-PNTS	<default>

CITY OF NANAIMO
THE HARBOUR CITY

SURVEY CODE DESCRIPTIONS
AND DESCRIPTION KEY SETS
SHEET 3 OF 3

Scale: NTS
Created: NOV 2015
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SECTION 2 – GENERAL DEFINITIONS AND REFERENCES

SECTION 2 – GENERAL DEFINITIONS AND REFERENCES

2.01 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 "DIRECTOR OF ENGINEERING" shall mean the person appointed to the office of Director of Engineering acting, either directly or through authorized staff, or agents 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 "City Engineer" shall mean the Director of Engineering.

.8 "ENGINEER" or "DESIGN 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) 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 Engineers and Geoscientists of BC 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 engage by an architect, an engineer or a material supplier.

.18 “SUPPLY” shall mean supply and pay for or provide and pay for.

.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.

2.01A 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
MOTI	Ministry of Transportation and Infrastructure
NBC	National Building Code of Canada
NEC	National Electrical Code
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

.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/CSAS234.1, 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:

ITEM	BASIC SI UNIT	(SIU) ABBREVIATION	EQUIVALENT IMPERIAL UNIT (EIU)	CONVERSION FACTOR (CF) (CF X EIU = SIU)
Length	metre	m	foot	0.3048
Length	millimeter	mm	inch	25.4
Area	square metre	m2	square foot	0.0929
Area	square metre	m2	square yard	0.836
Volume	cubic metre	m3	cubic foot	0.0283
Volume	cubic metre	m3	cubic yard	0.765
Volume	litre	L	imperial gallon	4.546
Mass	kilogram	kg	pound	0.454
Mass	tonne	t	ton (short)	0.907
Density	kilogram per cubic metre	kg/m3	pound per cubic inch	27,680.0
Temperature	degree Celsius	C	degree Fahrenheit	(F-32) x 5/9 = C

ITEM	BASIC SI UNIT	(SIU) ABBREVIATION	EQUIVALENT IMPERIAL UNIT (EIU)	CONVERSION FACTOR (CF) (CF X EIU = SIU)
Force	newton	N	pound force	4.448
Pressure*	kilopascal	kPa	pound per sq. inch	6.8948
Pressure*	kilopascal	kPa	inch water column	0.2491
Pressure, stress (concrete)	megapascal	MPa	pound per sq. inch	0.0069
Volume	litre	l/s	imperial gallon	0.07758
flow	per second		per minute	
Volume	cubic metre	m3/s	cubic feet	0.0283
flow	per second		per second	
Volume	litre	l/s	cubic feet	28.316
flow	per second		per second	
Power	kilowatt	kW	horsepower (electric)	0.746
Energy	joule	J	British Thermal Unit	1055.06
Illuminance	lux	lux	footcandles	10.76391
Frequency	hertz	Hz	Cycles per second	1.0

*As used in these standards, pressure shall mean gauge pressure unless otherwise noted

Standard Sieve Sizes

EIU	SI	EIU	SI	EIU	SI
4”	100 mm	1-1/2”	37.5 mm	3/8”	9.5 mm
3”	75 mm	1”	25 mm	1/4”	6.3 mm
2-1/2”	63 mm	3/4"	19 mm		
2”	50 mm	1/2"	12.5 mm		
#4	4.75 mm	#20	0.85 mm	#60	0.25 mm
#8	2.36 mm	#30	0.6 mm	#80	0.18 mm
#10	2 mm	#40	0.425 mm	#100	0.15 mm
#16	1.18 mm	#50	0.3 mm	#200	0.075 mm

Standard Pipe Sizes

EIU	SI	EIU	SI	EIU	SI
1/2"	12.5 mm	4”	100 mm	15”	375 mm
3/4"	19.0 mm	6”	150 mm	18”	450 mm
1”	25.0 mm	8”	200 mm	21”	525 mm
1-1/2”	37.5 mm	10”	250 mm	24”	600 mm
2”	50.0 mm	12”	300 mm	42”	1050 mm
2-1/2”	65.0 mm				

Concrete Strengths

EIU	SI
2200 psi	15 MPa
2500 psi	18 MPa
2900 psi	20 MPa
3700 psi	25 MPa
4500 psi	30 MPa
5000 psi	36 MPa

Reinforcing Steel

Comparison of Imperial and Metric Sizes
(Note: % difference based on area of bars in in^2)

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

2.01B REFERENCES

.1 The Manual of Engineering Standards and Specification 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 inconsistent with the Manual.

SPEC NUMBER	TITLE
ANSI A 300	Standard Tree Care Operations
ANSI B 16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI B 16.5	Standard Specification for Pipe Flanges and Flanged Fittings
ANSI/IES RP-8	Roadway Lighting
ANSI/NSF 61	NSF/ANSA 61 Drinking Water System Components – Health Effects

ASTM 3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM A 48	Standard Specification for Gray Iron Castings
ASTM A 123/A 123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 354	Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs , and Other Externally Threaded Fasteners
ASTM A 536	Standard Specification for Ductile Iron Castings
ASTM A 563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 653/A 653M	Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process
ASTM A 746	Standard Specifications for Ductile Iron Gravity Sewer Pipe
ASTM A 775	Standard Specification for Epoxy-Coated Reinforcing Steel Bars
ASTM A 775M	Standard Specification for Epoxy-Coated Reinforcing Steel Bars
ASTM B 42	Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B 62	Standard Specifications for Composition Bronze or Ounce Metal Castings
ASTM B 88	Standard Specification for Seamless Copper Water Tube
ASTM B 633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM B 766	Standard Specification for Electrodeposited Coatings of Cadmium
ASTM C 14M	Standard Specification for Non-reinforced Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C 33	Standard Specification for Concrete Aggregates
ASTM C 55	Standard Specification for Concrete Building Brick
ASTM C 67	Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
	(REVISED MAY 2020)
ASTM C 76M	Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric)
ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate
ASTM C 117	Standard Test Method for Material Finer than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate

ASTM C 131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 140	Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C 144	Standard Specification for Aggregate for Masonry Mortar
ASTM C 295	Standard Guide for Petrographic Examination of Aggregates for Concrete
ASTM C 309	Standard Specification for Liquid Membrane – Forming Compounds for Curing Concrete
ASTM C 443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 443M	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
ASTM C 478	Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C 579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes
ASTM D 429	Standard Test Methods for Rubber Property – Adhesion to Rigid Substrates
ASTM D 638	Standard Test Methods for Tensile Properties of Plastics
ASTM D 751	Standard Test Methods for Coated Fabrics
ASTM D 977	Standard Specification for Emulsified Asphalt
	(REVISED MAY 2020)
ASTM D 1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3(2,700 kN-m/m3))
ASTM D 1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 2241	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2412	Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2466	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe Systems

ASTM D 2657	Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
ASTM D 2726	Standard Test Method for Bulks Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D 3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing ***(REVISED MAY 2020)***
ASTM D 3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials ***(REVISED MAY 2020)***
ASTM D 3549	Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens
ASTM D 4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6928	Standard Test Method for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
ASTM D 6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM F 436	Standard Specification for Hardened Steel Washers
ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F 594	Standard Specification for Stainless Steel Nuts
ASTM F 679	Standard Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F 2620	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings ***(REVISED MAY 2020)***
AWWA C 104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
AWWA C 105	Polyethylene Encasement for Ductile Iron Pipe Systems ***(REVISED MAY 2020)***
AWWA C 110	Ductile-Iron and Grey-Iron Fittings
AWWA C 111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C 150	Thickness Design of Ductile-Iron Pipe
AWWA C 151	Ductile-Iron Pipe, Centrifugally Cast
AWWA C 153	Ductile-Iron Compact Fittings
AWWA C 200	Steel Water Pipe, 6in (150mm) and Larger
AWWA C 203	Coal-Tar Protective Coatings and Linings for Steel Water
AWWA C 206	Field Welding of Steel Water Pipe
AWWA C 208	Dimensions for Fabricated Steel Water Pipe Fittings

AWWA C 209	Cold-Applied Tape Coatings for Steel Water Pipe, Special Sections, Connections and Fittings
AWWA C 210	Standard Specification for Liquid – Epoxy Coatings and Linings for Steel Water Pipe and Fittings
AWWA C 213	Standard Specification for Fusion – Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings
AWWA C 217	Standard Specification for Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines ***(REVISED MAY 2020)***
AWWA C 219	Standard Specification for Bolted, Sleeve – Type Couplings for Plain – End Pipe
AWWA C 500	Metal Seated Gate Valves for Water and Sewerage Systems
AWWA C 502	Dry-Barrel Fire Hydrants
AWWA C 504	Rubber-Seated Butterfly Valves
AWWA C 509	Resilient-Seated Gate Valves for Water Supply Services
AWWA C 515	Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service ***(REVISED MAY 2020)***
AWWA C 550	Protective Interior Coatings for Valves and Hydrants ***(REVISED MAY 2020)***
AWWA C 600	Installation of Ductile Iron Water Mains and Their Appurtenances
AWWA C 651	Disinfecting Water Mains
AWWA C 800	Underground Service Line Valves and Fittings
AWWA C 900	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inch Through 12 Inch (100mm through 300mm), for Water Transmission Distribution
AWWA C 905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. through 48 in. (350mm through 1,620mm), for Water Distribution and Transmission
AWWA C 906	Standard Specification for Polyethylene (PE) Pressure Pipe and Fittings, 4 in (100mm) through 63 in. (1,600mm), for Water Distribution and Transmission
	(REVISED MAY 2020)
AWWA M 17	Installation, Field Testing, and Maintenance of Fire Hydrants
CAN/CSA A 23.1	Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
CAN/CSA A 23.2	Methods of Test for Concrete
CAN/CSA A 23.5	Supplementary Cementing Materials
CAN/CSA A 3000	Cementitious Materials Compendium
CAN/CSA 3 A 266.2	Chemical Admixtures for Concrete
CAN/CSA G 40.21	General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
CAN/CSA Z 234.1	Canadian Metric Practice Guide
CGSB 41 GP 25M	Pipe, Polyethylene, for the Transport of Liquids

CSA 22.2 No. 85	Standard Specifications for Rigid PVC Boxes and Fittings
CSA 6164	Standard Specification for Concrete Masonry Units
CSA B 137.1	Thermoplastic Pressure Piping Compendium ***(REVISED MAY 2020)***
CSA B 137.3	Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications
CSA B 182.1	Plastic Drain and Sewer Pipe and Pipe Fittings
CSA B 182.2	PSM Type PVC Sewer Pipe and Fittings
CSA B 182.4	Profile PVC Sewer Pipe and Fittings
CSA B 1800	Standard Specification for Thermoplastic Non-Pressure Piping Compendium
CSA C 22.2 No. 45.1	Canadian Electrical Code, Electrical Rigid Metal Conduit – Steel
CSA C 22.2 No. 211.2	Canadian Electrical Code, Rigid PVC (Unplasticized) Conduit
CSA A 231.1/A 231.2	Standard Specification for Precast Concrete Paving Slabs/Precast Concrete Pavers
CSA G 30.3	Cold Drawn Steel Wire for Concrete Reinforcement
CSA G 30.5	Welded Steel Wire Fabric for Concrete Reinforcement
CSA G 30.15	Welded Deformed Steel Wire Fabric for Concrete Reinforcement
CSA G 30.18	Carbon-Steel Bars for Concrete Reinforcement
CSA G 164	Hot Dip Galvanizing of Irregularly Shaped Objects
CSA S 16	Design of Steel Structures
CSA S 157	Strength Design in Aluminum
CSA S 269.3	Concrete Formwork
CSA W 48	Standard Specifications for Filler Metals and Allied Materials for Metal Arc Welding
CSA W 59	Welded Steel Construction (Metal Arc Welding)
CSA W 186	Welding of Reinforcing Bars in Reinforced Concrete Construction
IMSA 19-1	Standard Specifications for Polyethylene Insulated, Polyvinyl Chloride Jacketed Signal Cable
IMSA 50-2	Standard Specification for Polyethylene Insulated, Polyethylene Jacketed, Loop Detector Lead-In Cable
MOTI SS 952	Contractor Supply Asphalt and Paving Materials for Highway Use

2.01C SUPPLEMENTARY DOCUMENTS

.1 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) City of Nanaimo, Steep Slope Development Permit Area Guidelineshttp://www.nanaimo.ca/assets/Departments/Community~Planning/Publications~and~Forms/SSguidelines.pdf

(b) ***(REVISED NOVEMBER 2020)***FHWA, Manual of Uniform Control Devices http://mutcd.fhwa.dot.gov/pdfs/2003/pdf-index.htm

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

(d) 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

(e) Motor Vehicle Act Regulations – Division 23 – Traffic Control Devices http://www.bclaws.ca/civix/document/id/complete/statreg/26_58_06

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

(g) City of Nanaimo, Urban Forest Management Strategy https://www.nanaimo.ca/docs/services/home-and-property/ufms-edited-2012-1.pdf

(h) BCLNA, British Columbia Landscape Standards https://bclna.com/bclna-resource/canadian-landscape-standards/

(i) City of Nanaimo, Invasive Plant Management Strategy https://www.nanaimo.ca/docs/default-document-library/con-invasive-plant-management-strategy-(final).pdf

(j) Nanaimo Transportation Master Plan https://www.nanaimo.ca/your-government/projects/projects-detail/nanaimo-transportation-master-plan

(k) City of Nanaimo, Erosion and Sediment Control Guideline https://www.nanaimo.ca/docs/property-development/soil-removal/11-erosion-sediment-control.pdf

(l) Department of Fisheries and Oceans and the Ministry of Environment, Land Development Guidelines for the Protection of Aquatic Habitat http://www.dfo-mpo.gc.ca/Library/165353.pdf

(m) BC Traffic Control Manual for Work on Roadways. https://www2.gov.bc.ca/gov/content/transportation/transportation-infrastructure/engineering-standards-guidelines/traffic-engineering-safety/trafficmanagementmanual

(n) TAC Geometric Design Guide for Canadian Roads https://www.tac-atc.ca/en/publications-and-resources/geometric-design-guide-canadian-roads

(o) Ministry of Transportation and Infrastructure Electrical and Traffic Engineering Manual http://www.th.gov.bc.ca/publications/eng_publications/electrical/electrical_and_traffic_eng/Electrical_Signing_Design_Manual/tableofcontents.htm

(p) BC Building Access Handbook ***(REVISED MAY 2020)*** https://www2.gov.bc.ca/gov/content/industry/construction-industry/building-codes-standards/accessibility

2.01D CITY BYLAWS

.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. 7224
https://www.nanaimo.ca/bylaws/ViewBylaw/7224.pdf

(b) Crossing Control Bylaw No. 5174
https://www.nanaimo.ca/bylaws/ViewBylaw/5174.pdf

(c) Development Parking Regulations Bylaw No. 7013
https://www.nanaimo.ca/bylaws/ViewBylaw/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
https://www.nanaimo.ca/docs/services/home-and-property/tree-protection-bylaw-7126.pdf

(g) Noise Control Bylaw No. 4750
http://www.nanaimo.ca/UploadedFilesPath/Bylaws/4750.pdf

(h) Official Community Plan Bylaw No. 6500
https://www.nanaimo.ca/property-development/community-planning-land-use/community-plans/official-community-plan

(i) Soil Removal and Depositing Regulation Bylaw No. 1747
https://www.nanaimo.ca/ByLaws/ViewBylaw/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
https://www.nanaimo.ca/ByLaws/ViewBylaw/3808.pdf

(l) Traffic and Highways Regulation Bylaw 1993 No. 5000
https://www.nanaimo.ca/bylaws/ViewBylaw/5000.pdf ***(REVISED MAY 2020)***

(m) Waterworks Rate and Regulation Bylaw No. 7004
https://www.nanaimo.ca/ByLaws/ViewBylaw/7004.pdf

(n) Zoning Bylaw No. 4500
http://www.nanaimo.ca/EN/main/departments/Current-Planning/Zoning.html

SECTION 3 – GENERAL REQUIREMENTS
CONTENTS

3.01 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.

3.02 OPERATING MANUALS

.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 work 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 take apart for periodic inspection and replacement.

3.03 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 *Occupational Health and Safety Regulation Part 21: Blasting Operations and Explosives Act and Regulation* of British Columbia and must conform to local police requirements.

.2 Explosives shall be kept only in registered premises, which have been licensed under the *Explosives Act* (Canada).

3.04 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 time, 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 for his operations.

3.05 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. Testing of pipe and cleanup of the site shall be completed no later than 30 days following commencement of construction on any street block. ***(REVISED MAY 2020)***

.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.

3.06 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) Surface runoff is to be prevented from seeping into trenches.
(b) 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.
(c) 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.
(d) 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.
(e) Existing drainage courses and culverts are to be preserved and maintained as required.
(f) 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.

3.20 LOCATION OF STRUCTURES

.1 Prior to commencing any excavation the Contractor shall be responsible for exposing existing surface and underground structures that may affect the work or may be damaged during construction. ***(REVISED MAY 2020)***

.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 the location of these structures. Measurements and location of the existing underground structures shown on the drawings are no guaranteed to be accurate, and must be verified by the Contractor prior to proceeding with construction.

3.21 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.

3.22 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 elimination 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.

3.23 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.

3.24 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 forty-eight (48) hours prior to the time of shut-off. The notification shall be in the form of a hand delivered letter with the contractors contact information.

3.25 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 4.0 –Excavation, Trenching and Backfill. ***(REVISED MAY 2020)***

.4 Where excavations for works cross underneath existing asbestos cement or cast iron piping the existing pipe shall be replace 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 4.0 –Excavation, Trenching and Backfill as determined by the Engineer. ***(REVISED MAY 2020)***

3.26 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 replace 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 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.

3.27 TREE PROTECTION ***(REVISED MAY 2020)***

.1 Tree protection fencing is to be installed around all areas where trees are to be retained, as per the Tree Protection Area Plan. Refer to Standard Drawing No. TP-1. ***(REVISED MAY 2020)***

.2 Excavation is not to occur within the Tree Protection Area without direction and supervision from a qualified project arborist. After excavation outside of the Tree Protection Area has occurred, all exposed roots over 2.5 cm in dia. must be cleanly cut. ***(REVISED MAY 2020)***

.3 The operation of equipment, placing of fill, debris or any other construction related materials within the Tree Protection Area is prohibited. ***(REVISED MAY 2020)***

3.60 CONTROL OF PUBLIC TRAFFIC – GENERAL

.1 The following general principles shall be maintained when performing construction or maintenance work upon Municipal Rights-of-Way and thereby affecting use of Municipal facilities.

(a) All control of public traffic will be carried out in accordance with the BC Traffic Control Manual for Work on Roadways, current edition and as amended.
(b) All control of public traffic will be carried out in accordance with WorkSafeBC regulations.
(c) Make adequate provision to accommodate normal traffic along streets and highways immediately adjacent to or crossing the Works so as to cause minimum of inconvenience to the general public whilst maintaining the required level of safety.
(d) Emergency vehicles utilizing warning devices (sirens, horns, lights) shall be given immediate access through the site at all times.
(e) Regional District of Nanaimo Transit and other forms of public transit shall be given priority over regular vehicles, such that they are not unnecessarily delayed. Co-ordination with transit authorities is the responsibility of the Contractor.
(f) Regardless of the condition/width of existing facilities, accommodation is to be made for all forms of travel, including, but not limited to, pedestrians, cyclists, wheelchairs and mobility scooters, and users who are visually impaired. ***(REVISED MAY 2020)***
(g) Provide and maintain reasonable road access and egress to properties fronting along, or in the vicinity of, the work.
(h) The length of the worksite shall be directly proportional to the amount of work that a contractor reasonably expects to complete in any one shift.
(i) Unless otherwise accepted by the City, all regular forms of traffic shall be reinstated to as near normal as possible when work is not in progress.

.2 Contractors shall prepare Traffic Management Plan(s) encompassing all activities on the Municipal rights-of-way.

(a) Traffic Management Plans shall be submitted to the City for review.
(b) Traffic Management Plans will be reviewed within ten (10) working days and either accepted or returned with a request for re-submission.
(c) Re-submissions will be reviewed within ten (10) working days from the date of resubmission.
(d) No works shall occur before the Traffic Management Plan has been accepted by the City.
(e) Acceptance of the Traffic Management Plan, by the City, does not imply any responsibility or liability for the completeness or correctness of the Traffic Control Plan.
(f) The City, as part of the Traffic Management Plan, may require traffic disruptions to be limited to specific hours.

.3 The minimum level of Traffic Management Plan required for any works within the Municipal right-of-way (local roads, lane ways, path ways, parks and other Municipal facilities) shall include, but not limited to, the following:

(a) Name of the Contractor; Traffic Control Personnel/Subcontractor; Contractor's Traffic Manager.
(b) Provide 24 hour emergency contract information.
(c) Note the location(s) of worksite identification signs. These signs shall have the name and phone number of the contractor and identify the project.
(d) Note the location of safety equipment, muster station(s) and any other site facilities.
(e) Note locations of equipment/materials laydown/storage areas are for both working and non-working hours.
(f) Identify the figures used from the ***BC Traffic Control Manual for Work on Roadways.***
(g) Identify the expected truck movements to/from and through the site.
(h) Identify how the following road users will be accommodated: ***(REVISED MAY 2020)***

(i) Pedestrians ***(REVISED MAY 2020)***
(ii) Visually Impaired ***(REVISED MAY 2020)***
(iii) Persons with Mobility Issues ***(REVISED MAY 2020)***
(iv) Cyclists ***(REVISED MAY 2020)***
(v) Transit ***(REVISED MAY 2020)***
(vi) Heavy Trucks ***(REVISED MAY 2020)***
(vii) Vehicles ***(REVISED MAY 2020)***

.4 For all major roads and any local roads which have special requirements identified by the City (adjacent school zones, Municipal facilities), the following items are required in addition to the above:

(a) Be prepared by a Professional Engineer, and in accordance with the BC Traffic Control Manual for work on Roadways, current edition and as amended.
(b) Be prepared using editable computer program, relatively to scale, and submitted in digital PDF 11x17 format.
(c) Include an accurate road configuration with road names, north arrow marker, speed limit and proposed extents of the relevant work item.
(d) Indicate placement marker and distance of signs; sign images and sign number; delineators, cones, barricades, etc; position of dedicated TCP's; and any traffic control equipment including Flashing Arrow Boards (FAB) and High Level Warning Devices (HLWD); symbols should match those within Chapter 3 and 4 of the BC Traffic Control Manual for Work on Roadways.
(e) Identify lanes to be obstructed, along with taper lengths and widths of lanes.
(f) Identify impacts to driveways, bus stops, parking, pedestrian and cyclist traffic. Include measures to facilitate and maintain access.
(g) Identify any road closures or detours.

.5 It is expected that the site superintendent designate in charge of traffic control, will have the plan and/or copies of the relevant traffic control figures onsite available for review, at all times, that work is occurring within the right-of-way. It is understood that traffic control operations may require adjustment to site specific conditions; however, significant changes should be submitted to the City for acceptance. ***(REVISED MAY 2020)***

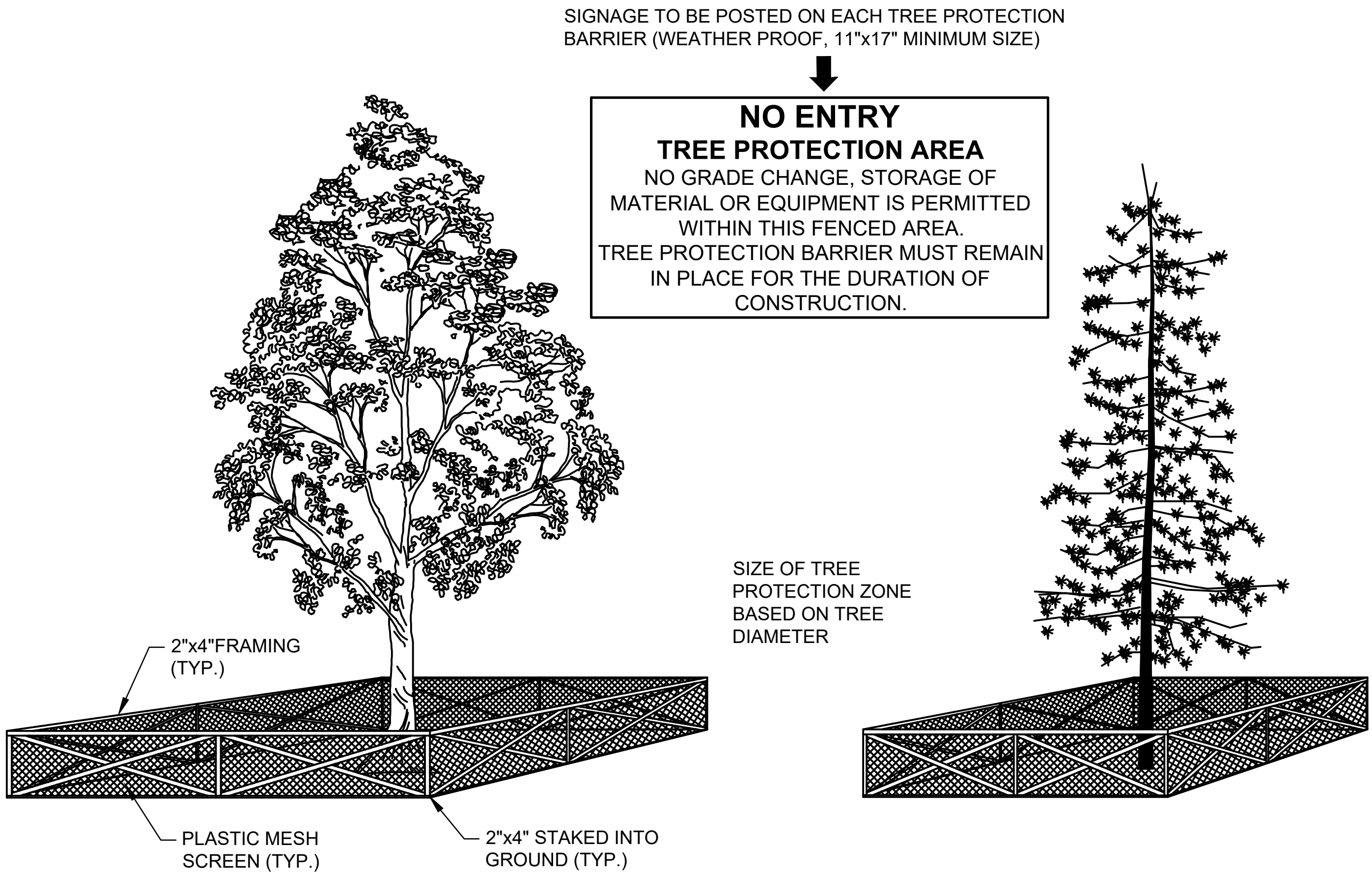
.6 The City reserves the right to issue a Shut Down Notice for works within the City right-of-way at any time if:

(a) The Contractor's traffic set-up on site, differs significantly from the accepted Traffic Management Plan.
(b) A copy of the accepted Transportation Master Plan and/or figures cannot be supplied.
(c) Emergency services or Regional District of Nanaimo Transit needed cannot be accommodated.

Work within the right-of-way is not to resume until a subsequent Traffic Management Plan has been submitted and accepted.

.7 Road Closures and Detours:

(a) Road closures and detours require approval of the City Engineer and may not be granted.
(b) A road closure must accommodate emergency traffic at all times unless otherwise approved by the City Engineer.
(c) At a minimum, local traffic must reinstated at the end of every shift for Road Closures.
(d) Where practical, detours shall avoid diverting traffic from a major or collector road to a local road.
(e) Where detours are to be installed, directional signage shall be installed for length of the detour in both directions.
(f) Where detours or road closures are permitted, the Contractor will notify emergency services (fire, police and ambulance), as well as the Regional District of Nanaimo Transit, if the closure is on a bus route.
(g) Where detours are to be in place for longer than five days, the Contractor is to submit a pre-construction photo survey prior to implement the detour. At the end of construction, the contractor is to complete a final inspection of the detour route and rectify any damage at the contractors cost, in the opinion of the City Inspector, that was not evident prior to the detour implementation.
(h) Where road closures/detours affect private residences, the contractor shall provide five (5) days notice to all properties affected by the closure and all properties for the length of any detours. Letters are not to be issued prior to approval of the closure/detour.



TREE PROTECTION FENCING:

PRIOR TO CONSTRUCTION TAKING PLACE ON THE SITE A PROTECTION FENCE (SEE SPECIFICATIONS BELOW) SHALL BE INSTALLED ON THE SITE ACCORDING TO THE LAYOUT ON THE DRAWING ALONG THE EXISTING GRADE. PRIOR TO THE INSTALLATION OF THIS FENCE, THE LAYOUT SHOULD BE REVIEWED BY THE CITY ENGINEER. THE ENGINEER WILL INSTRUCT THE CONTRACTOR AND ALL SUBCONTRACTORS ON THE IMPORTANCE OF FOLLOWING THESE TREE PROTECTION MEASURES. THE CONTRACTOR AND ALL SUBCONTRACTORS WILL BE REQUIRED TO SIGN OFF THEIR CONCURRENCE OF THIS PLAN.

1. HEIGHT OF FENCE TO BE 1.2m (4').
2. 2"X4" S TO BE USED FOR VERTICAL POSTS, TOP AND BOTTOM RAILS AND CROSS BRACING (IN AN "X"); ROUND UN-TREATED VERTICAL POSTS MAY BE USED WITH A MINIMUM DIAMETER OF 9cm.
3. SPACING BETWEEN VERTICAL POSTS TO BE NO FURTHER APART THAN 3.7m (12') ON CENTRE.
4. STRUCTURE MUST BE STURDY WITH VERTICAL POSTS DRIVEN FIRMLY INTO THE GROUND.
5. CONTINUOUS PLASTIC MESH SCREENING (E.G. ORANGE SNOW FENCING).
6. SIGNS ENTITLED "TREE PROTECTION AREA" TO BE POSTED ON FENCE EVERY 15m.
7. LOCATION OF FENCE AS SHOWN ON PLAN.

MINIMUM PROTECTION REQUIRED AROUND TREE

TRUNK DIAMETER (cm)	DISTANCE FROM TRUNK (m)	TRUNK DIAMETER (cm)	DISTANCE FROM TRUNK (m)
20	1.2	50	3.0
25	1.5	55	3.3
30	1.8	60	3.6
35	2.1	75	4.5
40	2.4	90	5.0
45	2.7	100	6.0

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2.13.2020

CITY OF NANAIMO
THE HARBOUR CITY

TREE PROTECTION FENCING

Scale:	N.T.S.
Created:	FEB 2019
Rev Date:	MAY 2020
Dwg No:	TP-1

SECTION 4 –EXCAVATION, TRENCHING AND BACKFILL
CONTENTS

(REVISED MAY 2020)

SECTION 4 –EXCAVATION, TRENCHING AND BACKFILL
CONTENTS

SECTION 4 – TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

4.01 SCOPE

.1 This specification refers to excavation, trenching, and backfill and all work pertaining thereto. Only those aggregates and granular materials approved by the City Engineer will be accepted for installation. ***(REVISED MAY 2020)***

.2 Utility 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. ***(REVISED MAY 2020)***

(REVISED MAY 2020)

4.02 TESTING

.1 For testing requirements, refer to Section 9.21. ***(REVISED MAY 2020)***

4.03 -NOT USED-

4.04 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 centerline. 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. ***(REVISED MAY 2020)***

.5 Pavement Restoration shall be done in accordance with Section 4.29 – Pavement Restoration. ***(REVISED MAY 2020)***

4.05 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 removed fences, shrubs, small tress 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 his/her 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 be removed by the property owner upon expiration of the 14 day notice, shall be removed and disposed of by the Contractor.

.5 Remove all topsoil 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 topsoil and disposed of as specified in Section 4.11 – Disposal of Excavated Material. Do not handle topsoil 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.

4.06 TRENCH ALIGNMENT AND DEPTH

.1 The trench shall be excavated so that the 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.

4.07 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 Large rock, boulders, and large stones shall be removed to provide a clearance of at least 150 mm 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 300 mm 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 dimensions which will permit assembly of the sections in accordance with these specifications.

.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 m.

.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.

.2 All material classified as common excavation shall be removed, to the design subgrade cross-section, or as otherwise established by the Engineer***. (REVISED MAY 2020)***

.3 Material which, in the opinion of the Engineer, is not suitable for use as earth fill or rock fill, or not required for the works as shown on the construction drawings, shall be disposed of as specified in Section 4.11 – Disposal of Excavated Material. ***(REVISED MAY 2020)***

.4 Material which is suitable for earth fill or rock fill shall be placed and compacted in those areas requiring filling to the design subgrade cross-section, as per Section 9.26. ***(REVISED MAY 2020)***

4.07B 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 one 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 pieced 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.

(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.

(REVISED MAY 2020)

(REVISED MAY 2020)

.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/she shall be responsible for any accidents or injury, loss and/or damage which might occur as a result of his/her blasting.

(c) Overbreak shall be removed as directed by the Engineer and replaced with approved granular material, placed and compacted as specified herein at no additional cost to the Owner. ***(REVISED MAY 2020)***

(d) Rock excavation shall be carried out to the design subgrade cross-section. No points or pinnacles of rock shall be left protruding above the rock cut cross-section. Subgrade rock shall be shattered at least 300 mm below the subgrade. ***(REVISED MAY 2020)***

(e) In rock cuts, care shall be exercised to ensure no damage is caused to the supporting rock below the roadway. Damage so caused, shall be repaired to a condition acceptable to the Engineer at no additional cost to the Owner. ***(REVISED MAY 2020)***

4.08 -NOT USED-

4.09 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.

4.09A <u>AUTHORIZED OVEREXCAVATION</u> ***(REVISED MAY 2020)***

.1 Authorized overexcavation is that excavation requested by the Engineer as a result of unsuitable foundation conditions not resulting from the Contractor's operation. ***(REVISED MAY 2020)***

.2 Authorized overexcavation shall be replaced with earth fill, rock fill, approved granular material, sub base material or base course as directed by the Engineer. Replacement fill shall be placed as specified elsewhere herein. ***(REVISED MAY 2020)***

4.09B <u>UNAUTHORIZED OVEREXCAVATION</u> ***(REVISED MAY 2020)***

.1 Unauthorized overexcavation is that excavation required as a result of the Contractor's operation as determined by the Engineer. ***(REVISED MAY 2020)***

.2 Replacement of unauthorized excavation shall be as specified in Section 4.09A.2 – Authorized Overexcavation and shall be at no additional cost to the Owner***. (REVISED MAY 2020)***

4.10 <u>STOCKPILING OF EXCAVATED TRENCH MATERIAL</u> ***(REVISED MAY 2020)***

.1 Common excavation approved by the Engineer for reuse as approved granular backfill, may be stockpiled along the trench in accordance with WorkSafeBC regulations and provided the working space is adequate for this purpose and provided that by doing the backfill material does not spill onto private properties adjacent to the line of the trench thereby disturbing fenced, buildings, shrubs, lawns, or other items of value. ***(REVISED MAY 2020)***

.2 Stockpiling 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. ***(REVISED MAY 2020)***

.3 In order that excavated material may be stockpiled along the trench, the road 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 stockpiled 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. ***(REVISED MAY 2020)***

.5 The Contractor shall retain sufficient approved granular backfill material for the backfilling of the trench. Surplus approved granular backfill material shall be taken to and used at other locations within the project site suitable for material placement. ***(REVISED MAY 2020)***

.6 The Contractor shall take all measures required to protect approved granular backfill from contamination, segregation and weather. ***(REVISED MAY 2020)***

4.11 DISPOSAL OF EXCAVATED MATERIAL

.1 Surplus of 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 the 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. ***(REVISED MAY 2020)***

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 150 mm 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 600 mm 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 the 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 approved granular material, subbase gravel, drainrock or bedding material shall be at the discretion of the Engineer. ***(REVISED MAY 2020)***
(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 augured.

.4 The augured 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 augured.

4.16 CASING PIPES

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

.2 The same bedding and backfill criteria shall be used for casing pipe as required for the 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/C136M: ***(REVISED MAY 2020)***

Gradation Limits (Percent by Weight Passing)		
Sieve Designation	**Type 1**	**Type 2**
19.0 mm	100	90-100
12.5 mm		65-85
9.5 mm	85-100	50-75
4.750 mm	70-100	25-50
2.36 mm		10-35
1.18 mm	20-65	
0.850 mm		5-20
0.6 mm	0-45	
0.425 mm		0-15
0.180 mm		0-8
0.15 mm	0-10	
0.075 mm	0-5	0-5

.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 100 mm on completion of compaction. In rock excavation, the minimum depth of bedding below the pipe shall be 150 mm after completion of compaction.

.5 Bedding material shall be compacted in maximum 150 mm 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 300 mm above the crown of the pipe.

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.

.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:

SANITARY AND STORM GRAVITY SEWERS		**WATERMAINS AND FORCEMAINS**	
SLOPE	**MAXIMUM SPACING**	**SLOPE**	**MAXIMUM SPACING**
10% - 15%	30 m	10% - 29%	10m (upon approval of City Engineer)
15% - 20%	25 m		
20% - 35%	20 m		
35% - 50%	15 m	30% - Over	See Section 4.18.5
50% - Over	10 m		

.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 EGBC. 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 MAY 2020)***

.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) Road Sub Base as per Section 9.30 - Road Sub-Base Gravel Course. ***(REVISED MAY 2020)***

(b) Road Base as per Section 9.31 - Road Base Gravel Course. ***(REVISED MAY 2020)***

(c) Approved Granular Material as per Section 9.29 – Approved Granular Backfill. ***(REVISED MAY 2020)***
(d) Recycled Aggregate Material (RAM) as per Section 9.32 - Recycled Aggregate Material. ***(REVISED MAY 2020)***
(e) Controlled Density Fill as per 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 of maximum of 300 mm (200 mm for Approved Granular Backfill) in loose thickness. ***(REVISED MAY 2020)***
(d) Crushed, granular, imported materials shall be used for backfill unless native soils are suitable and approved by the Engineer, and are specified on the construction drawings. ***(REVISED MAY 2020)***
(e) Deficiencies in the quantities of approved granular 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. ***(REVISED MAY 2020)***
(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 material specified in Section 4.19. RAM and Approved Granular Material requires specific approval by the City Engineer, and may only be used up to the bottom of the sub-base layer. Trenches located in existing arterial, collector or commercial/industrial roads shall be backfilled with controlled density backfill in accordance with Section 4.24***. (REVISED MAY 2020)***
(d) All backfill materials shall be compacted to 95% Modified Proctor Density (ASTM D1557), and field tested in accordance with ASTM D6938). ***(REVISED MAY 2020)***

.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 or material specified in Section 4.19 and compacted to 90% Modified Proctor Density (ASTM D1577). ***(REVISED MAY 2020)***

4.20 -NOT USED- ***(REVISED MAY 2020)***

4.21 CONCRETE

.1 Concrete for pipe base, encasement or backfill shall have a minimum compressive strength of 32MPa at twenty-eight (28) days and be in accordance with Section 11.31 – Concrete. ***(REVISED MAY 2020)***

.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 -NOT USED- ***(REVISED MAY 2020)***

4.22A -NOT USED- ***(REVISED MAY 2020)***

4.23 -NOT USED- ***(REVISED MAY 2020)***

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.
(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.
(f) Chemical admixtures: To CAN3 – A266.2. Use of admixtures to accelerate or retard curing as directed by the Engineer.

.3 Mix Design:

(a) Compressive strength: 0.5MPa at twenty-eight (28) days.
(b) Cement content: 25kg per m^3.
(c) Slump: 150 – 200 mm.
(d) Air entertainment: 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 -NOT USED- ***(REVISED MAY 2020)***

4.26 FISH HABITAT GRAVEL

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

.2 Gradation:

GRADATION LIMITS (Percent by Volume & Percent by Weight)		
US STANDARD SIEVE SIZE	**GRADATION LIMITS (PERCENT BY WEIGHT PASSING)**	**PERCENT BY VOLUME**
100 mm	100	0
75 mm	95	5
50 mm	80	15
37.5 mm	60	20
19 mm	25 - 30	30 - 35
9.5 mm	10 - 15	10 - 20
6.3 mm	0 - 15	0 - 5

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, re-grading, and compacting the surface, or if required, re-gravelling 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 shall match the existing road structure, whichever is greater, unless otherwise noted on the construction drawings. ***(REVISED MAY 2020)***

LOCATION	SUB-BASE	BASE	SURFACE TREAMTMET
Gravel Shoulders	300 mm	50 mm	-
Asphalt Roads (Existing)			Refer to Section 9.02.1
Asphalt Roads (With CDF)	CDF	100 mm	75 mm Asphalt
Gravel Driveways	-	100 mm	-
Asphalt Driveways	-	100 mm	50 mm Asphalt
Concrete Driveways			Refer to Standard Drawings in Section 8.0
Concrete Sidewalks & Walkways			Refer to Standard Drawings in Section 8.0
Asphalt Paths & Walkways			Refer to Standard Drawings in Section 8.0

(REVISED MAY 2020)

(b) Place sub-base and base in 300 mm lifts (unless otherwise specified) and compact to 95% modified Proctor Density (ASTM D1557). Field compaction testing to be conducted in accordance with ASTM D6938 and at the frequencies referred to in Section 9.21. ***(REVISED MAY 2020)***
(c) Restore asphalt road surfaces in accordance with Section 4.29 – Pavement Restoration. ***(REVISED MAY 2020)***
(d) Concrete shall be in accordance with Section 8.0 – Transportation and Section 11.0 – Cast In Place Concrete Works. ***(REVISED MAY 2020)***

(REVISED MAY 2020)

.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 300 mm of approved granular material, or other material specified of the Engineer where stability of ditch slopes and bottom cannot be maintained. ***(REVISED MAY 2020)***
(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 contact documents.
(b) Surface restoration shall be a minimum depth of 100 mm, 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 topsoil, 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 topsoil 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) Topsoil, 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 FINAL CUTTING PAVED SURFACES

.1 All final pavement cuts shall be sawn in accordance with Section 4.29 – Pavement Restoration.

.2 All final cuts shall be a minimum of 300 mm 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 If the edge of the trench is within 1 m of the edge of the road, curb, or gutter, the Contractor is required to remove and replace the asphalt to the edge of pavement.

4.29 PAVEMENT RESTORATION

.1 All permanent restorations will require a minimum 75 mm asphalt thickness and shall be constructed in accordance with Standard Drawing No. T-4A or as directed by the Engineer. ***(REVISED MAY 2020)***

.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 50 mm.
(c) On Local roads, with specific approval by the City Engineer, compacted granular material as specified in Section 4.19 may be used as temporary restoration for a maximum 5 day period as per the contract documents. ***(REVISED MAY 2020)***
(d) 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 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. All edges are to be saw cut or milled. ***(REVISED MAY 2020)***
(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 re-compacted; 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 4.28 – Final Cutting Paved Surfaces, and so that the pavement edge is a minimum of 300 mm from the trench wall. ***(REVISED MAY 2020)***

(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 9.0 – Aggregate and Granular Material. ***(REVISED MAY 2020)***

(f) Pavement edges shall be thoroughly cleaned. Tack coat, in accordance with Section 12.27, shall be applied to completely cover all pavement edges.

(g) Minimum compacted pavement thickness shall be equal to the existing pavement thickness or 75 mm, whichever is greater. ***(REVISED MAY 2020)***

(h) Material and placement of pavement shall be in accordance with Section 12.0 – 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 3.0 m 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.

(REVISED MAY 2020)

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.

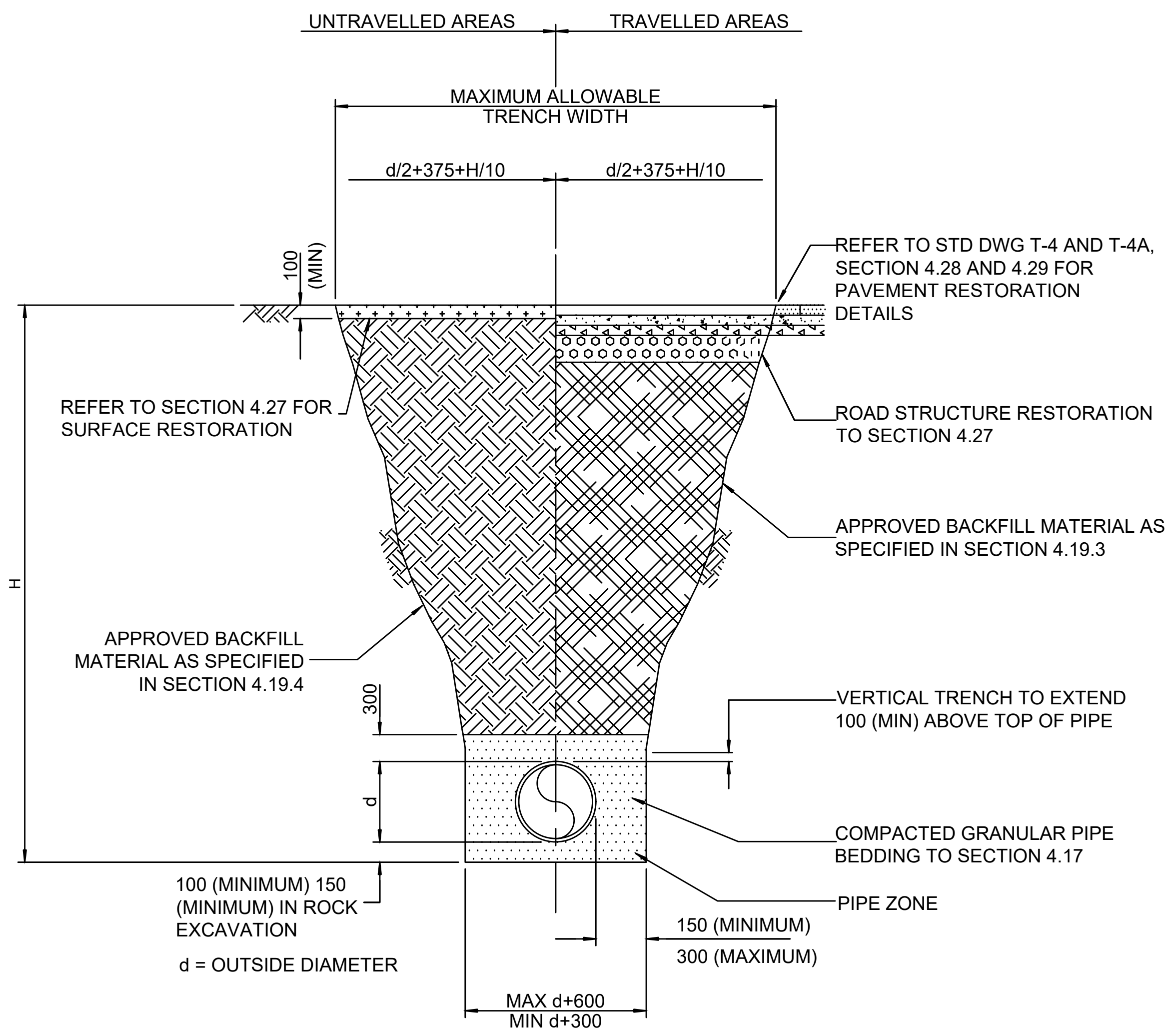
.2 Trenches in which backfill settles shall be refilled with the specified backfill material, and paved surfaces that are adjacent to trenches or on trench backfill, which fail during this period, shall be replaced or repaired in an approved manner.

4.31 PRIVATE UTILITES 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.



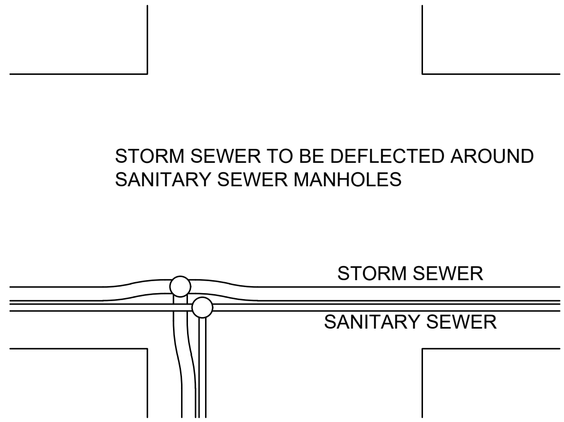
NOTES:

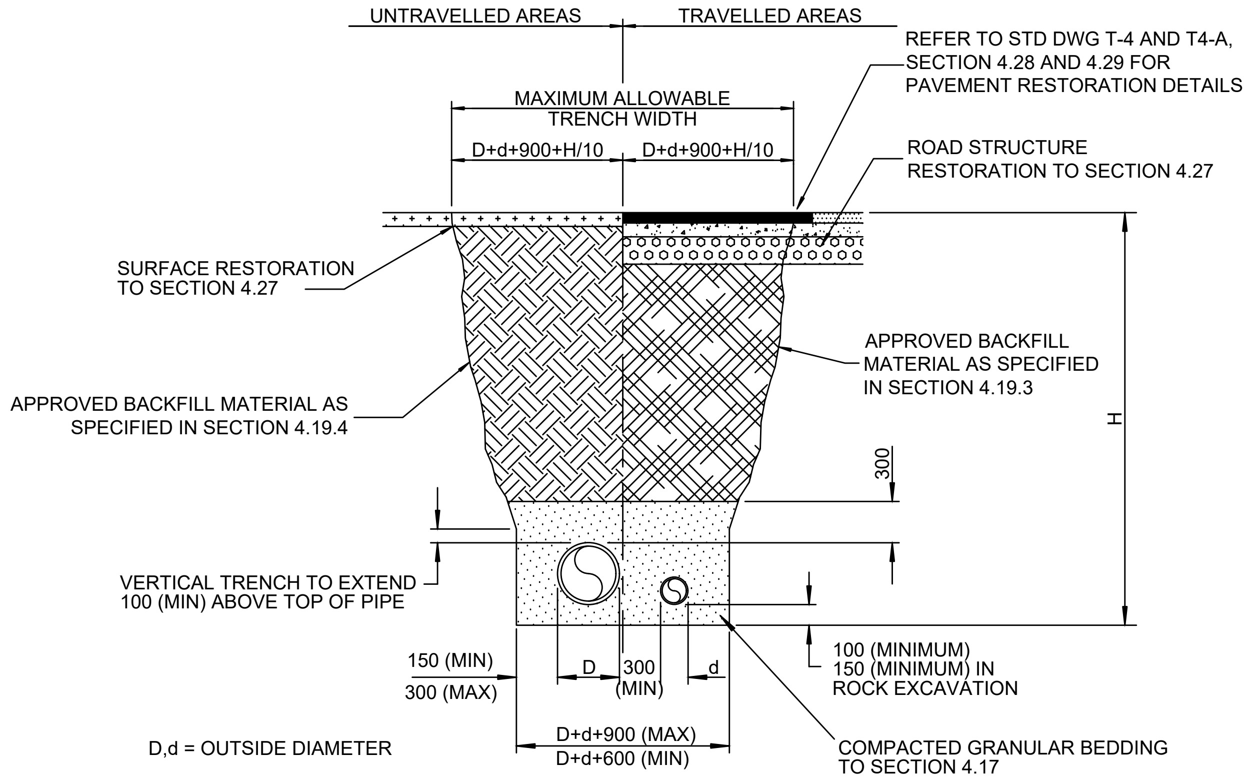
1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

CITY OF NANAIMO
THE HARBOUR CITY

TRENCH DETAILS

Scale:	NTS
Created:	OCT 2012
Rev Date:	MAY 2020
Dwg No:	T-1





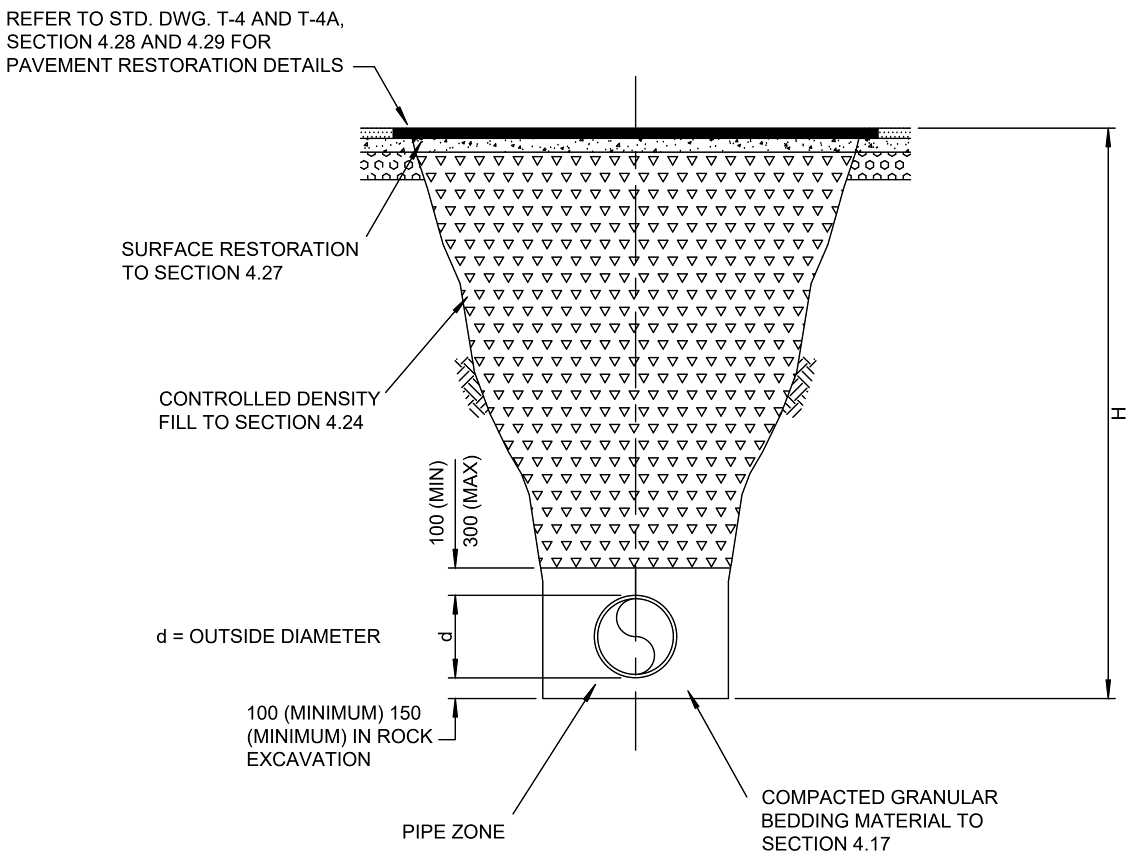
NOTES:

1. REFER TO STANDARD DRAWING T-1 FOR ADDITIONAL TRENCH DETAILS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

CITY OF NANAIMO
THE HARBOUR CITY

SANITARY & STORM SEWER
IN COMMON TRENCH

Scale:	NTS
Created:	OCT 2012
Rev Date:	MAY 2020
Dwg No:	T-2



NOTES:

1. REFER TO STANDARD DRAWING T-1 FOR ADDITIONAL TRENCH DIMENSIONS AND DETAILS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

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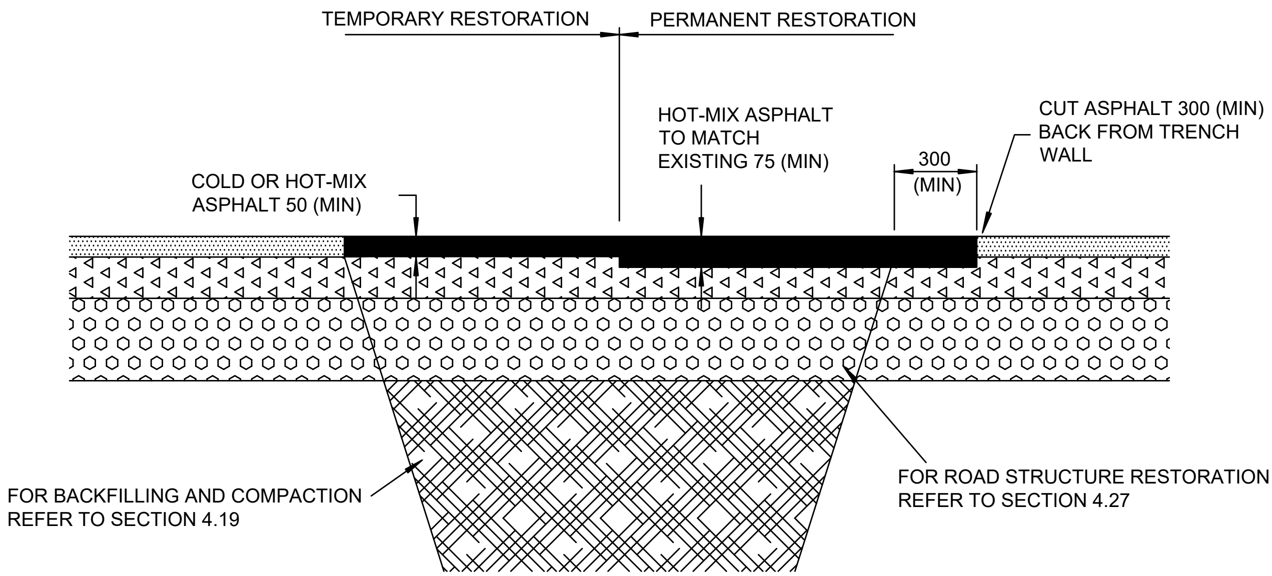
3.6.2020

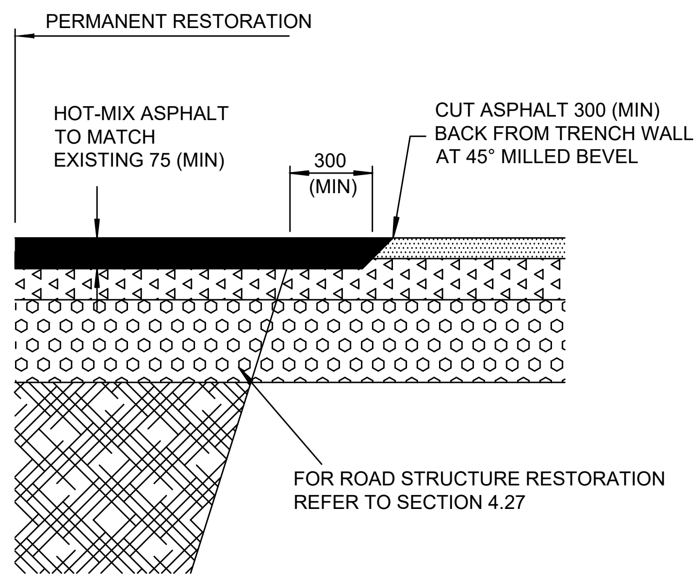
CITY OF NANAIMO
THE HARBOUR CITY

CONTROLLED DENSITY FILL
IN PAVED SURFACE AREA

Scale:	NTS
Created:	MAY 1996
Rev Date:	NOV 2016
Dwg No:	T-3



ALTERNATIVE 1 - STRAIGHT CUT



ALTERNATIVE 2 - BEVEL CUT

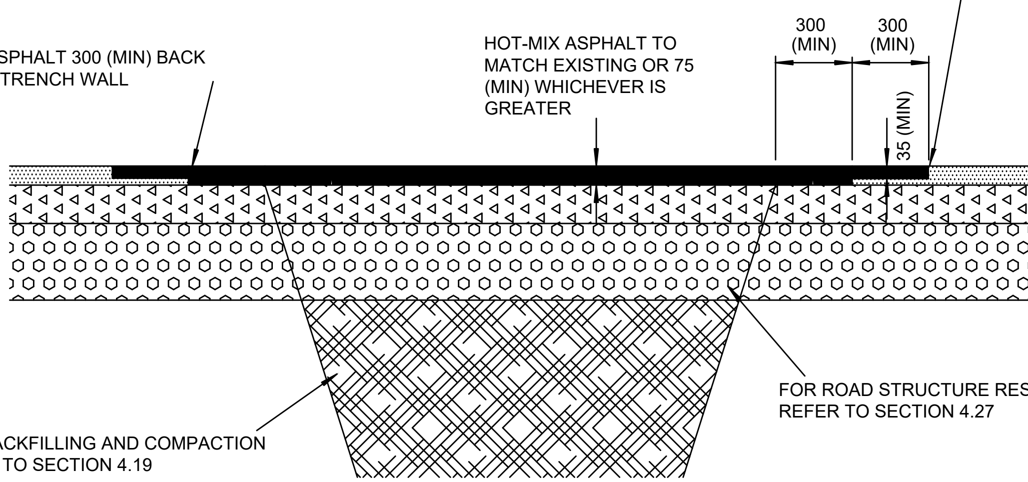
NOTES:

1. REFER TO STANDARD DRAWING T-1 FOR ADDITIONAL TRENCH DIMENSIONS AND DETAILS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

CITY OF NANAIMO
THE HARBOUR CITY

PAVEMENT RESTORATION TYPE 1
(ASPHALT THICKNESS < 75mm)

Scale:	NTS
Created:	APR 2016
Rev Date:	MAY 2020
Dwg No:	T-4



PERMANENT RESTORATION

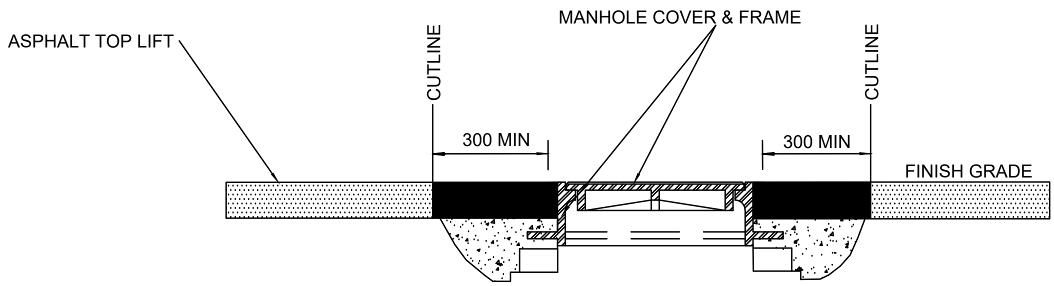
NOTES:

1. REFER TO STANDARD DRAWING T-1 FOR ADDITIONAL TRENCH DIMENSIONS AND DETAILS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

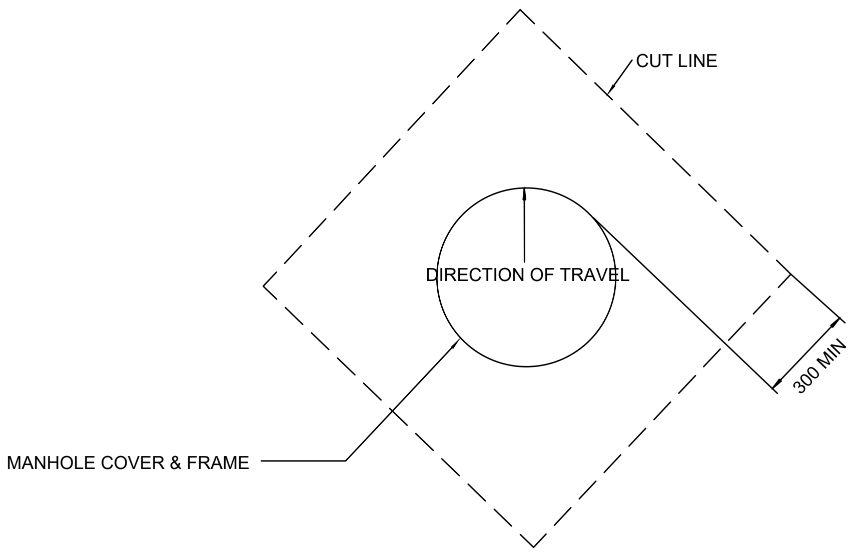
CITY OF NANAIMO
THE HARBOUR CITY

PAVEMENT RESTORATION TYPE 2
(75mm MINIMUM THICKNESS)

Scale:	NTS
Created:	OCT 2012
Rev Date:	NOV 2016
Dwg No:	T-4A



CONCRETE ENCASEMENT
SUPPORT DETAIL



SQUARE CUT PLAN VIEW

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 MILLIMETERS UNLESS SHOWN OTHERWISE.

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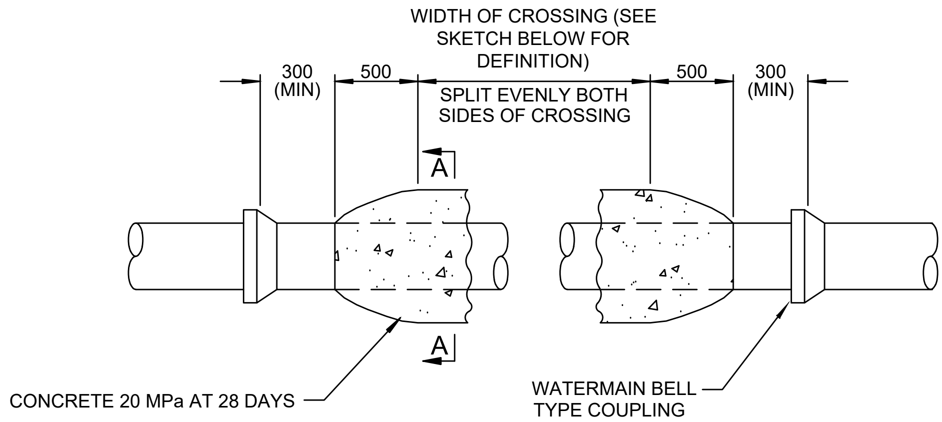
3.20.2020

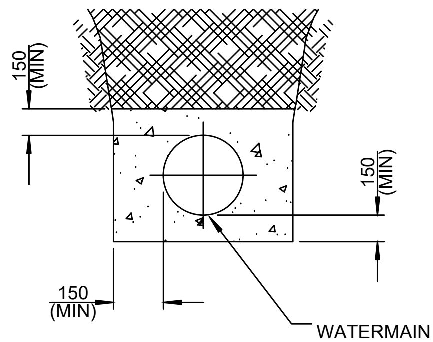
CITY OF NANAIMO
THE HARBOUR CITY

PAVEMENT RESTORATION
ASPHALT CUTTING FOR A MANHOLE

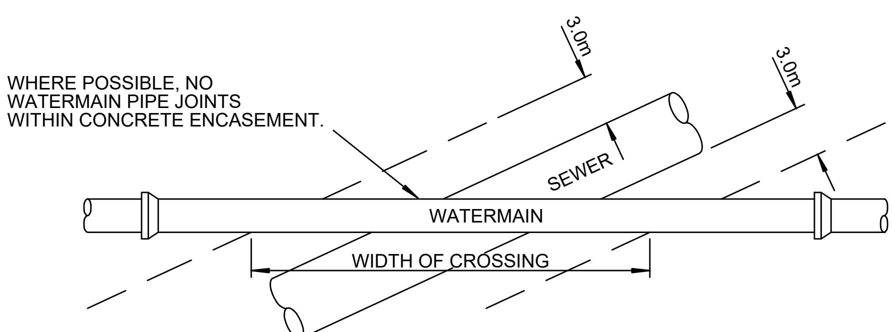
Scale:	NTS
Created:	NOV 2012
Rev Date:	NOV 2016
Dwg No:	T-4B



ELEVATION



SECTION A-A



PLAN

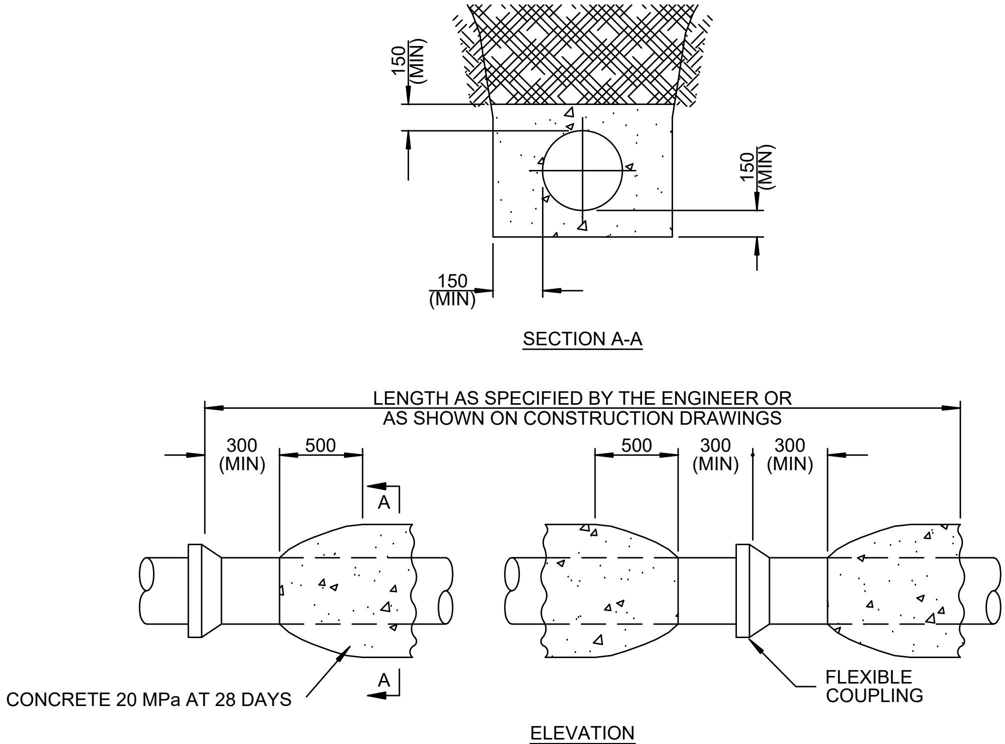
NOTES:

1. USE OF PETROLATUM TAPE WRAPPING 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.

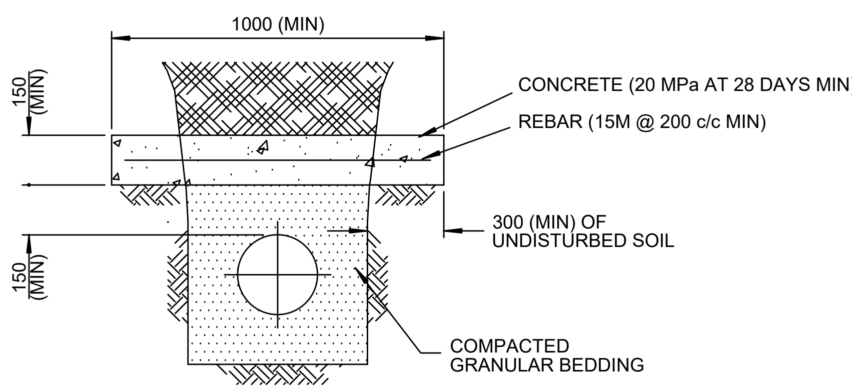
CITY OF NANAIMO
THE HARBOUR CITY

CONCRETE ENCASEMENT FOR
WATERMAIN \ SEWER SEPARATION

Scale:	NTS
Created:	OCT 1993
Rev Date:	MAY 2020
Dwg No:	T-5



ALTERNATIVE 1 - ENCASEMENT



ALTERNATIVE 2 - PROTECTIVE SLAB

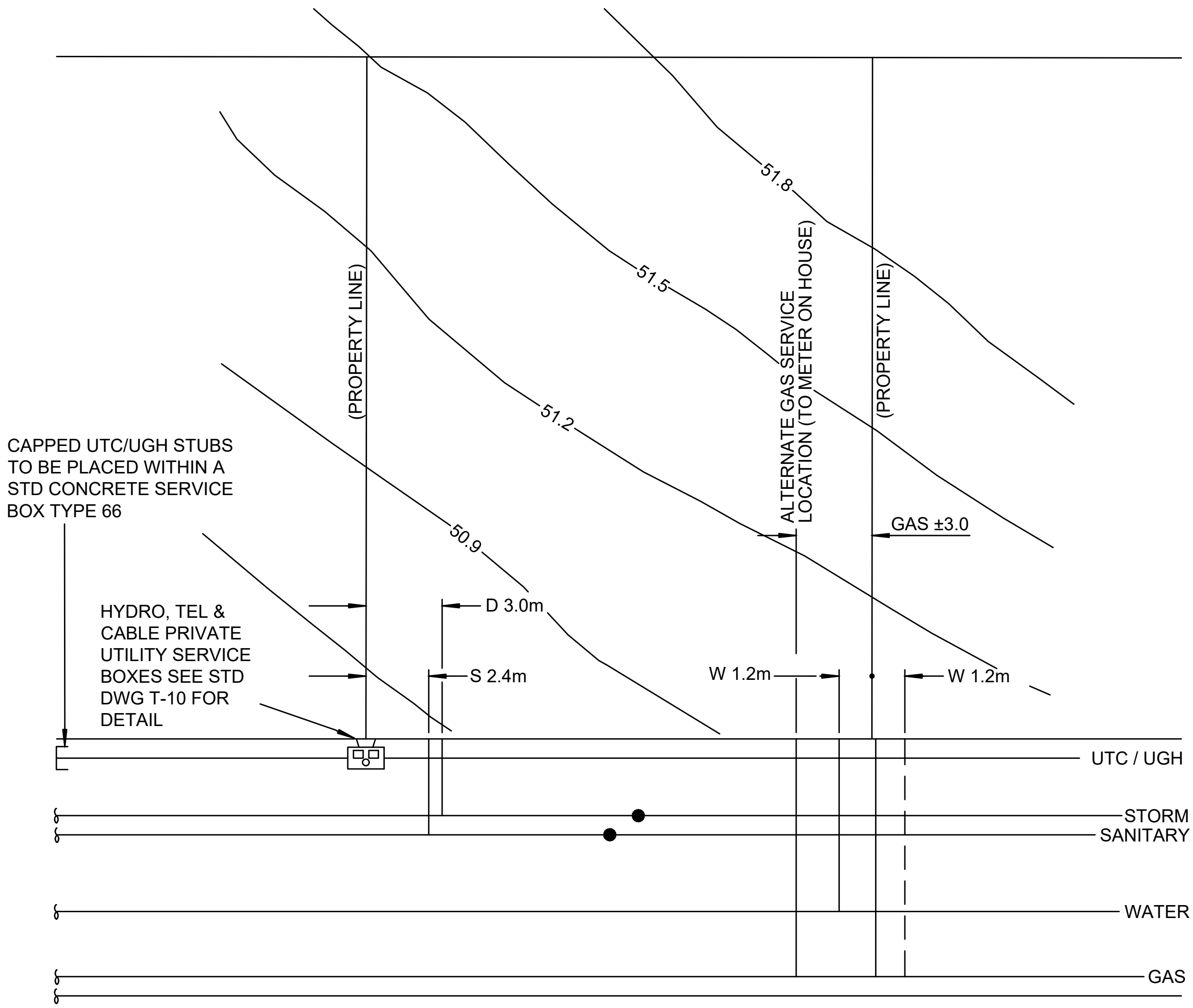
NOTES:

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.

CITY OF NANAIMO
THE HARBOUR CITY

PIPE PROTECTION
WITH CONCRETE

Scale:	NTS
Created:	OCT 1993
Rev Date:	NOV 2016
Dwg No:	T-6



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 UTH/UGH STUBS MUST BE PLACED WITHIN A STANDARD CONCRETE SERVICE BOX TYPE 66.

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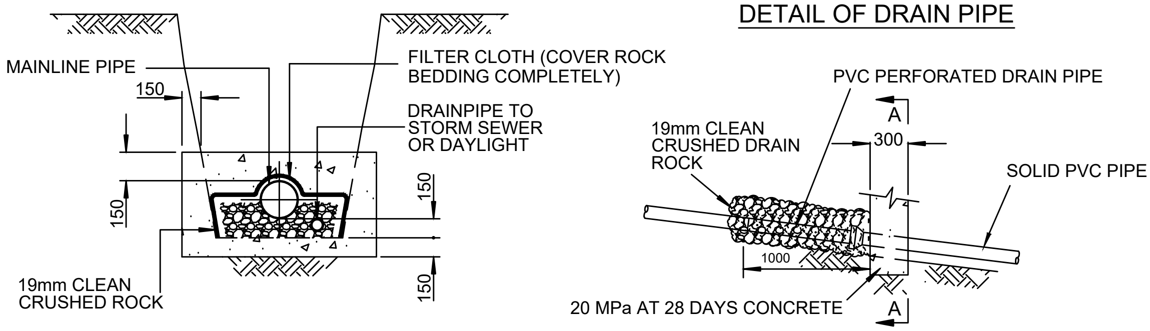
3.20.2020

CITY OF NANAIMO
THE HARBOUR CITY

TYPICAL LOCATION OF SERVICE CONNECTIONS TO RESIDENTIAL VACANT LOTS

Scale:	NTS
Created:	OCT 2012
Rev Date:	NOV 2016
Dwg No:	T-7



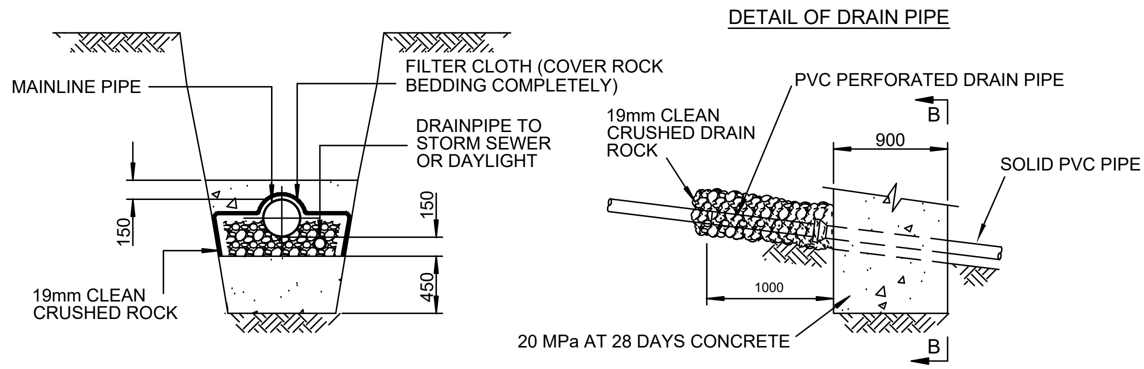
SECTION A-A

PROFILE

ALTERNATIVE 1

FOR USE IN TILLS AND OTHER STABLE, WELL COMPACTED NATIVE MATERIALS.

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



SECTION B-B

PROFILE

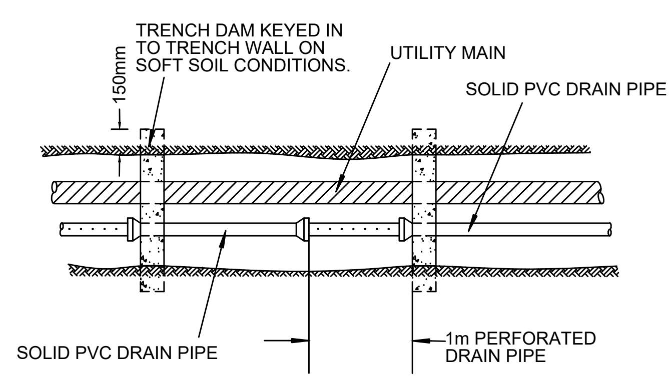
ALTERNATIVE 2

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 35 PVC.



TYPE 1-PLAN VIEW

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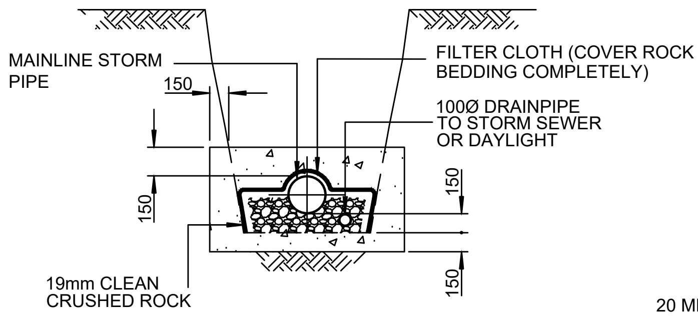
3.20.2020

CITY OF NANAIMO
THE HARBOUR CITY

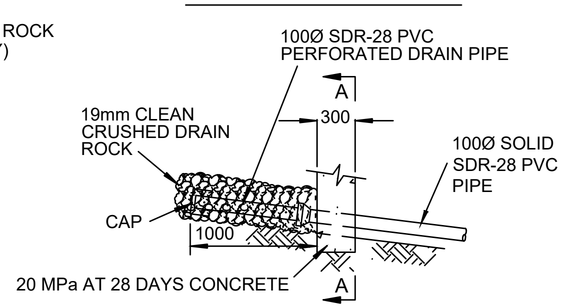
TRENCH DAMS - TYPE 1
FOR ALL UTILITY MAINS

Scale:	NTS
Created:	OCT 2012
Rev Date:	MAY 2020
Dwg No:	T-8



SECTION A-A

DETAIL OF DRAIN PIPE

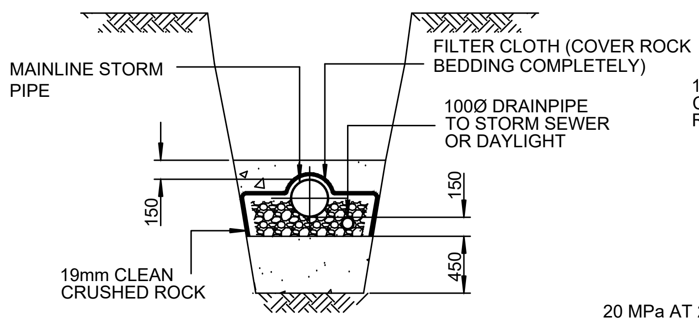


PROFILE

ALTERNATIVE 1

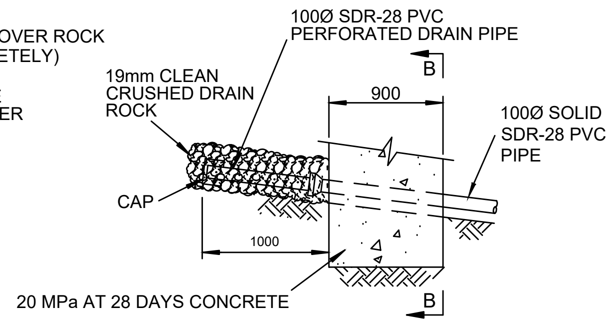
FOR USE IN TILLS AND OTHER STABLE, WELL COMPACTED NATIVE MATERIALS.

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



SECTION B-B

DETAIL OF DRAIN PIPE

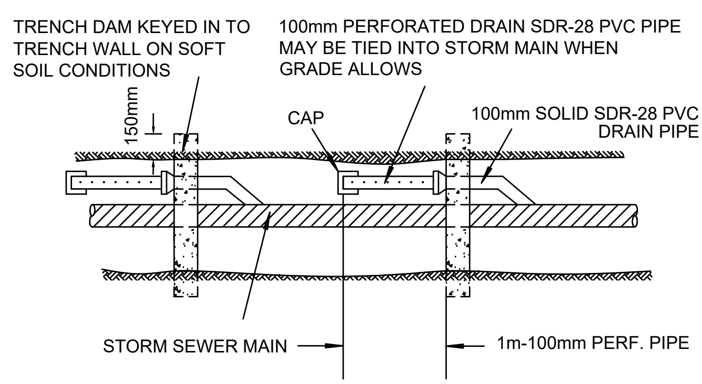


PROFILE

ALTERNATIVE 2

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

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



TYPE 2-PLAN VIEW

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.

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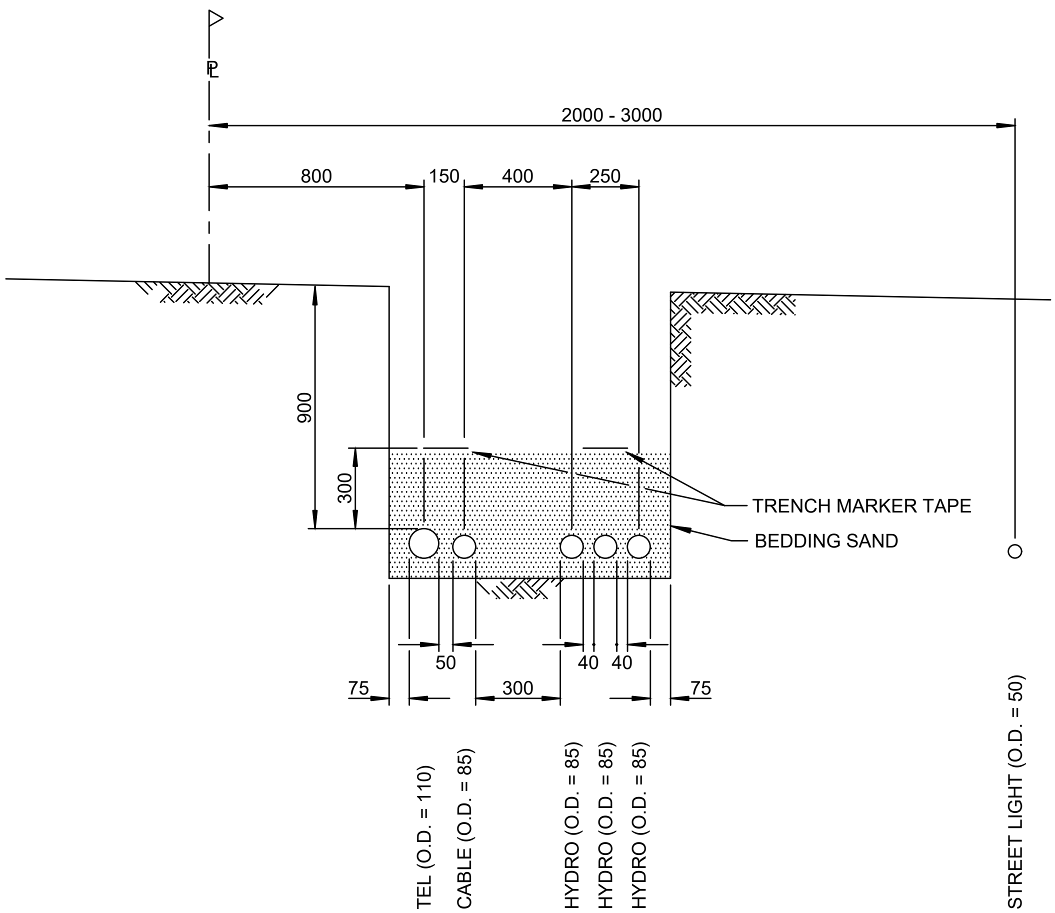
3.20.2020

CITY OF NANAIMO
THE HARBOUR CITY

TRENCH DAMS - TYPE 2
OPTIONAL FOR STORM SEWER MAINS

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



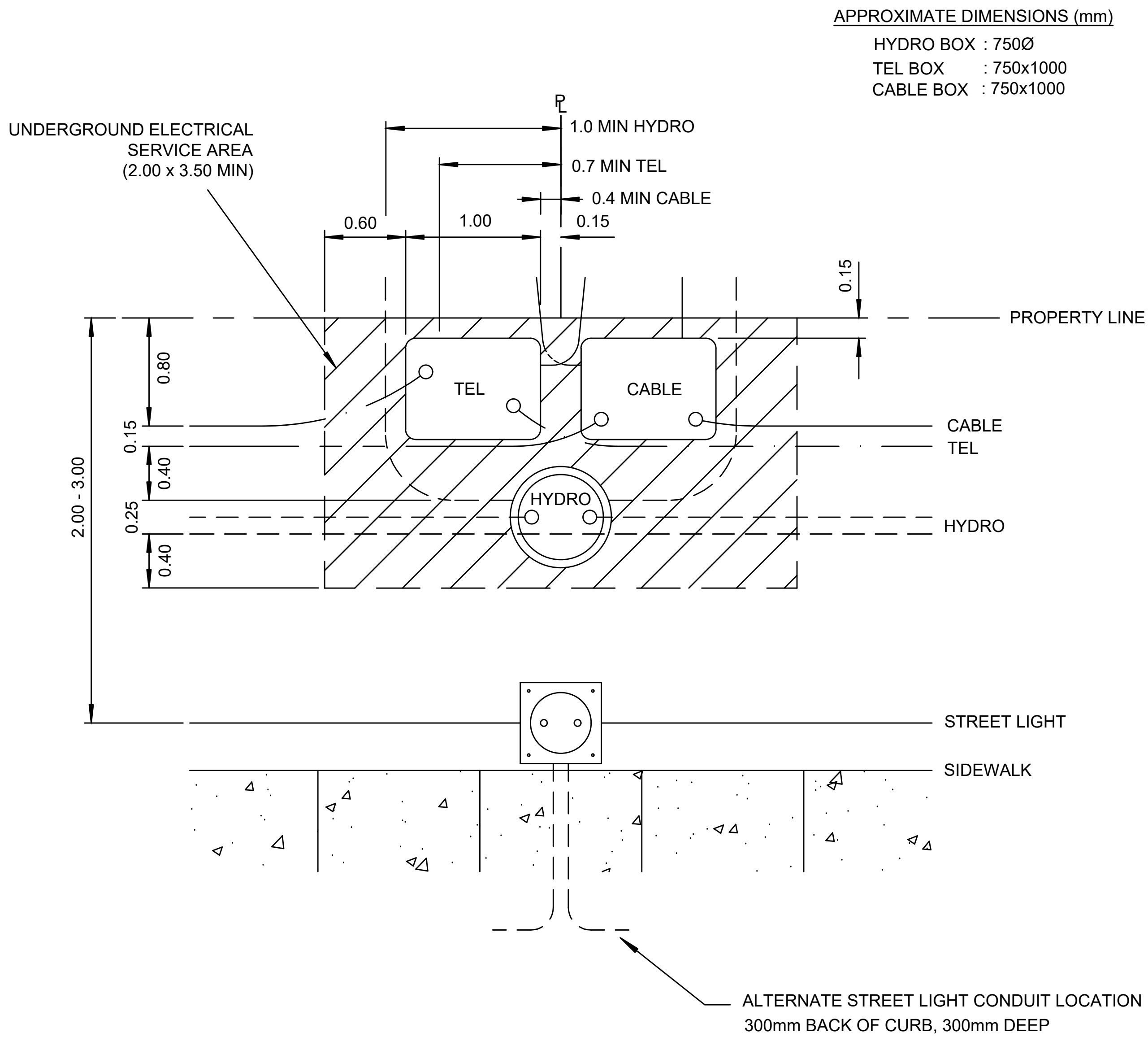
NOTE:

1. DIMENSIONS ARE SUGGESTIONS ONLY, DETAILS ARE TO BE DETERMINED BY PRIVATE UTILITY.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN.
3. REFER TO UTILITY CONSTRUCTION DRAWINGS FOR DUCT SIZE AND OTHER CONSTRUCTION REQUIREMENTS.
4. ALL UTILITIES SHALL BE TRACEABLE ELECTRONICALLY.

CITY OF NANAIMO
THE HARBOUR CITY

PRIVATE UTILITIES
UNDERGROUND ELECTRICAL
COMMON TRENCH DETAIL

Scale:	NTS
Created:	MAY 2001
Rev Date:	MAY 2020
Dwg No:	T-9



NOTES:

1. REFER TO SECTION 8 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. DIMENSIONS ARE SUGGESTIONS ONLY, DETAILS TO BE DETERMINED BY PRIVATE UTILITY.
7. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN.

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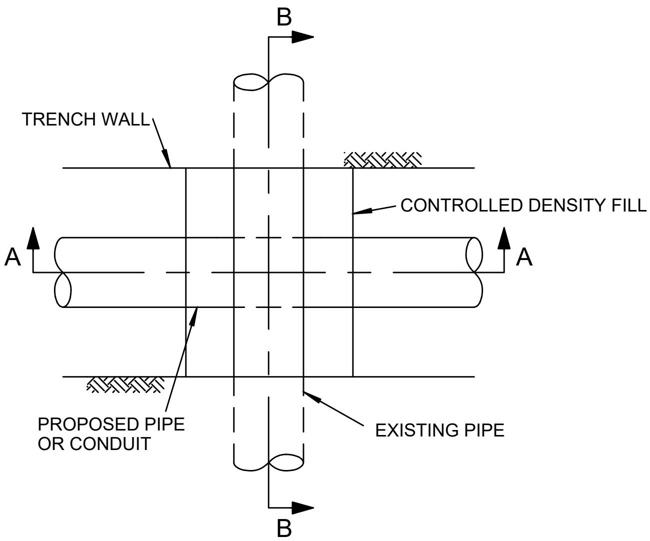
3.20.2020

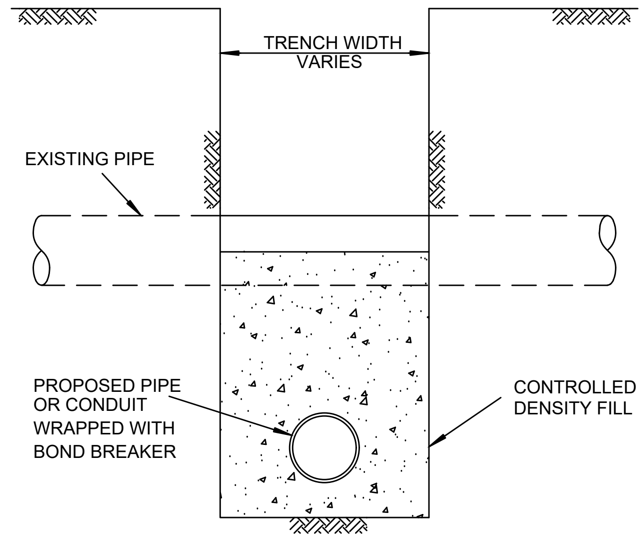
CITY OF NANAIMO
THE HARBOUR CITY

PRIVATE UTILITIES
UNDERGROUND ELECTRICAL
TYPICAL SERVICE BOX LOCATION

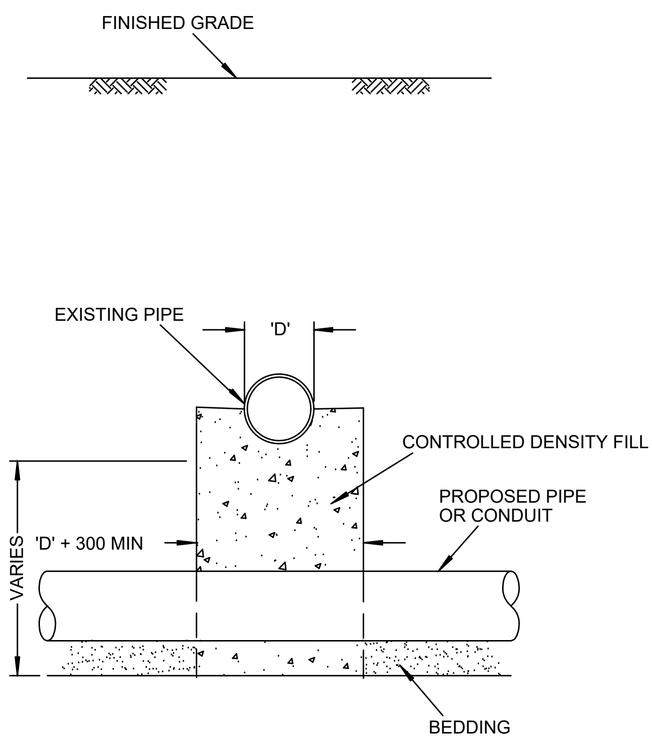
Scale:	NTS
Created:	OCT 2012
Rev Date:	MAY 2020
Dwg No:	T-10



PLAN



SECTION B-B



SECTION A-A

NOTES:

1. ALL DIMENSION IN MILLIMETERS UNLESS SHOWN OTHERWISE.

CITY OF NANAIMO
THE HARBOUR CITY

DETAIL OF SUPPORT FOR EXISTING UTILITIES

Scale:	NTS
Created:	MAY 1998
Rev Date:	NOV 2016
Dwg No:	T-11

3.6.2020

SECTION 5 – WATER DISTRIBUTION SYSTEM
CONTENTS

(REVISED MAY 2020)

SECTION 5 – WATER DISTRIBUTION SYSTEM
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(REVISED MAY 2020)

CROSS CONNECTION CONTROL

(REVISED MAY 2020)

SECTION 5 – WATER DISTRIBUTION SYSTEM
CONTENTS

(REVISED MAY 2020)

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:

5.01A 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.

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.

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.

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 flows with a minimum of 75 l/s during Maximum Day Demand, a residual pressure at all flowing hydrant(s) is 150 kPa (22 psi) and no other point in system less than 35 kPa (5 psi). 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. ***(REVISED MAY 2020)***

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 portion of the system at their own cost or modify the proposed development to match existing fire flows at the main.

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

LAND USE ZONE (BYLAW 4500)		Hydrant Flows at main (ℓ/s)
R1-3	Single Dwelling Residential	75
R4	Duplex Residential (not sprinklered)	150
R5	Three & Four Unit Residential	110
R6	Townhouse Residential	130
R7	Row House Residential ((s) for larger buildings)	90
R8	Medium Density Residential	240
R9 *	High Density (High Rise) Residential	300
R10	Steep Slope Residential (SFD / (s) for Multi)	75 / 175
R11	Recreational Vehicle Park	120
R12	Mobile Home Park Residential	120
R13	Old City Duplex Residential	180
R14	Old City Low Density (Four plex) Residential	115
R15	Old City Medium Density Residential	140
AR1	Rural Resource	75
AR2	Urban Reserve	75
COR1	Residential Corridor	230
COR2 *	Mixed Use Corridor	300
COR3 *	Community Corridor	300
CC1	Local Service Centre	105
CC2	Neighbourhood Centre	200
CC3 *	City Commercial Centre	300
CC4 *	North Nanaimo Urban Centre	300
CC5	Hospital Urban Centre	240
CC6	Commercial Recreation Centre (s)	----
DT1	Core ((s) for high rise)	230
DT2	Fitzwilliam	300
DT3 *	Wallace	300
DT4	Terminal Avenue	210
DT5	Chapel ((s) for high rise)	240
DT6 *	Port Place ((s) for high rise)	300
DT7	Quennell Square	225
DT8	Old City Mixed Use	140
DT9	Old City Central	150
DT10	Old City Infill Business Commercial	170
DT11	Old City Infill Service Commercial	170
DT12	Gateway	215
PRC1/2/3	Parks, Recreation and Culture One, Two, Three (s)	----
I1	Highway Industrial	225
I2 *	Light Industrial	300
I3 *	High Tech Industrial	300
I4 *	Industrial	300
CS1/2/3	Community Service One, Two, Three (s)	----
W1	Waterfront	75
W2 *	Harbour Waterfront	300
W3	Newcastle Waterfront	285
W4 *	Industrial Waterfront	300
CD1 – CD6	Comprehensive Development	----

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

5.02 WATER PRESSURE

.1 Minimum design distribution pressure in all areas at peak hour demand 300 kPa (44 psi) based on design low reservoir level. With the combination of maximum daily demand and the specified fire flow, the minimum residual water pressure at all flowing hydrant(s) is 150 kPa (22 psi) and no other point in the system less than 35 kPa (5 psi). 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 MAY 2020)***

.2 The maximum allowable distribution line pressure is 860 kPa (125 psi) static, except where individual connections are permitted directly from trunk mains and where special precautions are taken. Otherwise, where distribution pressures will exceed 860 kPa (125 psi) static due to a drop in elevation, a pressure reducing station shall be installed as part of the distribution system. Where distribution pressures exceed 550 kPa (80 psi), occupants of existing houses in the area shall be advised to install individual pressure reducing valves. ***(REVISED MAY 2020)***

5.02A VELOCITY

.1 The maximum desirable velocity at maximum peak hour flow shall not exceed 2.0m/s.

.2 The maximum desirable velocity during fire flow conditions *plus* the maximum day rate shall not exceed 3.5 m/s. ***(REVISED MAY 2020)***

5.03 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.

Land Use	Population Density
Single Family	36 persons per hectare
Low Density multi-family	48 persons per hectare
High density multi-family	120 persons per hectare
Industrial & Commercial	36 persons per hectare

5.04 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.

5.05 <u>WATER DISTRIBUTION PIPING</u>

.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 1000 m 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 200 mm dia., except that 150 mm dia. may be allowed for short interconnecting streets, or short dead ends not over 100 m 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. Minimum pipe size to the fire hydrant shall be 200 mm dia. ***(REVISED MAY 2020)***

(c) Lines furnishing domestic supply only, and not serving hydrants, may be 100 mm in dia.. 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.

(REVISED MAY 2020)

(REVISED MAY 2020)

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(d) All pipes shall be designed for the maximum pressures and earth loading to which the pipe will be exposed. ***(REVISED MAY 2020)***

(i) For PVC, the minimum Dimension Ratio shall be DR18. If design warrants, a thicker wall thickness may be required. ***(REVISED MAY 2020)***

(ii) For HDPE (PE4710) the minimum Dimension Ratio shall be DR11. If design warrants, a thicker wall thickness may be required. (REVISED MAY 2020)

(e) Design criteria for any watermain piping 350 mm or greater in dia. requires City Engineer approval. ***(REVISED MAY 2020)***

5.05A <u>EXTERNAL PIPE/FITTING CORROSION REPORT</u> ***(REVISED MAY 2020)***

.1 At the request of the City Engineer a pipe corrosion report shall be prepared by the Engineer, at the Applicants expense, on prevention of corrosion of ductile iron, copper, grey iron and/or steel pipe and fittings used for construction of the infrastructure. ***(REVISED MAY 2020)***

.2 The corrosion report shall be subject to an engineering analysis of the potential of external pipe corrosion due to graphitization, pitting corrosion, galvanic corrosion, microbiologically influenced corrosion, corrosion due to dissimilar electrolytes and/or stray current corrosion. The report shall outline the construction methods to provide maximum corrosion protection requirements based on the latest best management practices. ***(REVISED MAY 2020)***

.3 A geotechnical report may also be required for sites with adverse soil conditions, contaminated soils, groundwater, or other such conditions which, in the opinion of the City Engineer, require special attention. ***(REVISED MAY 2020)***

.4 All recommendations provided in the report shall become requirements for design and subsequent construction. ***(REVISED MAY 2020)***

5.05B CORROSION PROTECTION REQUIRED FOR BURIED METALS ***(REVISED MAY 2020)***

.1 Design and construction shall provide for external corrosion protection of all buried metals, pipe fittings and restraints. As a minimum, corrosion protection shall be with a petrolatum based wax and tape coating system approved for potable water per AWWA C217. ***(REVISED MAY 2020)***

.2 At the request of the City Engineer, other corrosion protection systems may be required. ***(REVISED MAY 2020)***

5.06 SERVICE CONNECTIONS

.1 All services greater than 50 mm dia. require Backflow Prevention Assemblies in accordance with the City of Nanaimo's Cross Connection Control Program Specifications outlined in Section 5.0 - Water Distribution System, Cross Connection Control, unless approved otherwise by the City Engineer. ***(REVISED MAY 2020)***

.2 Design drawings shall show the arrangement for water service connections. The minimum size of service connection to be specified is 25 mm dia. for polyethylene service tubing and 19 mm dia. for copper. All components shall be the same size as the service pipe to which they are connected, except for 25 mm dia. polyethylene service tubing, where the corporation stop, curb stop and water meter shall be 19 mm dia. All lots shall be provided with their own water service.

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

.4 For all services greater than 50 mm dia., a gate valve complete with valve box shall be provided at the watermain tee. There shall also be a gate valve located 300 mm from property line within the right-of-way complete with valve box. The service gate valve shall be a minimum 100 mm and service pipe shall be a minimum 100 mm dia. DR18 PVC as specified for watermain. ***(REVISED MAY 2020)***

(a) Where the meter is located in a chamber or vault, the gate valve immediately after the meter shall suffice as the gate valve at the property line. ***(REVISED MAY 2020)***

(b) Where the meter is located in a mechanical room, the gate valve at the property line is required. ***(REVISED MAY 2020)***

.5 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.

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

.7 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.

.8 The City of Nanaimo Water Meter Sizing Calculation Sheet in Appendix H4 shall be used for sizing of water meters.

5.07 HYDRANTS

.1 The minimum hydrant connection size shall be 150 mm.
The minimum depth of cover shall be 1.20 m.
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 150 mm to 200 mm above final grade.

.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 140 m 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 90 m.

.4 Two gate valves shall be provided at a watermain tee servicing a hydrant assembly: ***(REVISED MAY 2020)***

(a) A hub x flange (HxF) gate valve on the lead to the fire hydrant. The gate valve shall be a flange connection at the watermain tee. This flanged gate valve shall service the hydrant lead only. Hydrant bowls shall be a bell end pipe connection to the hydrant lead and shall not be flanged. ***(REVISED MAY 2020)***
(b) A hub x flange (HxF) gate valve inline with the watermain. The gate valve shall be a flange connection at the watermain tee. The location of this valve shall be on the upstream side of the watermain. ***(REVISED MAY 2020)***

.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 8.0 - Transportation, and where possible at property corners. Hydrants shall be located 2.0 m (minimum) from the edge of present and future vehicular traveled areas;

a minimum of 3.0 m from lamp standards, hydro poles, or other obstructions; and shall not be constructed closer than 1.0 m from front property line. ***(REVISED MAY 2020)***

.7 The maximum design flow per hydrant shall be 100 l/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.

5.08 VALVES

.1 In general, valves shall be located as follows:

(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.

(b) Distance between valves shall not be more than 150m.

.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 300 mm dia. Valves may be rubber seated butterfly valves if approved by the City Engineer.

.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.

5.09 THRUST BLOCKS AND JOINT RESTRAINTS

.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 300 mm nominal dia., 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:

(a) For sizes larger than 300 mm dia.
(b) Where pressures exceed 1035 kPa (150 psi). ***(REVISED MAY 2020)***
(c) Where allowable soil bearing is less than 96 kPa (14 psi). ***(REVISED MAY 2020)***
(d) Where vertical thrust/reaction blocking is required.
(e) Where joint restraints are used.

.2 For sizes larger than 200 mm dia., restraint fittings must be mechanical joints. ***(REVISED MAY 2020)***

.3 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 rod and joint restraints shall be protected with an approved petrolatum protection coating meeting AWWA Standards.

.4 Tie rods and joint restrains shall be provided, as a minimum for the following locations:

(a) Hydrants
(b) Blow-offs
(c) Temporary caps
(d) Fittings or pipes larger than 300 mm
(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.

5.10 WATERMAIN LOCATION, DEPTH AND GRADE

.1 The minimum depth of cover shall be 1.20 m unless otherwise permitted by the City Engineer. Minimum cover over watermain pipe crossings under ditches shall be 0.5 m.

.2 Unless otherwise approved by the City Engineer, tolerances for pipe alignment and grade shall be: ***(REVISED MAY 2020)***

Alignment	±50 mm
Grade	±25 mm

.3 Watermains shall be located not less than 3.0 m clear distance horizontally and 0.45 m 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.

.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 3 m 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.

.6 For trench dam design, refer to Section 4.18 – Trench Dams. ***(REVISED MAY 2020)***

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 2.0 m from the property boundary.

.3 Appurtenances such as valves, etc. shall not be located on property boundaries.

.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 860 kPa (125 psi). In general, the pressure reducing station shall be located at the elevation where the static pressure initially exceeds 860 kPa (125 psi). ***(REVISED MAY 2020)***

.2 General requirements for pressure reducing stations shall be as follows:

(a) A valved bypass shall be provided.
(b) A downstream surge of relief 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 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 an above ground kiosk. Underground vaults may be considered with the approval of the City Engineer. If approved, 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. ***(REVISED MAY 2020)***
(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 pain manufactured for the purpose of sealing concrete.
(j) Exterior wall below grade shall be black damp-proofed (tar coated) to prevent leakage.

5.12 <u>-NOT USED-</u>

5.13 <u>METER CHAMBERS/VAULTS AND BOXES</u> ***(REVISED MAY 2020)***

.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 50 mm dia. or less. ***(REVISED MAY 2020)***
(b) a statutory right-of-way on private property for services larger than 50 mm dia.. Chamber shall be as close to property line as possible. ***(REVISED MAY 2020)***
(c) Alternate locations may be considered with the approval of City Engineer.

.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.

.3 For small services, 50 mm in dia. 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 or vault designed to accommodate the meter arrangement including associated piping, isolation valves, and bypasses and shall be in accordance with this Section including Standard Drawing No. W-11 and Section 5.34 including Standard Drawing No. W-11A. ***(REVISED MAY 2020)***

.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 dia. 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 600 mm clearance shall be provided between the walls and the meter including associated piping. At least 600 mm 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 450 mm of clearance provided above the chamber floor. Overall inside height of the chamber shall not be less than 1.8 m.
(b) The meter shall be protected against freezing, mechanical damage and tampering.
(c) Bypass and isolation valves may be in approved valve boxes outside the chamber to minimize chamber/vault size. If bypass is installed within the chamber, exposed valves shall be approved by the City Engineer. ***(REVISED MAY 2020)***
(d) The chamber shall be constructed of reinforce 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 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 WorkSafeBC requirements for fixed ladders.
(k) Exterior walls below grade shall be watertight.
(l) Interior surfaces of chambers for meters 50 mm dia. 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 38 mm dia. and larger to avoid service shutdown during meter maintenance. For combination fire service and domestic meters, the bypass shall be size for the largest flow rate. In the absence of the flow rate, the bypass shall be the same diameter as the service.

.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.

5.13A BACKFLOW PREVENTION ASSEMBLIES CHAMBERS/ CONTAINMENT STRUCTURES ***(REVISED MAY 2020)***

.1 Unless otherwise approved by the City Engineer, all new developments and revisions to existing properties shall install Premise Isolation in accordance with the Specifications under Section 5.0 - Water Distribution System, Cross Connection Control. The owner of a property subject to Premise Isolation shall be the owner of all Backflow Prevention Assemblies, Associated Chambers/Containment Structures and associated appurtenances. ***(REVISED MAY 2020)***

(a) Backflow Prevention Assemblies shall be installed in accordance with Section 5.77 - Installation Standards for Backflow Prevention Assemblies for Premises Isolation. ***(REVISED MAY 2020)***

(i) Services including residential services greater than 50 mm dia. shall have a Backflow Prevention Assembly installed immediately after the service meter in a separate chamber/vault/containment structure, (such as mechanical rooms), located on the private property or parcel. ***(REVISED MAY 2020)***

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.

.2 Combination air valves shall be a minimum of 25 mm dia..

.3 For mains 300 mm dia. 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.

.4 Combination air valve chambers shall be drained to ensure that the chamber does not flood.

.5 Combination air valves shall be vented to an appropriate above-grade location to eliminate potential cross-connection in a flooded or contaminated chamber. ***(REVISED MAY 2020)***

5.15 FLUSHOUTS

.1 Flushouts shall be provided at the ends of all dead end mains whether permanent or temporary.

.2 On all mains greater than 350mm dia., flushouts shall be installed at the lowest points in the watermain network.

.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 8.0 - Transportation. Flushouts shall be located 2.0 m (minimum) from the edge of present and future vehicular traveled areas and shall not be constructed closer than 0.6m from front property line. ***(REVISED MAY 2020)***

.5 Where practical, and with the approval of the City Engineer, hydrants may also be used in a secondary role as a flushout.

5.16 FLOOR DRAIN CHAMBER ASSEMBLY ***(REVISED MAY 2020)***

.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 7.0 – Stormwater Management 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.
(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.

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 The Engineer shall arrange for a certified materials testing firm to carry out tests to determine whether the applicable standards and specifications have been met. Where initial testing indicates inadequacies, additional testing shall be required. ***(REVISED MAY 2020)***

5.22 WATERMAIN PIPE

.1 The sizes and types of pipe to be used shall be shown on the drawings.

.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:

Pipe Size	Class
75 – 300	350
350 – 500	250

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 C11 or shall be rubber gasket, bell and spigot, Tyton joint, or as approved.

The class or nominal thickness, net weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the manufacturer’s mark, country where cast, year in which the pipe was produced, and the letters “DI” or Ductile” shall be cast or stamped on that pipe. ***(REVISED MAY 2020)***

(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 AWWA C105 where warranted by soil conditions. ***(REVISED MAY 2020)***

Petrolatum Corrosion Protection system shall be installed to AWWA C217 where warranted by soil conditions. ***(REVISED MAY 2020)***

.3 Steel Pipe ***(REVISED MAY 2020)***

(a) Standard Specifications:

Steel pipe, fittings and specials, shall conform to the following standard specifications:

(REVISED MAY 2020)
AWWA C200 – Standard for Steel Water Pipe 150 mm and larger ASTM A36
AWWA C205 – Standard for Cement – Mortar Protective Lining and Coating for Steel Water Pipe 4 in. (100 mm) and Larger-Shop Applied
AWWA C206 – Field Welding of Steel Water Pipe ***(REVISED MAY 2020)***
AWWA C207 – Standard for Steel Pipe Flanges for Waterworks Service Sizes 4 in. through 144 in. (100 mm through 3,600 mm)
AWWA C208 – Standard for dimensions for Steel Water Pipe fittings.
AWWA C606 – Standard for Grooved and Shouldered Joints

(b) Steel pipe may be allowed in limited circumstances. Subject to pre-approval, the City Engineer will provide detailed specifications and requirements on a strict site by site basis. ***(REVISED MAY 2020)***

.4 Polyvinyl Chloride (PVC) Pipe:

(a) Standard Specifications:

100 to 350 mm dia. PVC pressure pipe for water:
- Pipe shall conform to AWWA C900, certified to CSA B137.3 and shall be cast-iron pipe equivalent outside diameter (CIOD).
- Pipe DR shall be:
  - DR 18 with pressure rating of 1620 kPa (235 psi), or
  - DR14 with pressure rating of 2100 kPa (305 psi), or as otherwise approved. ***(REVISED MAY 2020)***

(b) Supplementary Data:

An affidavit of compliance with the standard specifications and supplementary data shall be submitted from the supplier. All pipe shall be ULC Listed. 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 MAY 2020)***

All PVC water pipe shall be blue in colour.

.5 High Density Polyethylene (HDPE) Pipe ***(REVISED MAY 2020)***

(a) Standard Specifications:

HDPE pipe to be used for watermains shall be, at the discretion and approval of the City Engineer. (HDPE pipe shall not be used for services.) ***(REVISED MAY 2020)***

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, 100 mm through 1575 mm for Water Distribution and Transmission) and shall: ***(REVISED MAY 2020)***

(i) be PE grade 4710 at a minimum DR11 with a pressure class of 1375 kPa (200 psi); ***(REVISED MAY 2020)***
(ii) be COID, meet ASTM D3350, and ***(REVISED MAY 2020)***
(iii) installed with electrofusion fittings and/or conventional (butt) fusion fittings. ***(REVISED MAY 2020)***

1. Joints shall be fused in strict accordance with manufacturer’s instructions meeting ASTM D3261. ***(REVISED MAY 2020)***
2. Compatible mechanical joint fittings and valves without special adapters may be considered under approval by the City Engineer. ***(REVISED MAY 2020)***

(iv) Be certified to NSF 61 and clearly marked by the manufacturer with a permanent colour marking designation for the entire length of pipe meeting AWPA Uniform Colour Code Blue for potable water. ***(REVISED MAY 2020)***

(REVISED MAY 2020)

(b) Fittings:

Fabricated HDPE mitered fittings shall meet AWWA C906. ***(REVISED MAY 2020)***

Molded HDPE fittings shall meet ASTM 3261. ***(REVISED MAY 2020)***
Fittings shall be as recommended by the manufacturer for the PE grade and pressure rating of the pipe with no downrating of pipe pressure. ***(REVISED MAY 2020)***

(c) Supplementary Data:

An affidavit of compliance with the standard specifications shall be submitted from the supplier. All pipe and fittings shall bear the underwriters label. ***(REVISED MAY 2020)***

5.23 WATERMAIN FITTINGS

.1 All fittings for ductile iron and PVC pipe shall be:

(REVISED MAY 2020)

(a) Asphalt coated ductile iron compact fittings manufactured to AWWA C153, designed for a minimum working pressure of 2415 kPa (350 psi), and cement mortar lined to AWWA C104. ***(REVISED MAY 2020)***
(b) Asphalt coated ductile iron fittings manufactured to AWWA C110, designed for a minimum working pressure of 2415 kPa (350 psi) and cement mortar lined to AWWA C104. ***(REVISED MAY 2020)***

.2 The design pressure rating of all fittings shall meet or exceed the pressure class of the pipes they are connected to.

.3 Single rubber gasket for push-on bell and spigot type joint and/or mechanical pipe joints to ANSI/AWWA C111/21.11 (Tyton). All push-on joint hubs to be equipped with tie rod lugs. ***(REVISED MAY 2020)***

.4 Flanged joints on fittings shall be flat faced conforming in dimension and drilling to ANSA 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 1380 kPa (200 psi), fittings shall be as approved by the City Engineer. ***(REVISED MAY 2020)***

5.24 WATERMAIN VALVES

(REVISED MAY 2020)

.1 Unless otherwise approved by the City Engineer, valves conforming to the following specifications shall be installed in the distribution system: ***(REVISED MAY 2020)***

(REVISED MAY 2020)

(a) Resilient Wedge Gate Valves:

(i) Valves shall conform to the latest revision of AWWA C509 and AWWA C515 Resilient Seated Gate valves and shall be UL listed and FM approved. ***(REVISED MAY 2020)***
(ii) Valves shall be non-rising stem, open left (counter-clockwise) and have a 50 mm 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 meeting AWWA C550. 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. ***(REVISED MAY 2020)***
(viii) Every valve will have a positive stop to prevent distortion to the wedge.
(ix) Valve operating nuts greater than 1.2 m below finished grade require a valve nut extension rod complete with valve riser guide. Valve nut extension rods shall be a minimum 600 mm below finished grade. Refer to Standard Drawing No.W-16.
(x) Single rubber gasket for push-on bell and spigot type joint and/or mechanical pipe joints to ANSI/AWWA C111/21.11 (Tyton). All push-on joint hubs to be equipped with tie rod lugs. Valves shall have flange connection to fittings. ***(REVISED MAY 2020)***
(xi) Valves larger than 400 mm shall be complete with bypass gate valve. Subject to approval by the City Engineer, a butterfly valve conforming to ANSI/AWWA C504 in a chamber complete with bypass may be used. ***(REVISED MAY 2020)***

(b) Rubber Sealed 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 1035 kPa (150 psi). Valve construction shall be as follows, or as approved. ***(REVISED MAY 2020)***

(i) Body material shall be ductile. ***(REVISED MAY 2020)***
(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 location 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 50 mm 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.

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 450 mm of adjustment shall be available on all valve boxes. PVC valve hoods shall be used on all 200 mm and larger underground valve installations. ***(REVISED MAY 2020)***

.2 Valve box lids shall have a non-rocking fit and extend 75 mm 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.

.2 Where valve boxes are located outside the paved portion of a road, these markers shall be constructed of 50 mm steel pipe panted blue and set in a concrete base. They shall extend one 1.0 m above the ground surface. The markers shall be located at a safe and reasonable 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. ***(REVISED MAY 2020)***

.3 Where valve boxes are located in the paved portion of the road, valve tag markers shall be installed in a nearby reasonable location.

5.27 <u>HYDRANTS</u>

.1 Installed fire hydrants shall meet the following specifications:

(a) Hydrants shall be compression type complying fully with AWWA standard C502 for dry barrel hydrants. ***(REVISED MAY 2020)***
(b) Hydrants shall be clockwise opening and have a standard pentagonal operating nut with a circle diameter of 44.5 mm.
(c) The inlet connection shall be 150 mm dia. and made of the same material as the mainline piping. The hydrant shall have a bell and a preformed rubber gasket suitable for connection to the pipe being used.
(d) Hydrants shall have two nominal 65 mm dia. hose outlets without independent cut-off. The 65 mm dia. hose outlets shall conform to the B.C. Fire Hose Thread Standards, nominal 65 mm I.P., 75 mm O.D. male, 8 threads per 25 mmm tapering from 75.72 mm minimum O.D. to 82.63 mm maximum O.D.
There shall also be one nominal 100 m dia. (120 mm O.D.) pumper outlet. The 100 mm pumper outlet shall conform to the B.C. Fire Hose Thread Standards, nominal 100 mm I.P., 117.5 mm O.D. male, 6 threads per 25 mm.
(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) Self-draining with drain outlet provided. ***(REVISED MAY 2020)***
(g) Depth or 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 City Engineer. ***(REVISED MAY 2020)***
(i) Subject to discretion of the City Engineer, hydrant flow test on all new hydrants, in accordance with NFPA 291, may be required.

.2 <u>Tie Rods and Nuts:</u>

(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 sized to be minimum 19 mm dia. 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.

.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 9.31 – Road Base Gravel Course. ***(REVISED MAY 2020)***

5.28 FLUSHOUT

.1 All piping and fittings shall be 65 mm dia. iron pipe thread, galvanized steel pipe.

.2 Shut-off valves shall be a 65 mm 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 100 mm cedar post, painted white with a red top and extending 1.20 m 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 300 mm of adjustment shall be available. The 65 mm dia. 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 meeting AWWA C512. Bushings, reducers and unions to be used in the valve connection shall be brass manufactured to ASTM B62. Nipples shall be standard brass and threaded at both ends. ***(REVISED MAY 2020)***

.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 100 mm or less in dia. shall be wedge disc type with non-rising stem, hand wheel and stuffing box glands, as specified for 1380 kPa (200 psi)water (860 kPa (125 psi)steam) service. ***(REVISED MAY 2020)***

.3 All air valves shall have two 12 mm ball-type drain valves as shown on Standard DrawingNo.W-4.

.4 Air valves for watermains greater than 300 mm dia. shall be as approved by the City Engineer.

5.30 WATER SERVICE CONNECTIONS

.1 Service Up to and including 50 mm Diameter: ***(REVISED MAY 2020)***

Services up to and including 50 mm dia. (2 inch) shall conform to AWWA C901, CSA B137.5 and meet NSF 61. Service shall be compatible with AWWA C800 valves and fittings (service brass). ***(REVISED MAY 2020)***

(a) Tubing shall be: ***(REVISED MAY 2020)***

(i) Class 200 polyethylene tubing to AWWA C901 complete with manufacturer recommended stainless steel insert required to stiffen pipe. ***(REVISED MAY 2020)***

(ii) Tubing shall be installed complete with color coded (APWA Uniform Colour Code Blue for potable water) warning tape placed one foot above the tube in the trench. ***(REVISED MAY 2020)***

(b) Tracer wire shall be installed with all polyethylene service tubing and shall be: ***(REVISED MAY 2020)***

(i) Certified as tracer wire for direct burial, ***(REVISED MAY 2020)***

(ii) Affixed to the tube every 1.0 m with electrical tape and placed in the same orientation along the side of the tube and not wrapped around the tube. ***(REVISED MAY 2020)***

(iii) One end of the tracer wire terminated to a grounding anode approved by the tracer wire manufacturer, the other end terminated in the meter box with a coiled pigtail, ***(REVISED MAY 2020)***

(iv) Inspection and testing by the Engineer with City Engineer upon completion of the service. Inspection and testing required by conductivity test and locate prior to project approval. ***(REVISED MAY 2020)***

.2 Corporation Stops:

(a) Corporation stops shall be full port, no lead bronze conforming to ASTM B62, AWWA C800 with AWWA standard male threaded inlet (MIP) and compression outlet for copper or plastic tubing (CTS). ***(REVISED MAY 2020)***

(b) Shut-off head shall be solid tee head type.

(REVISED MAY 2020)

(REVISED MAY 2020)

.3 Curb Stops:

(a) Curb stops shall be full port, no lead bronze conforming to ASTM B62, AWWA C800 with compression inlet and AWWA standard female threaded outlet (FIP). ***(REVISED MAY 2020)***

(b) Shut-off head shall be solid tee head type.

(c) Stop and drain type curb stops are prohibited. ***(REVISED MAY 2020)***

.4 <u>Service Fitting:</u> ***(REVISED MAY 2020)***

(a) Service fittings shall be full port, no lead bronze conforming to ASTM B62, AWWA C800. ***(REVISED MAY 2020)***
(b) Service fittings may be compression, MIP, FIP, specifically excluding flairs. ***(REVISED MAY 2020)***

.5 <u>Service Connections Greater than 50 mm Diameter:</u> ***(REVISED MAY 2020)***

(a) Shall be minimum 100 mm dia., full restrained, and as specified for watermain pipe. ***(REVISED MAY 2020)***
(b) Mainline connection shall be with an inline tee complete with a flange connected gate valve leading to the service. ***(REVISED MAY 2020)***
(c) The service shall be fully restrained from the mainline tee to the meter chamber, and through the meter chamber to the Backflow Prevention Assembly. ***(REVISED MAY 2020)***

.6 <u>Meter Service Boxes, Box Extensions and Lids:</u>

(a) Service boxes for water services 25 mm dia. and smaller shall be 300 mm x 500 mm 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 MAY 2020)***
(b) Services boxes for 38 – 50 mm dia. water services shall be 425 x 750 mm concrete boxes complete with steel traffic covers marked “Water”.
(c) Service boxes or chambers for water services larger than 50 mm dia. 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.
(e) Box shall be of adequate depth to provide 450 mm depth as measured from the underside of the lid to sub surface ground elevation. Meters shall be installed at the ground elevation at the bottom of the box. ***(REVISED MAY 2020)***

.7 <u>Pipe Saddles:</u>

(a) Tapping threads to be tapered to AWWA C800.
(b) Saddles shall be compliant with NSF61.
(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.
(d) Saddle for ductile iron pipe:

(i) Saddles for 19 mm to 50 mm services to have a ductile iron body to ASTM A536.
(ii) Anti-corrosive coating to AWWA C219, AWWA C210, or AWWA C213.
(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 50 mm.

(e) Saddles for PVC pipe: ***(REVISED MAY 2020)***

(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.

(ii) Saddles for 19 mm to 50 mm services shall be:

1. Bronze body to ASTM B62 and two stainless steel straps to ANSI T304 with minimum width per strap of 50 mm.
2. All-stainless steel broadband saddle to ANSI T304; for services less than 37 mm dia., saddle shell must be a minimum of 125 mm wide and have double bolts; for services 37 mm to 50 mm, saddle shell must be a minimum of 190 mm 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.

(f) Pipe saddles shall be installed on all pipe at service junctions up to and including 50 mm dia. service tube. ***(REVISED MAY 2020)***

.8 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.

(c) For single family servicing, meters shall be 19 mm minimum positive displacement meters.

(d) For duplex servicing, meters shall be 25 mm positive displacement meters.

(e) All meters larger than 25 mm require approval from the City Engineer.

(f) All meters 100 mm 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.

(g) All meters used for a fire line service shall be UL listed and FM approved.

(h) All meters shall read in cubic meters.

.9 Backflow Prevention Assemblies: ***(REVISED MAY 2020)***

(a) Section 5.70 – Water Distribution System, Cross Connection Control. ***(REVISED MAY 2020)***

.10 Pipe in Chambers: ***(REVISED MAY 2020)***

(a) All pipe 50 mm dia. up to and including 75 mm dia. shall be corrosion resistant material. Only compression or threaded joints shall be permitted. ***(REVISED MAY 2020)***

(b) All pipe greater than 75 mm dia. shall be Schedule 10 Stainless Steel with flanged, treaded or compression joints. ***(REVISED MAY 2020)***

.11 <u>Gate Valves Domestic Service:</u>

(a) Gate valves shall be as per Section 5.24. ***(REVISED MAY 2020)***

.12 <u>Gate Valves Fire Line Service:</u>

(a) All valves shall be in conformance with NFPA regulations and shall be UL listed and FM approved. ***(REVISED MAY 2020)***
(b) Resilient wedge valves shall be in conformance with Section 5.24 – Watermain Valves. ***(REVISED MAY 2020)***
(c) Valves installed in chambers shall be of the indicating type as approved by the City Engineer. ***(REVISED MAY 2020)***

(REVISED MAY 2020)

5.31 <u>PRESSURE REDUCING STATIONS</u>

.1 <u>Valves:</u>

(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 shall be stainless steel.
(d) The valve stem on 50 mm 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 the pilot and main valve body.
(j) All PR valves use for fire line service shall be UL Listed and FM approved.

.2 <u>Gauges, pressure snubbers, isolation valves for gauges:</u>

(a) All pressure gauges shall have a 90 mm minimum dial size with a 6.5 mm 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 60 mm shall be copper, or brass.
(f) Piping over 75 mm shall be flanged steel pipe.

5.32 FLANGE ADAPTERS AND JOINT RESTRAINTS

.1 Flange adaptors 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 steel low allow steel conforming to AWWA C111, or stainless steel conforming to ASTM F593 and F594. Rolled threads, fit and dimensions shall be AWWA C111.

.4 Tie rods shall be continuous threaded, quenched and allowed steel conforming to ASTM A345, 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 Section7.22A – Piping, Fittings and Services, clause 7.22A.5.

.2 Pipe and fittings for 19 mm to 100 mm dia. sump pump connections shall conform to Section 5.30 – Water Service Connections.

.3 Service junctions at the storm main, where permitted, shall conform to Section7.23 – Service Junctions.

.4 Sump drainer assemblies, if required, shall consist of 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 150 mm.

.6 Perimeter drains shall consist of:

(a) 100 mm dia. PVC certified to CSA B182.1. Includes drain rock and geotextile wrap.

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 19 mm dia. aluminum alloy conforming to CSA S157.
(b) All steps shall be complete with approved polyethylene anchor insulating sleeves and installed in 25 mm to 26 mm dia. precast or drilled holes in a manhole section.
(c) Refer to Section5.58 for manhole steps installation.

.6 Concrete:

(a) All concrete work for cast in place manhole bases shall conform to Section 11.0 – Cast In Place Concrete Works. ***(REVISED MAY 2020)***

.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-

5.40 TRENCH EXCAVATION, BEDDING AND BACKFILL

.1 Refer to Section 4.0 – Excavation, Trenching and Backfill for installation requirements. ***(REVISED MAY 2020)***

5.41 PIPE ALIGNMENT

.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.

.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 Joint 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.

Arching or bending of the pipe is not permitted.

.3 Refer to Section5.10 – 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 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.

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 line 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.

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 specification shall be as per Section 11.0 – Cast In Place Concrete Works. ***(REVISED MAY 2020)***

.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 City Engineer. ***(REVISED MAY 2020)***

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.

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 1.0 m wide, 50 mm thick asphalt apron around the valve box.

.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 300 mm below final grade. Riser pipe shall be cut down where necessary so that the existing riser pipe is a minimum 300 mm below finished grade.
(c) The minimum 300 mm grade difference shall be backfilled with 25 mm 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 City Engineer. ***(REVISED MAY 2020)***
(e) Hydrants shall be set with the ground flange 150 – 200 mm above finished ground or sidewalk surface unless otherwise directed by the City Engineer. ***(REVISED MAY 2020)***
(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.

.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 in consultation with the City Engineer. Approval by the City Engineer is required. ***(REVISED MAY 2020)***
(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 9.47 – Placing and Compacting Aggregates. ***(REVISED MAY 2020)***

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 in consultation with the City Engineer. ***(REVISED MAY 2020)***

.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 65 mm dia. 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 in consultation with the City Engineer. ***(REVISED MAY 2020)***

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 Section7.61 – Service Connection Installation.

5.56 WATER SERVICES CONNECTION INSTALLATION

.1 All water service connections up to and including 50 mm dia. shall be installed in accordance with Standard Drawing No. W-1.

.2 All water service connections great than 50 mm 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. ***(REVISED MAY 2020)***
(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 1.2 m 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 50 mm dia. in size.
(c) In rock, the trench is to be extended 3.0 m into the property to facilitate future extension of the service connection.
(d) The trench bottom shall be graded to form a continuous support along the service pipe. All rocks or projections within 150 mm of the service tubing shall be removed.
(e) When a service box is to be installed in a driveway, a 150 mm wide x 150 mm deep concrete apron shall be installed around the concrete service box in addition to the 25 mm minus crush gravel base structure.
(f) For services up to and including 50 mm dia., the pipe shall be connected to the corporation stop and a gooseneck formed as shown on the drawings.

(REVISED MAY 2020)

(g) Copper pipe shall be cut with square ends and reamed with the proper tools. Care shall be taken to prevent the pipe for kinking or buckling on short radius bends. Joints shall be made using the specified couplings. Sweated joints shall not be made.
(h) Pipe installed in an augered hole shall be protected with a cap or plug to prevent the entrance of foreign material into the pipe.
(i) A gate valve complete with valve box shall be provided at the main on all services over 50mm dia.
(j) After installation, water service connection locations shall be marked with a 50 mm x 100 mm pressure treated wood marker take painted blue and located at the terminus of the water service next to the service box. The stake shall extend from a point approximately 600 mm above ground to 600 mm below ground

except in locations where the extension of the stake above ground surface would be hazardous, in which case the stake shall be place at a location satisfactory to the Engineer and City Engineer. ***(REVISED MAY 2020)***

.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 and City Engineer. The minimum distance of a tapping shall be 1.0 m from a pipe end or joint, or 2.0 m from a pipe end equipped with a flushout and a minimum of 1.0 m from an adjacent tapping unless a greater distance is specified by the pipe manufacturer. ***(REVISED MAY 2020)***

(b) Service connections tapped to 100 m dia. main pipe and AC and PBC main pipes (all diameter) shall have approved pipe saddles for hot tapping.

.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 City Engineer and shall be provided with a plastic plug to prevent the entrance of foreign material. ***(REVISED MAY 2020)***

(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 25 mm above finished grade in untraveled areas and 0 – 6 mm below finished grade in travelled areas as shown on Standard Drawing No. W-1.

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 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 4.0 – Excavation, Trenching and Backfill. ***(REVISED MAY 2020)***
(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 4.0 – Excavation, Trenching and Backfill. ***(REVISED MAY 2020)***
(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 150 mm thick base of 40 mm drain rock.
(c) Use of precast concrete bases requires approval by the City Engineer. ***(REVISED MAY 2020)***

.10 Concrete

(a) Cast In Place Concrete work shall conform to Section 11.0 – Cast In Place Concrete Works. ***(REVISED MAY 2020)***

.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) 62.5 mm thick concrete grade rings to a maximum of four (4) 62.5 mm thick grade rings. The concrete grade rings shall be laid in common bond with raked mortar joints and shall be mortared inside and outside 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 1.5 m x 1.5 m, 50 mm 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 Section5.34 for manhole covers and frames specifications.

.12 Manhole Steps

(a) Manhole steps shall be installed in manhole sections by the manufacturer unless the 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 Section5.34 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.

.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 one. 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 Inspector. ***(REVISED MAY 2020)***

.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 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 1035 kPa (150 psi) or 1.5 times the average system operating pressure at the point of test, whichever is greater. ***(REVISED MAY 2020)***
(d) Maintain the test pressure in the pipe to ± 70 kPa (10 psi) 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. ***(REVISED MAY 2020)***
(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:

$$L = \frac{SD \text{ x square root of } P}{715{,}317}$$

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

(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 Inspector. ***(REVISED MAY 2020)***

(i) Prior to accepting the work, all valves shall be checked to ensure they fully open.

5.62 FLUSHING, CHLORINATION AND BACTERIAL SAMPLING

.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.

On completion of chlorination, the entire piping system shall be thoroughly flushed and filled with potable water prior to bacterial sampling.

Flushing chlorination and bacterial sampling shall be conducted in the presence of the Design Engineer and the City of Nanaimo Inspector. ***(REVISED MAY 2020)***

.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 in consultation with the City Engineer. ***(REVISED MAY 2020)***

5.63 NOTIFICATION TO CITY ENGINEER – SYSTEM TESTS AND FINAL CONNECTION ***(REVISED MAY 2020)***

.1 The City Engineer and the City of Nanaimo Inspector shall be given 48 hours written notice in advance of all system tests and pipe chlorination by the Contractor. ***(REVISED MAY 2020)***

.2 On new water systems no physical connection (tie-in) to the public system shall be made until the new system passes:

(a) flushing,
(b) pressure testing,
(c) disinfection,
(d) satisfactory bacterial testing results by an accredited certified lab.

.3 Upon satisfactory passing, the Design Engineer shall submit copies of all of the above noted test results to the City Engineer with their written recommendation on connection to the Public Water Supply.

.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.

.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.

.6 Tie-in and connection shall be conducted in the presence of the Design Engineer and the City of Nanaimo Inspector. ***(REVISED MAY 2020)***

.7 <u>Final Connections</u>:

(a) If Connection is 1 pipe length or less (6 m or less) spray or swab disinfect all parts just prior to connection.

(b) If connection is greater than 1 pipe length (plus 6 m), the pipe must be set up above ground, disinfected and bacterial samples taken as described in AWWA C651 Section 5.0. Ends of pipe must be sealed watertight until installed.

CROSS CONNECTION CONTROL *(REVISED MAY 2020 – NEW SECTION)*

5.70 LEGAL AUTHORITY

.1 Legal Authority for the City of Nanaimo Cross Connection Control Program is provided by the City of Nanaimo Bylaw No. 7249 – A Bylaw Respecting Cross Connection Control and the British Columbia Plumbing Code, Division B, Part 2, Section 2.6.2, which requires potable water to be protected from contamination.

.2 This Cross Connection Control Program is:

(a) In compliance with the Island Health Authorities Permit to Operate a Water System as provided under the Drinking Water Act, Part 2, Section 8.0, and
(b) Follows recommended practices of the most current editions of AWWA Canadian Cross Connection Control Manual and CSA B64.10 & B64.10.1.

.3 Section 5.70 – Water Distribution System Cross Connection Control shall govern the public water supply for Premises Isolation of private property and parcels. Private property and parcels shall be governed under the British Columbia Plumbing Code.

5.71 OWNER'S RESPONSIBILITY

.1 The Owner of a property subject to Premise Isolation shall be the Owner of all Backflow Prevention Assemblies, associated chambers, vaults, containment structures such as mechanical rooms and associated appurtenances.

(a) For testable Backflow Prevention Assemblies, testing, maintenance and repairs shall be required at specified intervals and documented on the forms and tags provided by the Cross Connection Control Coordinator.

.2 All tests, repairs, overhauls, replacements and plumbing system improvements shall be at the expense of the Owner of the Backflow Prevention Assemblies. Reports on all testing, maintenance and repairs shall be documented on the specified forms and tags provided by the City of Nanaimo.

(a) Tags shall be placed on Backflow Prevention Assemblies with associated forms submitted to the Cross Connection Control Coordinator.
(b) When the installation of a Backflow Prevention Assembly for Premises Isolation creates a closed piping system, the Owner is required to assess the plumbing system to protect against an increase of pressure due to thermal expansion.

.3 Chambers, vaults and other containment structures such as a mechanical room housing the Backflow Prevention Assembly and associated appurtenances for Premises Isolation shall be located on the Owner's property.

(a) For residential services, check valves (Dual Check Valve – DuC) installed integrally with a water meter/meter setter shall be maintained and serviced by the residential owner.

5.72 ACCEPTABLE BACKFLOW PREVENTERS

.1 For the purpose of Premise Isolation, three CSA categories of Backflow Prevention Assemblies are acceptable.

(a) CSA B64.4:

(i) This includes the Reduced Pressure Principle (RP Backflow Prevention Assembly. For specialized service such as for fire supply, a Reduced Pressure Principle Detector (RPD) or RPF may be required.

(b) CSA B64.5:

(i) This includes the Double Check Valve Assembly (DCVA). For specialized service such as for fire supply, a Double Check Detector Assembly (DCDA) or DCVAF may be required.

(c) CSA B64.6:

(i) This includes the Dual Check Valve (DuC). For specialized service such as for fire supply, a DuCF may be required.

5.73 HAZARD CATEGORY

.1 There are three classifications of connection hazard. Classification shall be to CSA B64.10 as follows:

(a) **Minor** – nuisance to the water supply that results in a reduction in only the aesthetic quality of the water. This would include water that might have been heated or cooled and connections that cannot create a danger to health.
(b) **Moderate** – any minor hazard connection that has a low probability of being a severe hazard. This includes, but is not limited to, connections involving water where the aesthetic qualities of the water have been reduced and, under certain conditions can create a danger to health.
(c) **Severe** – any type of cross connection or potential cross connection involving water that has additives or substances that, under any concentration, can create a danger to health.

5.74 DEVICES REQUIRED FOR PREMISES ISOLATION

.1 Premises Isolation shall be provided by installation of a Backflow Prevention Assembly on the service line connection between the property/parcel and City of Nanaimo Water Distribution System. The Backflow Prevention Assembly installed, as service line protection, ensures water of questionable quality cannot leave a property and enter the City of Nanaimo Water Distribution System.

.2 Premises Isolation for a property shall be required in all cases even if the plumbing system on the property complies with the British Columbia Plumbing Code.

.3 Backflow protection shall provide Premises Isolation at one of the three hazard categories', as follows:

(a) Dual Check Valve (DuC) Backflow Prevention Assembly for properties with minor hazard classification. Also includes DuCF.
(b) Double Check Valve (DCVA) Backflow Prevention Assembly for properties with moderate hazard classification. Also includes DCVAF and DCDA.
(c) Reduced Pressure Principle (RP) Backflow Prevention Assembly for properties with a severe hazard classification. Also includes RPF and RPD.

.4 For fire protection, Backflow Prevention Assemblies shall be DuCF, DCVAF and RPF. Each Backflow Prevention Assembly shall be UL/ULC listed and FM approved.

5.75 PROPERTIES, HAZARD CLASSIFICATION AND PREMISES ISOLATION REQUIRED

.1 All properties require Premises Isolation with an approved Backflow Prevention Assembly on the service line(s) leading to and supplying a property. Subject to review by the Cross Connection Control Coordinator for appropriate hazard classification and required Backflow Prevention Assembly, Premises Isolation shall be required for the following properties.

(a) **Minor Hazard Classification -** Dual Check Valve (DuC) Backflow Prevention Assembly required.

(i) Duplex Housing with shared service
(ii) Residential Premises
(iii) Townhouse (shared services)

(b) **Minor/Moderate Hazard Classification -** Double Check Valve (DCVA) Backflow Prevention Assembly required.

(i) Church

(c) **Moderate Hazard Classification -** Double Check Valve (DCVA) Backflow Prevention Assembly required.

(i) Airport
(ii) Apartment Building
(iii) Arena
(iv) Auto Dealership
(v) Campsite
(vi) Grocer
(vii) Hair Salon
(viii) Dental Office
(ix) Hotel
(x) Fuel Dispensing Facility
(xi) Kennel
(xii) College
(xiii) Medical Clinic (non-surgical)

(xiv) Laundry (commercial, coin-operated)
(xv) Manufacturing Plant (not specified)
(xvi) Mobile Home Park
(xvii) Multi-Service Interconnected Facility
(xviii) Multi-Tenant Single-Service Facility
(xix) Nursing Home
(xx) Office Building
(xxi) Motel
(xxii) Penitentiary
(xxiii) Restaurant
(xxiv) School (elementary, junior high and senior high)
(xxv) Shopping Mall
(xxvi) Swimming Pool Facility
(xxvii) Water Park

(d) **Moderate/Severe** – Reduced Pressure Principle (RP) Backflow Prevention Assembly required.

(i) Animal Feed Lot
(ii) Animal Stock Yard
(iii) Commercial Premises
(iv) Farm
(v) Fire Station
(vi) Industrial and Institutional Premises
(vii) Golf Course
(viii) Funeral Home
(ix) Marina (pleasure boat)
(x) University
(xi) Veterinary Clinic
(xii) Waste Disposal Plant

(e) **Severe Hazard Classification** – Reduced Pressure Principle (RP) Backflow Prevention Assembly required.

(i) Aquaculture Farm
(ii) Aquarium (public)
(iii) Asphalt Plant
(iv) Auto Body Shop
(v) Automotive Repair Shop
(vi) Beverage Processing Plant (includes distillery and brewery)
(vii) Blood Clinic Severe
(viii) Campsite with RV Hook-Ups or Dump-Stations
(ix) Carwash
(x) Chemical Plant
(xi) Concrete Plant
(xii) Dental Surgery Facility
(xiii) Dock and Marine Facility
(xiv) Dry Cleaning Plant

(xv) Dye Plant
(xvi) Exhibition Ground
(xvii) Film Processing Facility
(xviii) Fish Farms or Hatchery
(xix) Food Processing Plant
(xx) Funeral Home
(xxi) Garbage Transfer Facility
(xxii) Hospital
(xxiii) Laboratory
(xxiv) Laundry (commercial)
(xxv) Meat Packing Plant
(xxvi) Medical Clinic (surgical)
(xxvii) Milk Processing Plant
(xxviii) Mining Facility
(xxix) Mortuary or Morgue
(xxx) Motorcycle Repair Facility
(xxxi) Oil Refinery
(xxxii) Paint Manufacturing Plant
(xxxiii) Petroleum Processing or Storage Facility
(xxxiv) Pharmaceutical Manufacturing Facility
(xxxv) Photo Processing Facility
(xxxvi) Plants Using Radioactive Material
(xxxvii) Plastic Manufacturing Plant
(xxxviii) Plating Shop and Plant
(xxxix) Poultry Farm
(xl) Power Generating Facility
(xli) Premises where access is prohibited or restricted
(xlii) Printing Plant
(xliii) Pulp and or Paper Plant
(xliv) Radiator Shop
(xlv) Recycling Facility
(xlvi) Refinery, Petroleum Processing
(xlvii) Rendering Facility
(xlviii) Research Building
(xlix) Sewage Dump Station
(l) Sewage Treatment Plant
(li) Steam Plant
(lii) Steel Manufacturing Plant
(liii) Trackside Facility for Trains
(liv) Wastewater Facility
(lv) Wastewater Pump Station
(lvi) Wastewater Treatment Plant
(lvii) Water Filling Station
(lviii) Water Treatment Plant
(lix) Water Treatment Pump Station
(lx) Zoo

(f) Irrespective of the previous list of properties, the Cross Connection Control Coordinator shall complete a survey of the property/parcel for hazard classification and shall specify the appropriate Backflow Prevention Assembly required for Premise Isolation.

5.76 TESTING, MAINTENANCE AND REPORTING

.1 Testable Backflow Prevention Assemblies:

(a) The following Backflow Prevention Assemblies are testable.

(i) DCVA, DCDA and DCVAF backflow prevention assemblies; and
(ii) RP, RPD and RPF backflow prevention assemblies.

.2 Tester Certification and Testing Requirements:

(a) British Columbia Water and Waste Association (BCWWA) certified backflow assembly testers shall test backflow prevention assemblies within the City of Nanaimo Water Distribution System. The tester is responsible for the accurate documentation, correct assessment of each assembly tested, device tagging and test form submission to the Cross Connection Control Coordinator.
(b) Testers shall have an active BCWWA backflow assembly tester certificate and are required to test Backflow Prevention Assemblies in accordance with CSA B64.10.1.

.3 Frequency of Field Testing and Maintenance:

(a) To ensure satisfactory operation, a Backflow Prevention Assembly shall be field tested in accordance with the applicable requirements specified for each Backflow Prevention Assembly in accordance with CSA B64.10.1 at the following times:

(i) Upon installation;
(ii) After a backflow incident;
(iii) After alteration of the supply pipe upstream of a Backflow Prevention Assembly;
(iv) When cleaned, repaired, or overhauled;
(v) When relocated;
(vi) Annually; and
(vii) As required by the Cross Connection Control Coordinator.

.4 Reporting:

(a) Test results shall be reported on the forms provided by the Cross Connection Control Coordinator appropriate for the type of Backflow Prevention Assembly and procedure. The tester shall complete the:

(i) Backflow Prevention Assembly test and inspection report and submit the completed form back to the Cross Connection Control Coordinator, and

(ii) Backflow Prevention Assembly test tag and affix the tag to the device.

(b) The form and tag shall be fully completed and accurate.
(c) Fire departments and fire alarm companies shall be notified when a fire protection service is to be shut down for field testing.
(d) The main Backflow Prevention Assembly and, if equipped, an equivalent bypass Backflow Prevention Assembly shall be tested at the same time.
(e) A detector type Backflow Prevention Assembly shall have the main line and bypass Backflow Prevention Assemblies tested at the same time.

5.77 INSTALLATION STANDARDS FOR BACKFLOW PREVENTION ASSEMBLIES FOR PREMISES ISOLATION

.1 Location of Backflow Prevention Assemblies:

(a) The location of Backflow Prevention Assemblies providing Premises Isolation shall be immediately after the water meter within the property line of a property or within a building (mechanical room) before any branching off. To facilitate inspection, field testing and maintenance, Backflow Prevention Assemblies shall be installed in accessible locations to facilitate maintenance and testing, but preferably not a confined space. A Backflow Prevention Assembly may be installed in an insulated above ground enclosure that complies with ASSE 1060 requirements. Class 1 freeze protection and complete with manufacturer installed heater for wet/damp locations.

(i) For dedicated fire service lines with no meter connection, Premises Isolation shall be immediately within the property line of a property or within a building (mechanical room) before any branching off. Backflow Prevention Assembly shall be detector type.

(b) Air gaps, backflow preventers, or vacuum breakers with vents to atmosphere shall not be installed in a corrosive or polluted environment.
(c) DuC Backflow Prevention Assemblies for residential service are normally part of the water meter/setter installation and shall be contained in the same pit as the water meter.
(d) DCVA Backflow Prevention Assemblies may be installed in a dry, below grade chamber, if equipped with a drain to daylight or sump pump. All test cocks on the device shall be capped and watertight.
(e) RP Backflow Prevention Assemblies shall not be installed in a below grade pit, vault or chamber.
(f) Relief ports shall not be directly connected to a drain. Adequate drainage, as recommended by the manufacturer, shall be provided for discharge from relief ports.

(i) A connection to the relief port of a RP Backflow Prevention Assembly shall be made using the manufacturer's drain connection fitting. The pipe from the outlet of the drain connection fitting shall:

1. Be at least equal in size to that of the drain connection fitting;
2. Be rigid;
3. Slope downward from the Backflow Prevention Assembly; and
4. Terminate with an indirect connection (air break) above a floor drain, sump, or other safe location.

.2 Mounting Clearance and Orientation:

(a) Backflow Prevention Assemblies shall be installed at a convenient height for testing, maintenance and proper operation. Mounting clearances shall be as per the City of Nanaimo Specifications and Standard Detail Drawings, manufacturer's recommended clearances or the following clearances, whichever are greater.

(i) Height above floor or platforms as measured to the center of a device:

1. Minimum vertical clearance from floor or platform: 750 mm.
2. For a RP minimum vertical clearance from bottom of relief valve to floor shall be 300 mm.
3. Maximum vertical clearance from floor or platform: 1500 mm.

(ii) Minimum workspace clearance to the nearest wall or obstruction:

1. Above the device: 300 mm.
2. In front of the device: 750 mm.
3. Behind the device: 20 mm.

(b) Backflow Prevention Assemblies shall be installed in the orientation in which they have been tested and approved, showing compliance with the applicable Standard of the CSA B64 Series.

.3 Bypass:

(a) Bypass around a Backflow Prevention Assembly shall be prohibited unless the bypass is fitted with equivalent piping and an equivalent Backflow Prevention Assembly.

.4 Shut-off Valves and Test Cocks:

(a) Each testable Backflow Prevention Assembly shall be complete with approved shut-off valves and test cocks with resilient seats providing a drip-tight shut-off.
(b) All valves shall be indicating.

.5 In-line Strainers:

(a) In-line strainers shall be installed before the water meter with Backflow Prevention Assemblies installed after the water meter, fire protection systems are an exception.

(i) A fire protection system shall not have a strainer installed anywhere upstream of the Backflow Prevention Assembly.

5.78 FIRE PROTECTON SYSTEMS

.1 Premise Isolation with listed devices shall be required for all service connections to fire protection systems. The municipal water supply shall be protected against backflow caused by back siphonage or back pressure.

.2 Devices installed in fire protection systems, as required by the Fire Code, should be maintained and tested in accordance with the requirements of the Fire Code Standards.

.3 Classes of Fire Protection Systems:

(a) **Class 1 System** – a fire protection system that has direct connections only from public watermains, has no pumps, tanks, or reservoirs, and has all sprinkler drains discharging to atmosphere, dry wells, or other safe outlets.
(b) **Class 2 System** – a fire protection system that is the same as a Class 1 system, but also includes a booster pump in the connection from the municipal water supply system.
(c) **Class 3 System** – a fire protection system that has direct connections from the municipal potable water supply system, elevated storage tanks (either open or closed), fire pumps talking suction from above-ground covered reservoirs or tanks, and pressure tanks. In Class 3 systems, storage facilities are only filled from, or connected to, the municipal potable water supply system, and the water in the tanks is maintained in a potable condition. Class 3 systems resemble Class 1 systems in all other respects.
(d) **Class 4 System** – a fire protection system that has direct connections from the municipal potable water supply system (similar to Class 1 and Class 2 systems) and an auxiliary water supply dedicated to fire department use and available to the premises, such as an auxiliary supply located within 500 m of the pumper connection.
(e) **Class 5 System** – a fire protection system that has direct connections from the municipal potable water supply system and that is also interconnected with an auxiliary water supply.
(f) **Class 6 System** – a fire protection system that is a combined industrial and fire protection system and is supplied from the municipal potable water supply system only, with or without gravity storage or pump suction tanks.
(g) **Residential "partial flow through" System** – a fire protection system in which flow (during non-functioning periods of the fire system) only occurs through the main header to a water closet located at the farthest point of the system.

.4 Acceptable Premises Isolation:

(a) Class 1 System with materials acceptable for use in potable water systems and no antifreeze or additives – DCVAF or RPF.
(b) Class 2 System with materials acceptable for use in potable water systems and no antifreeze or additives – DCAF or RPF.

(c) Class 1 and Class 2 Systems with materials not acceptable for use in a potable water system or antifreeze or additives – RPF.
(d) Class 3, Class 4, Class 5 and Class 6 Systems – RPF.
(e) Residential “partial flow through” system with materials acceptable for use in potable water systems and no antifreeze or additives – DuCF, DCVAF, RPF.

.5 Fire Protection Service:

(a) A detector type Backflow Prevention Assembly shall be required when no water meter is installed up-stream of the detector type Backflow Prevention Assembly.

.6 Retrofitting Older Fire Protection Systems:

(a) A comprehensive evaluation by a qualified, competent person (such as a professional engineer) shall be undertaken. This qualified person shall ensure adequate flow and pressure through the device(s) to meet fire protection needs, and to address the thermal expansion issues associated with installing Backflow Prevention Assemblies.

5.79 DISTRIBUTION SYSTEM PROTECTION

.1 Any outlet used on a permanent or temporary basis to dispense potable water from the City of Nanaimo Water Distribution System to water hauling equipment shall be protected against backflow caused by back siphonage or back pressure with an RP Backflow Prevention Assembly.

.2 For Permanent Connections:

(a) Reservoirs and storage tanks: A screened air-gap separation is recommended on overflow pipes.
(b) Air release, vacuum, combination valves: A screened air-gap separation is recommended on air-discharge outlet pipes. The valve air opening must be properly vented above the ground and provided with an insect screen on the vent. Ideally the valves should be installed above ground and protected from freezing.
(c) Fire hydrants and other appurtenances with underground drain ports: Eliminate all underground drain connections, wherever possible. For dry barrel fire hydrants, no recommended protection is presently available.

.3 For Temporary Connections:

(a) Supply of water for filling or disinfecting new mains, etc.: A RP Backflow Prevention Assembly shall be required.
(b) Supply of water for construction sites, filling tanks, etc.: A RP Backflow Prevention Assembly shall be required.

(c) Supply of water for sewer flushing:

(i) The use of water directly from hydrants/standpipes is prohibited for sewer flushing. All sewer flushing water shall be provided from tanker trucks.

5.80 USE OF FIRE HYDRANTS AND STANDPIPES

.1 No hydrant or standpipe may be operated or used for the purpose of accessing water without a Hydrant or Temporary Use Permit issued by the Cross Connection Control Coordinator.

(a) A water meter complete with a RP Backflow Prevention Assembly in a secured portable container shall be provided by the City of Nanaimo.

5.81 IRRIGATION SYSTEMS

.1 Annual testing and documentation shall be required and is the responsibility of the Owner of the irrigation system.

.2 All irrigation systems (including residential systems) installed shall be subject to:

(a) Periodic review by the Cross Connection Control Coordinator.
(b) CSA B64.10/B64.10.1
(c) AWWA Canadian Cross Connection Control Manual, and
(d) The National Plumbing Code of Canada.

.3 Any outlet used to dispense potable water from the City of Nanaimo Water Distribution System to supply an in-ground irrigation system shall be protected against backflow caused by back siphoning with the following:

(a) For systems without injection of chemicals:

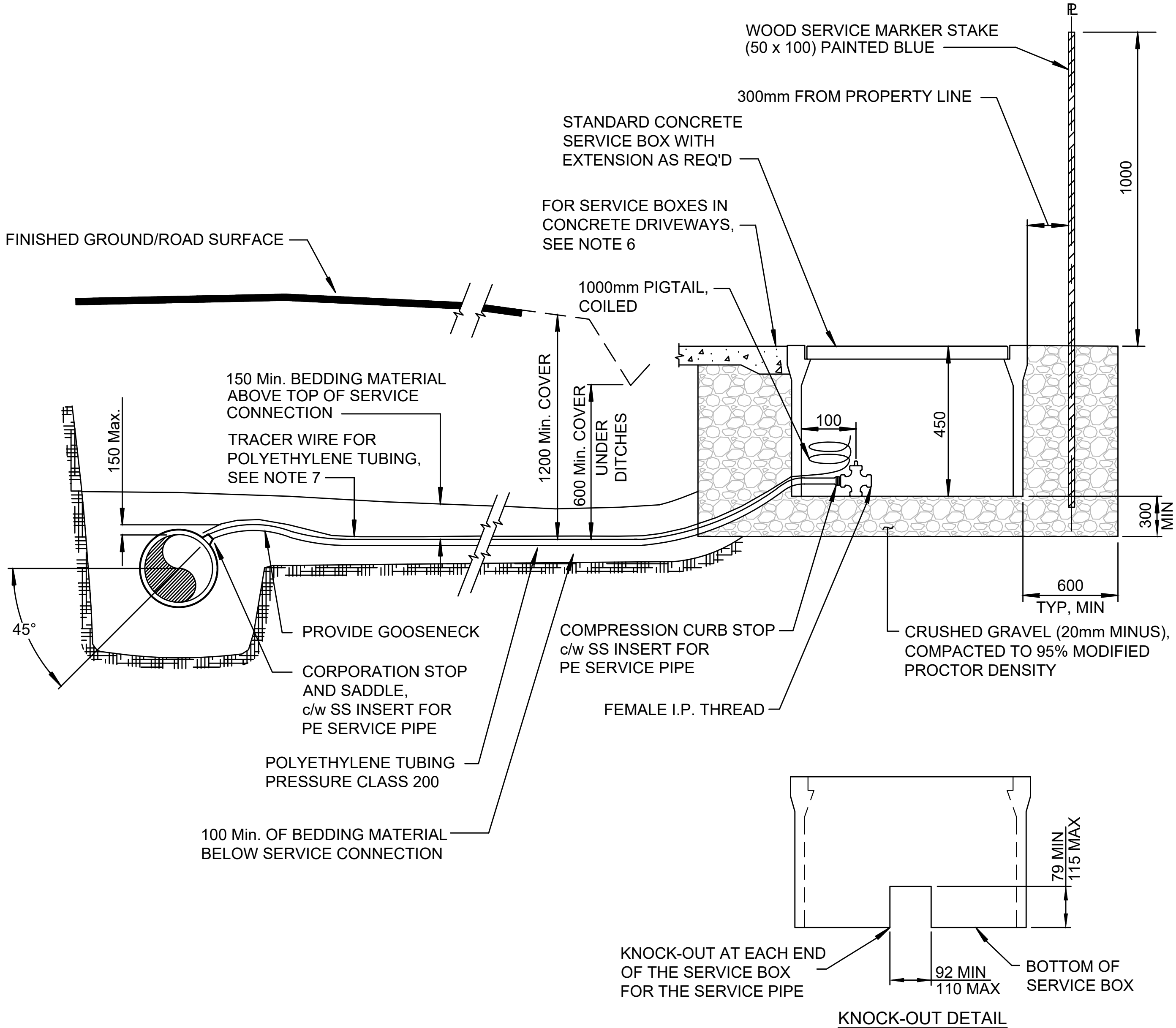
(i) A DCVA Backflow Prevention Assembly installed upstream of the irrigation system shut-off or other control valves.

1. For 19 mm to 50 mm dia. Irrigation Mains a DCVA Backflow Prevention Assembly shall typically be installed in a below grade box in accordance with Section 14.0 Standard Drawing No. I-1. All test cocks on the device shall be capped and watertight.
2. A DCVA Backflow Prevention Assembly may also be installed in an insulated above ground enclosure that complies with ASSE 1060 requirements, Class 2 frost protection.

(b) For any system with injection of chemicals:

(i) A RP Backflow Prevention Assembly shall be installed upstream of the irrigation system shut-off valves.

1. A RP Backflow Prevention Assembly shall be installed in an insulated above ground enclosure that complies with ASSE 1060 requirements, Class 2 frost protection.



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.
3. CONCRETE SERVICE BOX SHALL BE INSTALLED AS PART OF THE INITIAL SERVICE INSTALLATION AS PER SECTION 5.56.6
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 1000mm 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.

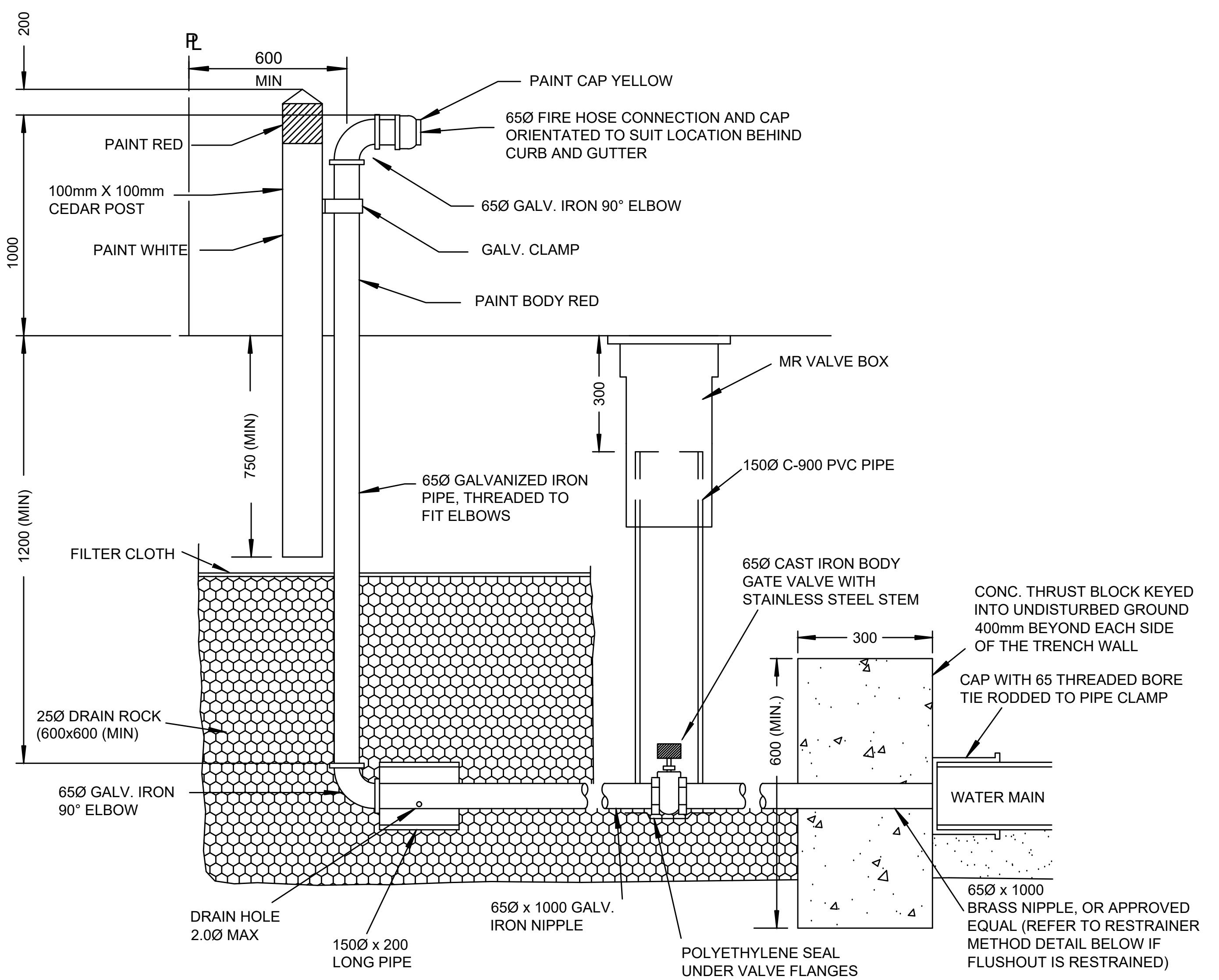
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 5 DWGS\W-1

3.6.2020

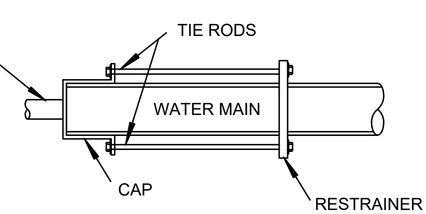
CITY OF NANAIMO
THE HARBOUR CITY

WATER SERVICE CONNECTION
(19Ø TO 50Ø)

Scale:	NTS
Created:	MAR 2016
Rev Date:	MAY 2020
Dwg No:	W-1



THRUST BLOCK METHOD



RESTRAINER METHOD

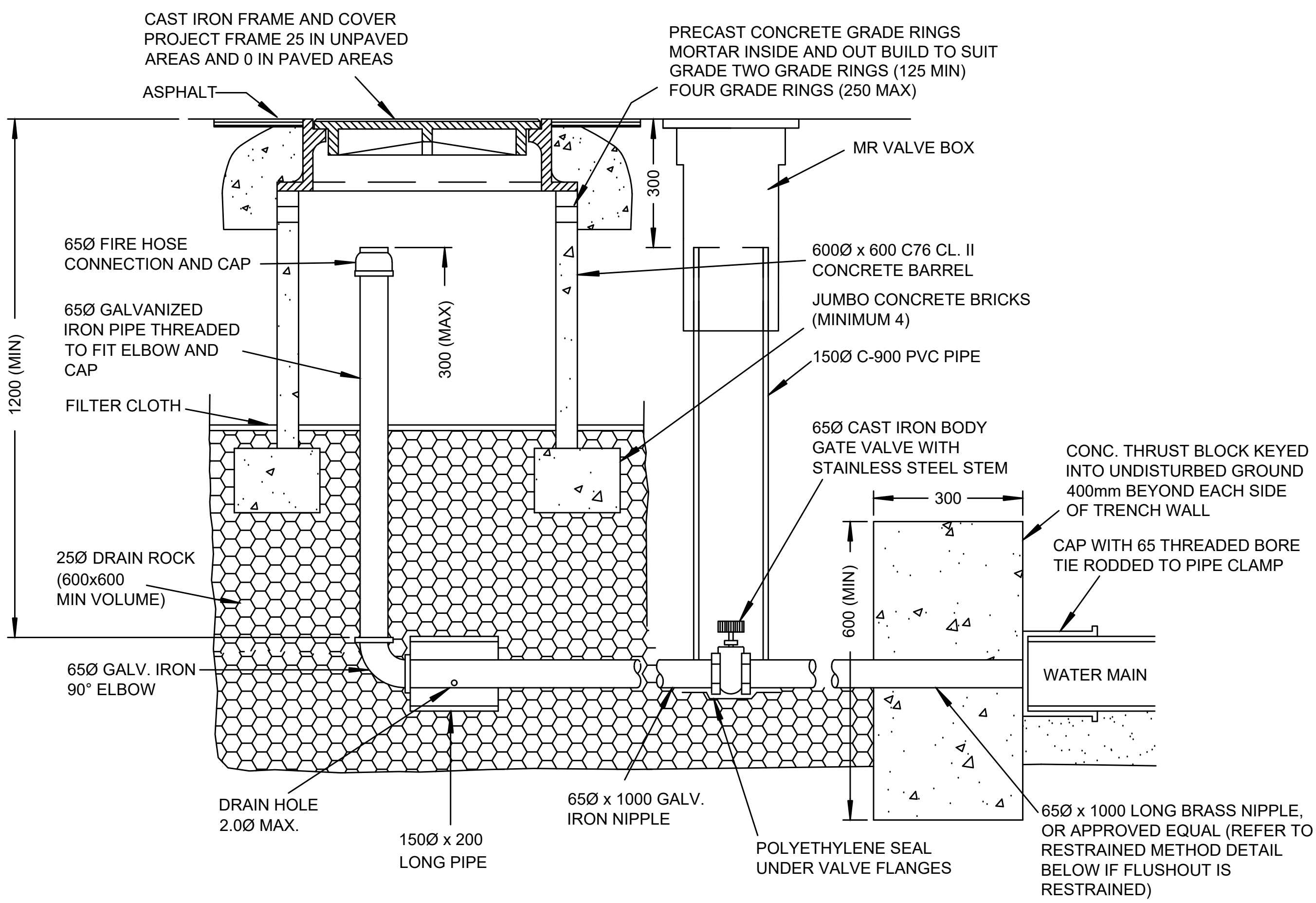
NOTES:

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.

CITY OF NANAIMO
THE HARBOUR CITY

ABOVE GROUND FLUSHOUT C/W THRUST BLOCK AND OPTIONAL RETRAINED METHOD

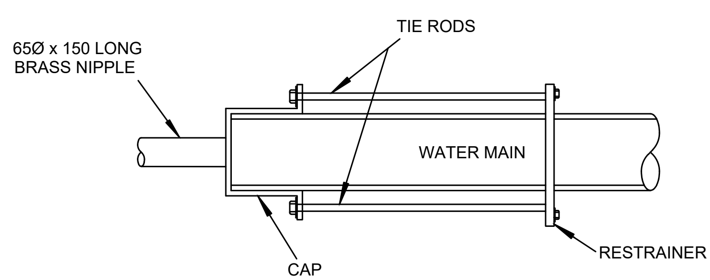
Scale:	NTS
Created:	MAY 2013
Rev Date:	NOV 2016
Dwg No:	W-2A



THRUST BLOCK METHOD

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.

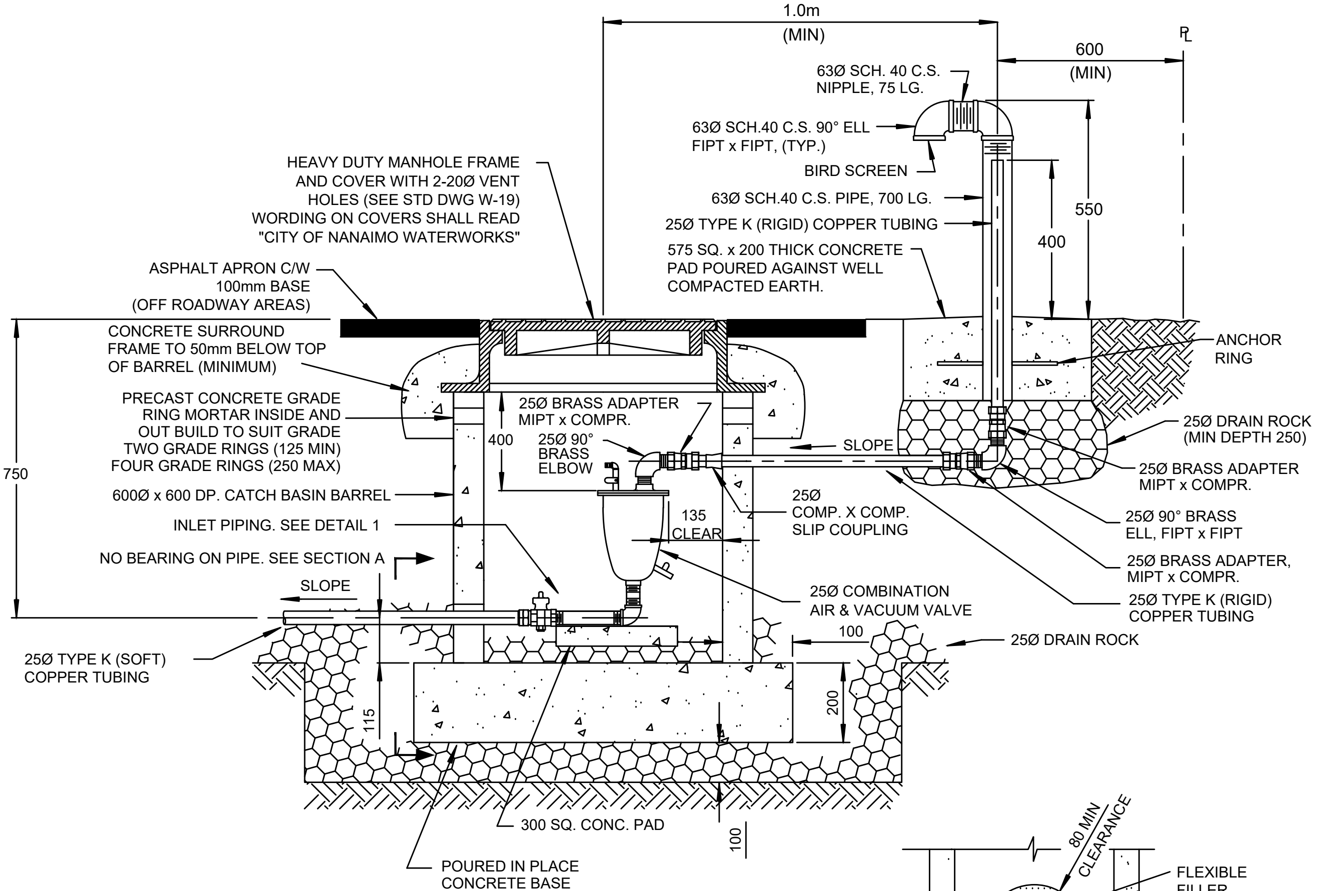


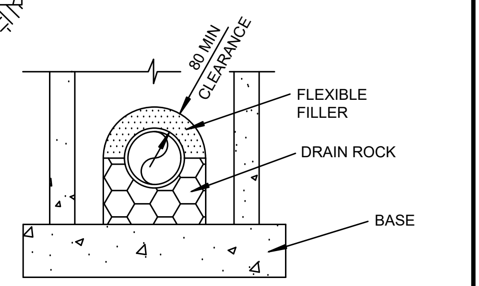
RESTRAINER METHOD

CITY OF NANAIMO
THE HARBOUR CITY

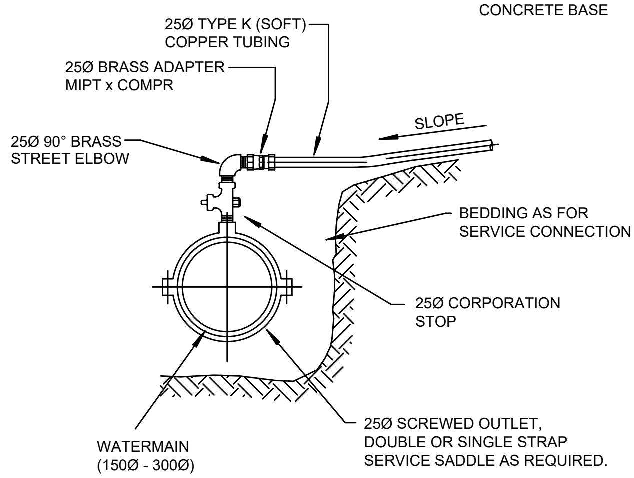
BELOW GROUND FLUSHOUT C/W THRUST BLOCK AND OPTIONAL RESTRAINED METHOD

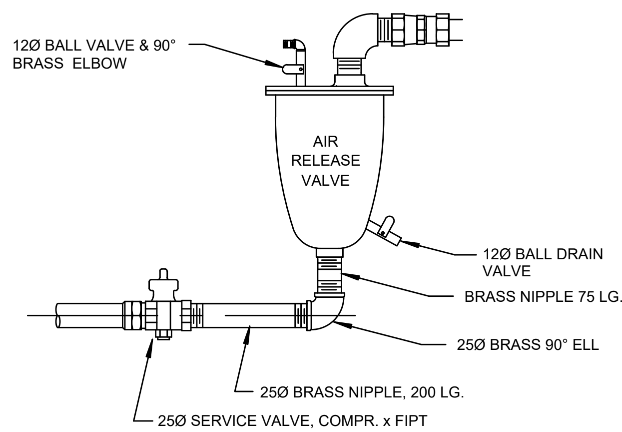
Scale:	NTS
Created:	NOV 2009
Rev Date:	NOV 2016
Dwg No:	W-2B





SECTION A





DETAIL 1

NOTES:

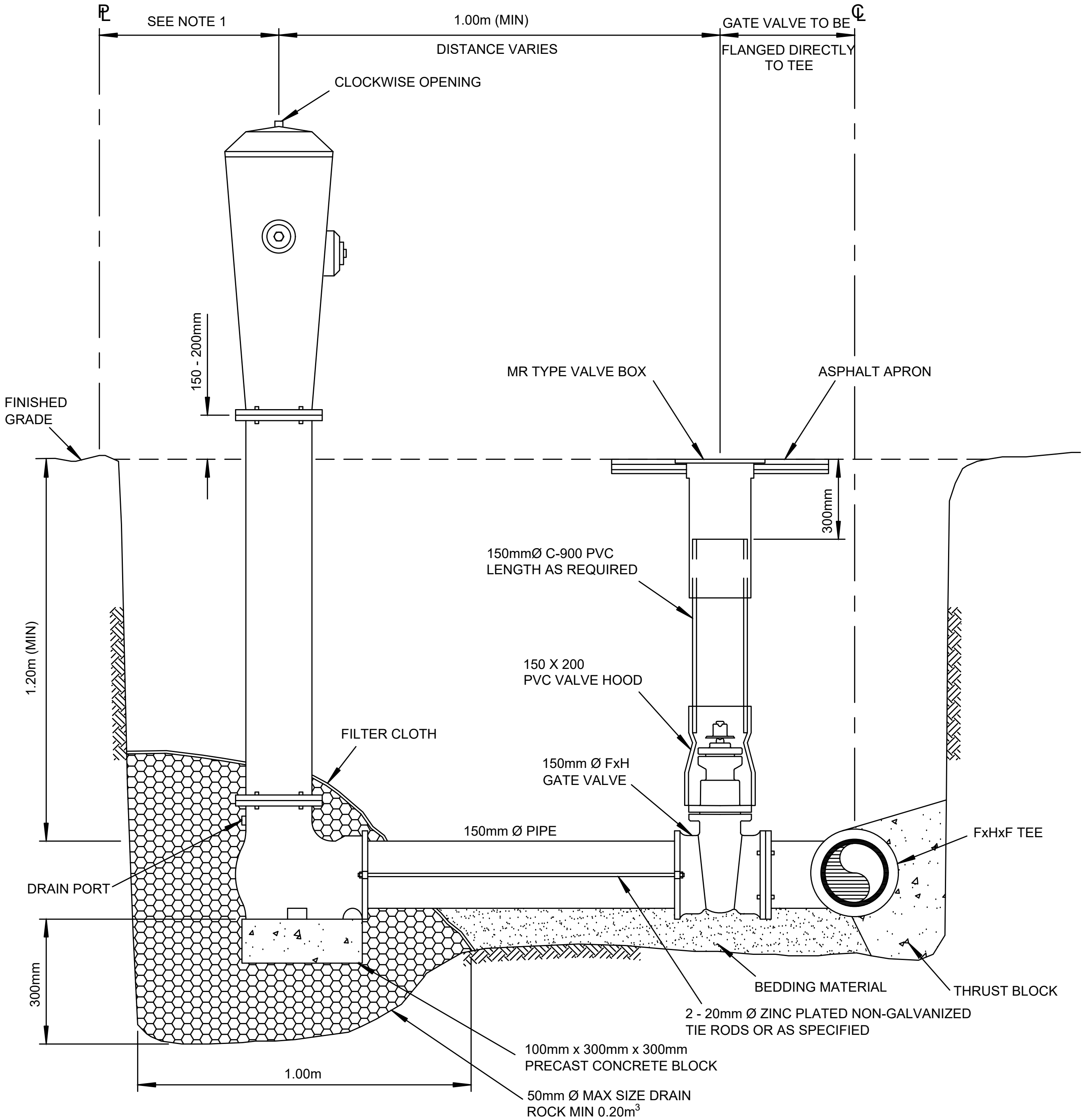
1. CHAMBERS LOCATED ON GRAVEL ROADS OR SHOULDERS REQUIRE A 1.5m x 1.5m HOT MIX ASPHALT APRON, 50 THICK.
2. PLACE FILTER CLOTH OVER DRAIN ROCK PRIOR TO BACKFILL.
3. ABOVE GROUND VENT PIPING TO BE PAINTED FOREST GREEN.
4. PRECAST CB BARREL SHALL BE AN ACCEPTABLE ALTERNATIVE TO MANHOLE BARREL AND POURED 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.

3.6.2020

CITY OF NANAIMO
THE HARBOUR CITY

AIR RELEASE VALVE ASSEMBLY AND CHAMBER FOR 150Ø - 300Ø MAIN

Scale:	NTS
Created:	MAY 2013
Rev Date:	NOV 2016
Dwg No:	W-4



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 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).

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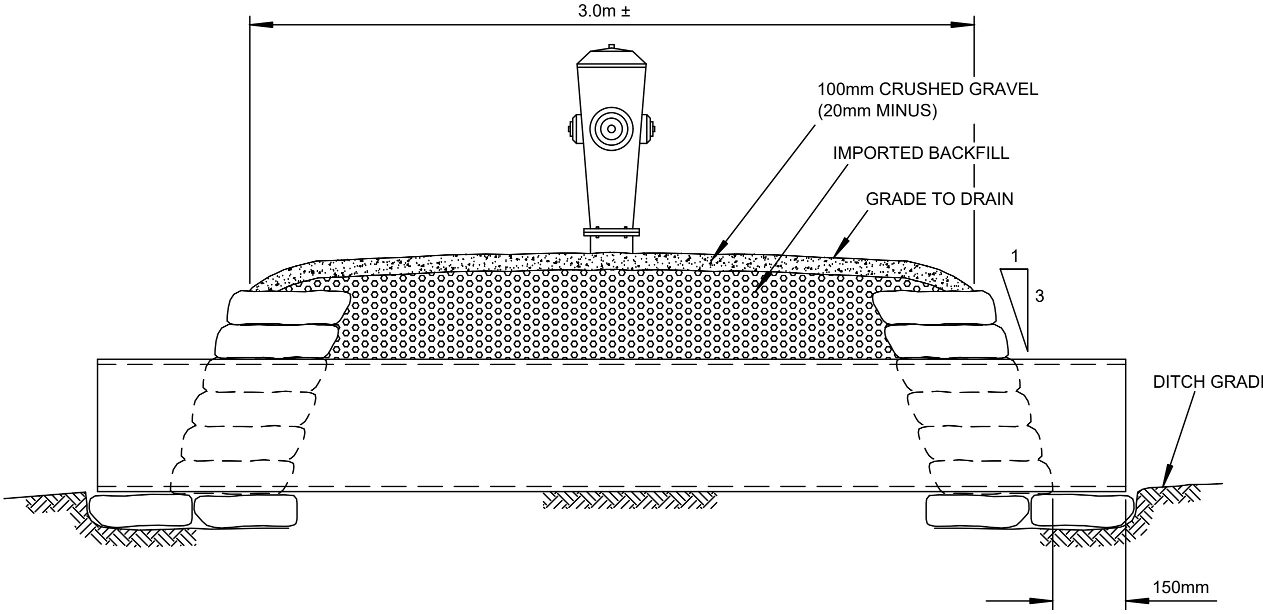
3.6.2020

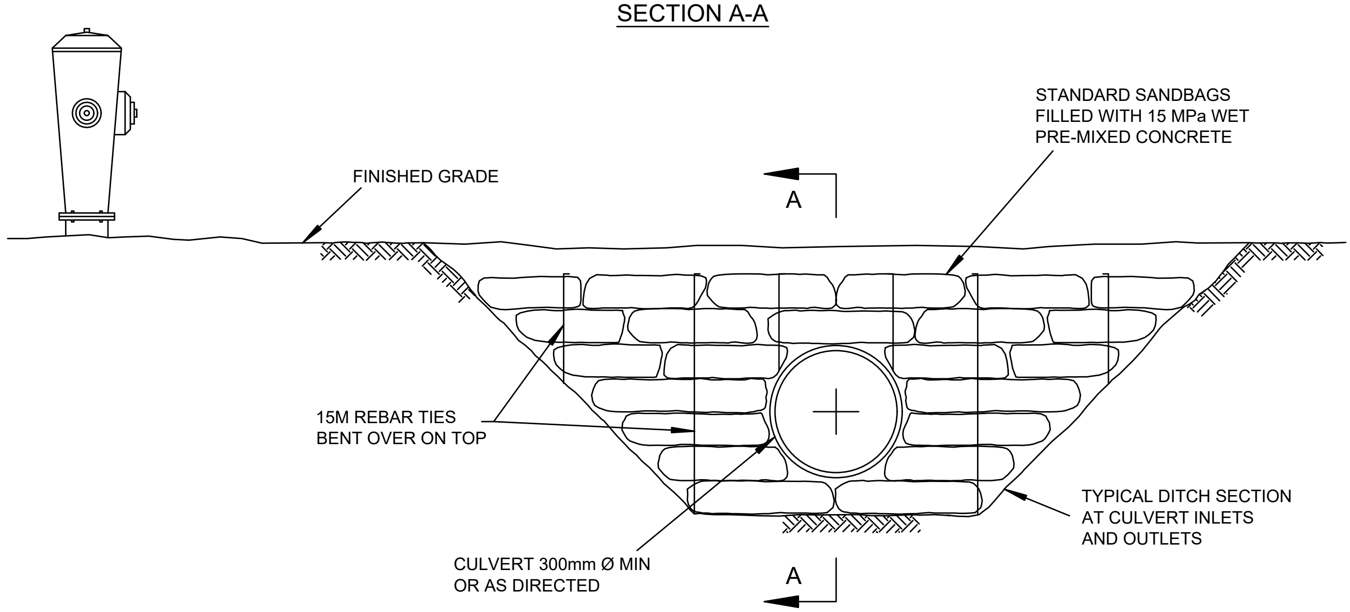
CITY OF NANAIMO
THE HARBOUR CITY

HYDRANT CONNECTION

Scale:	NTS
Created:	NOV 2009
Rev Date:	NOV 2016
Dwg No:	W-5



SECTION A-A



ELEVATION

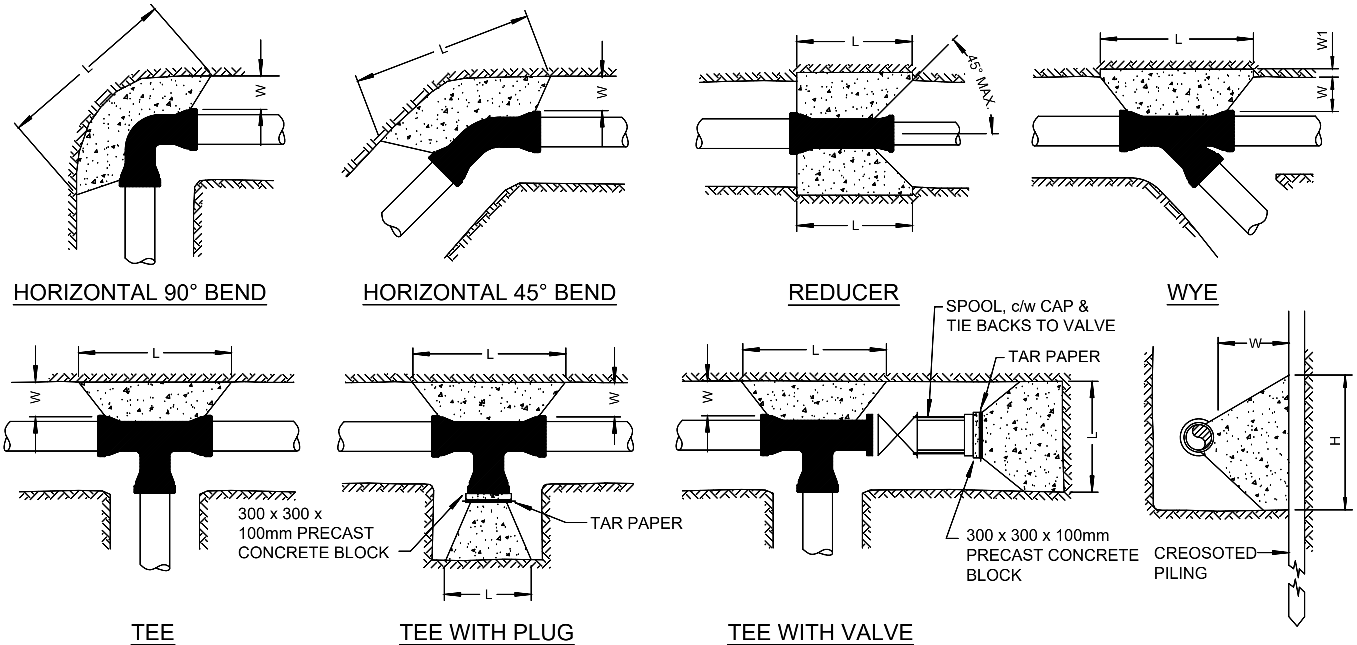
NOTES:

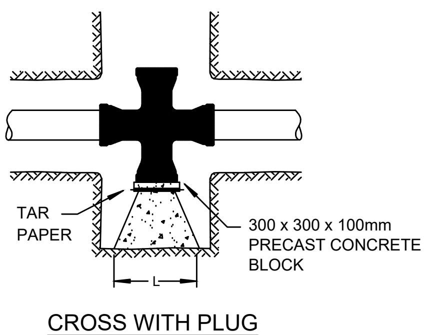
1. IF THE HORIZONTAL DIRECTION OF FLOW AT CULVERT INLETS AND OUTLETS EXCEEDS 30°, THE THE SANDBAG BULKHEADS REQUIRE CURVED WING WALLS TO FUNNEL THE FLOW.
2. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.

CITY OF NANAIMO
THE HARBOUR CITY

HYDRANT ACCESS - DITCH
CROSSING DETAIL

Scale:	NTS
Created:	MAY 1999
Rev Date:	NOV 2016
Dwg No:	W-7





NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
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 @ 28DAYS.
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.

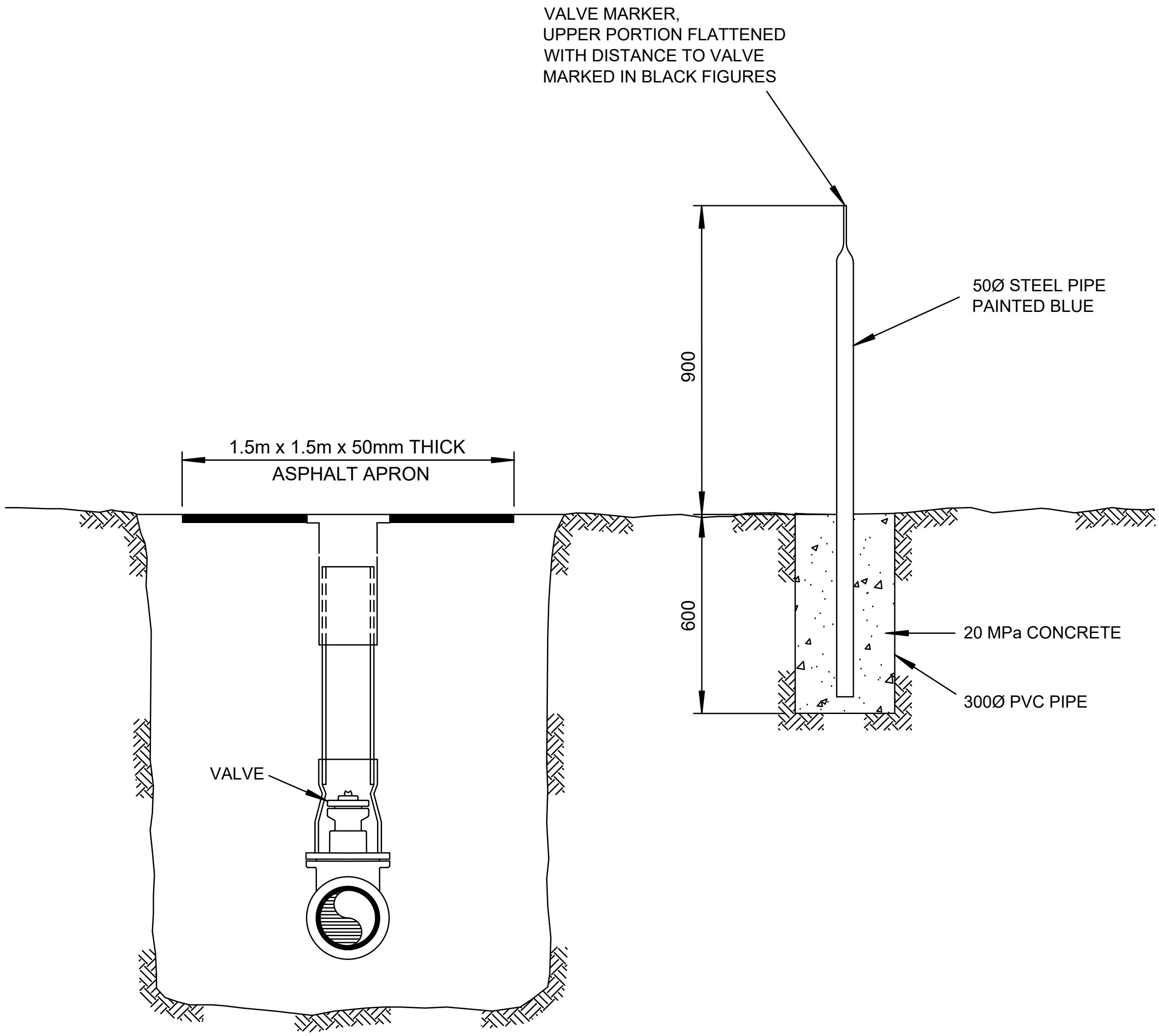
MINIMUM THRUST AREAS FOR FITTINGS AT 1034 kPA PRESSURE AND FOR SOILS WITH MIN. BEARING OF 96kPA
(NOT TO BE USED FOR SOFT CLAY, MUCK, PEAT, etc.)

TYPE OF FITTING	FITTING SIZE	OUTSIDE OF FITTING TO BEARING FACE	LENGTH	HEIGHT	TYPE OF FITTING	FITTING SIZE	OUTSIDE OF FITTING TO BEARING FACE	RECESS IN TRENCH	LENGTH	HEIGHT
	D	W	L	H		D	W	W	L	H
90° BEND	150	300	900	450	CROSS	150	300		600	450
	200	350	1050	600		200	350		750	600
	250	375	1450	750		250	375		1000	750
	300	400	1650	900		300	400		1200	900
45° BEND	150	300	450	450	45° WYE	150	300	300	450	450
	200	350	600	600		200	350	400	600	600
	250	375	750	750		250	375	500	750	750
	300	400	900	900		300	400	600	900	900
11 1/4° BEND 22 1/2° BEND	150	300	450	225	* REDUCER	150	300	150	450	450
	200	350	600	300		200	350	200	600	600
	250	375	835	450		250	375	250	750	750
	300	400	900	450		300	400	300	900	900
TEE	150	300	600	450	CAPS AND PLUGS (IF NOT BOLTED)	150	300		450	450
	200	350	750	600		200	350		600	600
	250	375	1000	750		250	375		750	750
	300	400	1200	900		300	400		900	900

CITY OF NANAIMO
THE HARBOUR CITY

THRUST BLOCK DETAILS

Scale: NTS
Created: MAY 2006
Rev Date: NOV 2016
Dwg No: W-8



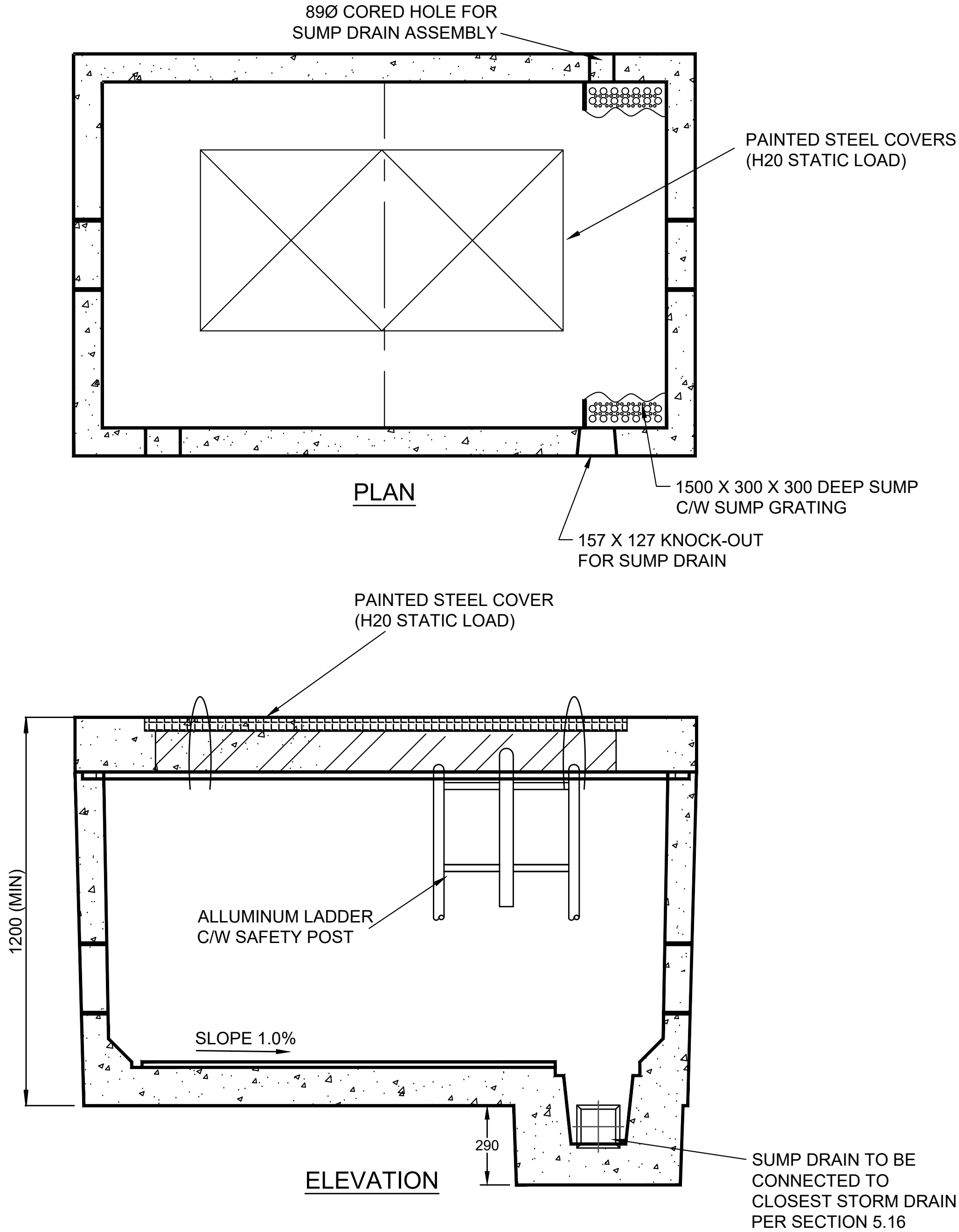
NOTES:

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.

CITY OF NANAIMO
THE HARBOUR CITY

VALVE BOXES IN UNPAVED AREAS

Scale:	NTS
Created:	NOV 2009
Rev Date:	NOV 2016
Dwg No:	W-9



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.
9. A DCVA BACKFLOW PREVENTION ASSEMBLY SHALL BE A SPECIAL CASE. THE PRECAST VAULT SHALL BE A MINIMUM OF 2000mm L X 1200mm W. DEPENDENT UPON THE DCVA MANUFACTURED CLEARANCE AND ORIENTATION A LARGER VAULT MAY BE REQUIRED.
10. SUBJECT TO APPROVAL BY THE CITY ENGINEER A METER AND BACKFLOW PREVENTION ASSEMBLY MAY BE INSTALLED IN A MECHANICAL ROOM.

MINIMUM INTERVAL DIMENSION FOR THE PRECAST VAULT METER CHAMBER

DOMESTIC/ FIRE METER	LENGTH	WIDTH
100-150Ø	2000	1200
150-250Ø	2600	1200
DCVA	SEE NOTE 9	

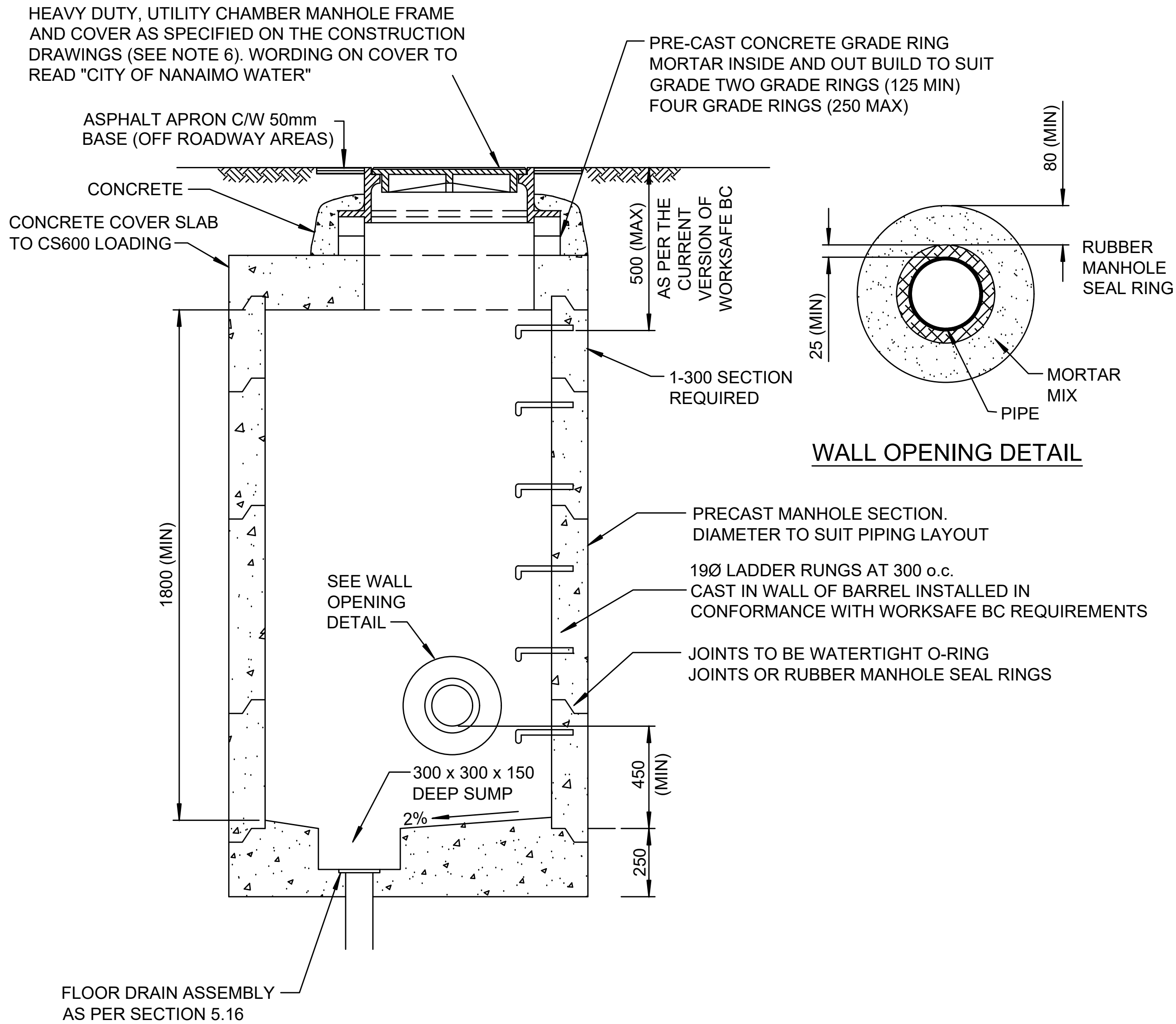
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 5 DWGS\W-11

3.6.2020

CITY OF NANAIMO
THE HARBOUR CITY

METER / DCVA BACKFLOW PREVENTION ASSEMBLY PRECAST VAULT

Scale: NTS
Created: MAY 2012
Rev Date: MAY 2020
Dwg No: W-11



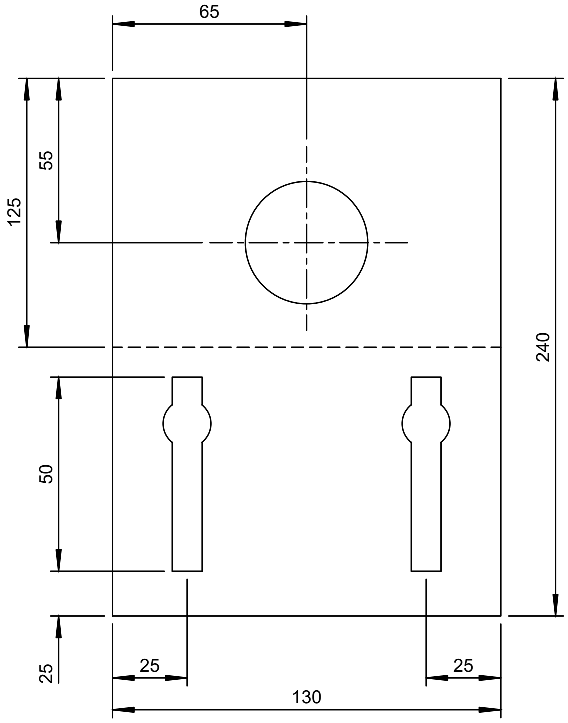
NOTES:

1. CHAMBERS LOCATED IN UNPAVED AREAS REQUIRE 1.5m X 1.5m GRAVEL OR PAVED SURFACE AROUND COVER. PROJECT COVER 0mm IN PAVEMENT OR 25mm IN UNPAVED AREAS.
2. CHAMBER MANHOLES LOCATED IN UNPAVED 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.

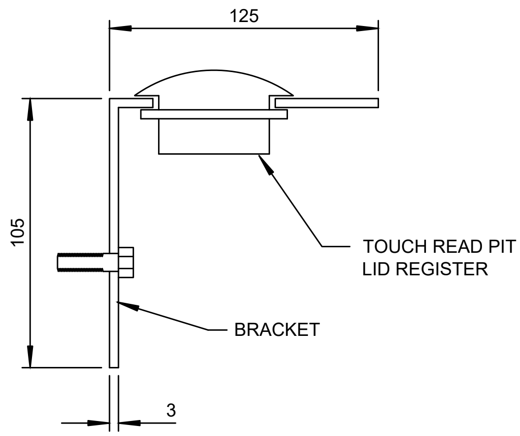
CITY OF NANAIMO
THE HARBOUR CITY

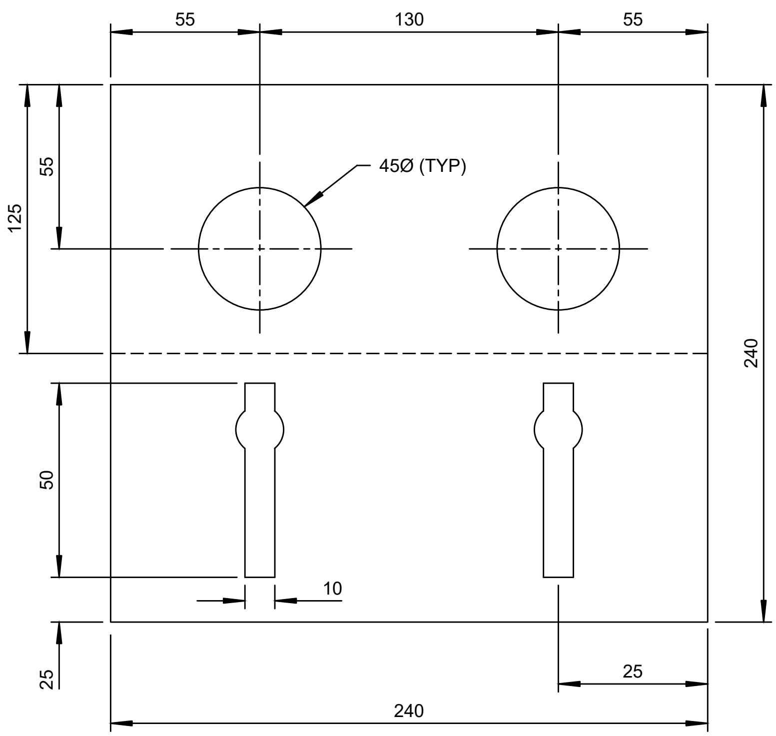
METER CHAMBER
PRECAST CIRCULAR
MANHOLE

Scale:	NTS
Created:	MAY 2013
Rev Date:	NOV 2016
Dwg No:	W-11A



SINGLE METER BRACKET





DOUBLE METER BRACKET

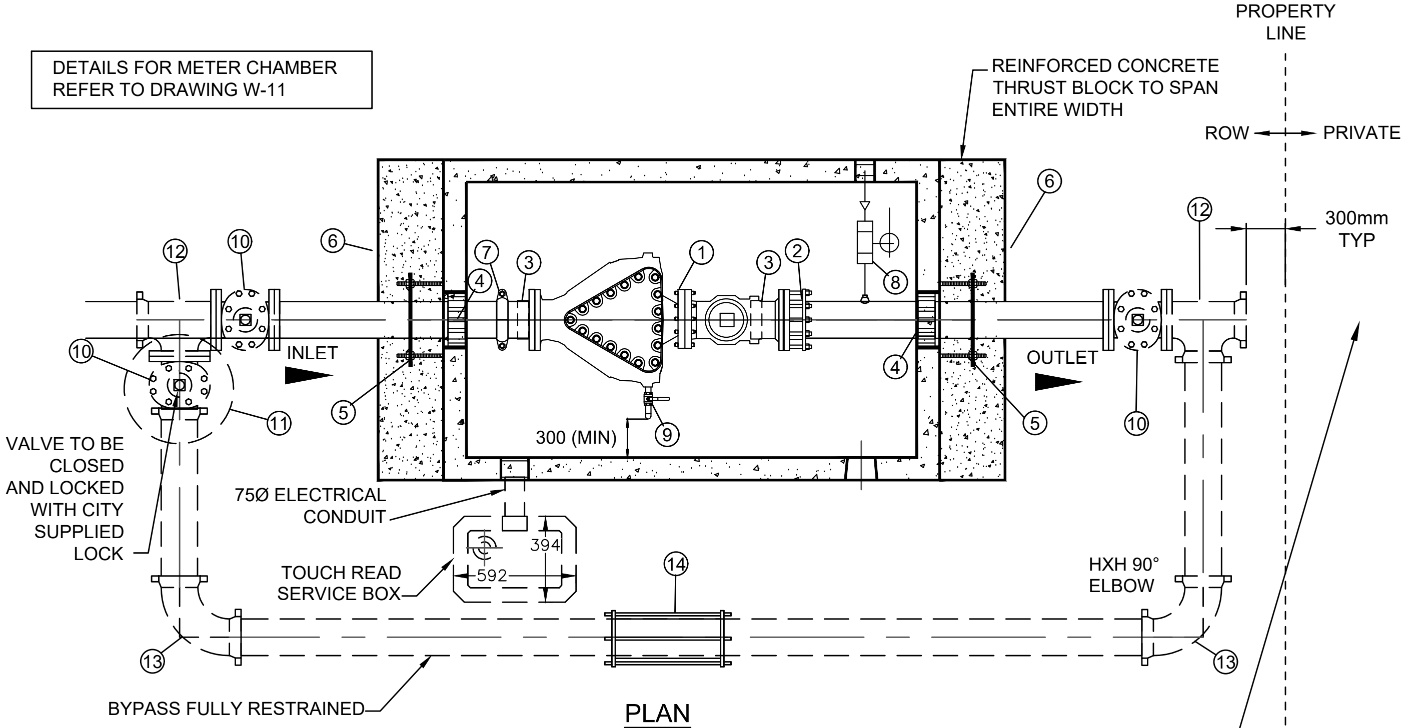
NOTES:

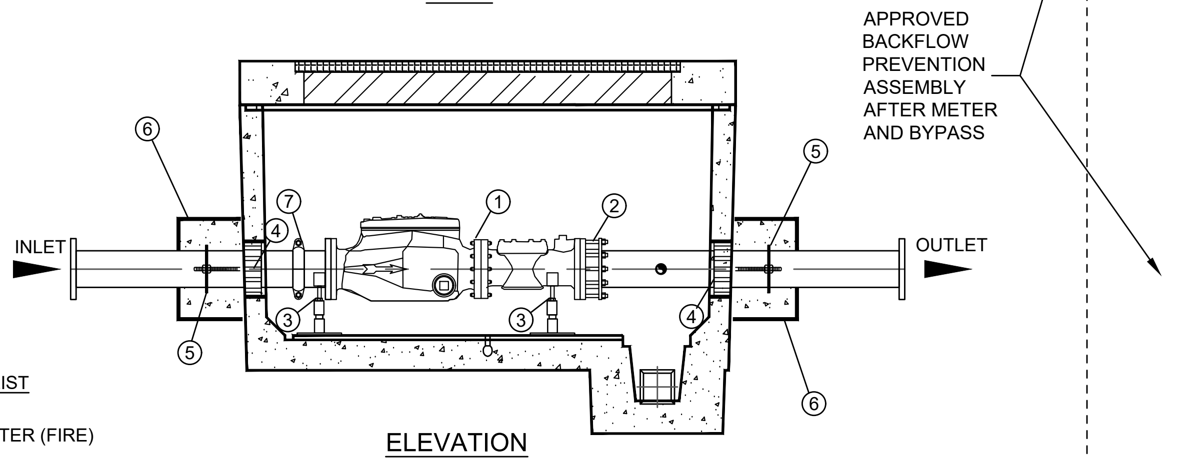
1. BRACKETS TO BE CONSTRUCTED OUT OF 3mm ALUMINUM PLATE.
2. BRACKETS TO BE MOUNTED WITH TWO 6mm STAINLESS STEEL BOLTS WITH LEAD ANCHORS.
3. IN PRECAST MANHOLE METER CHAMBERS THE BRACKET SHALL BE MOUNTED BETWEEN THE FIRST AND SECOND LADDER RUNG.
4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN.

CITY OF NANAIMO
THE HARBOUR CITY

WATER METER
TOUCH READ
BRACKET

Scale:	NTS
Created:	MAY 2013
Rev Date:	NOV 2016
Dwg No:	W-12





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

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.
6. PROVIDE APPROVED BACKFLOW PREVENTION ASSEMBLY AFTER THE METER AND BYPASS ACCORDING TO CITY OF NANAIMO CROSS CONNECTION CONTROL BYLAW.

3.6.2020

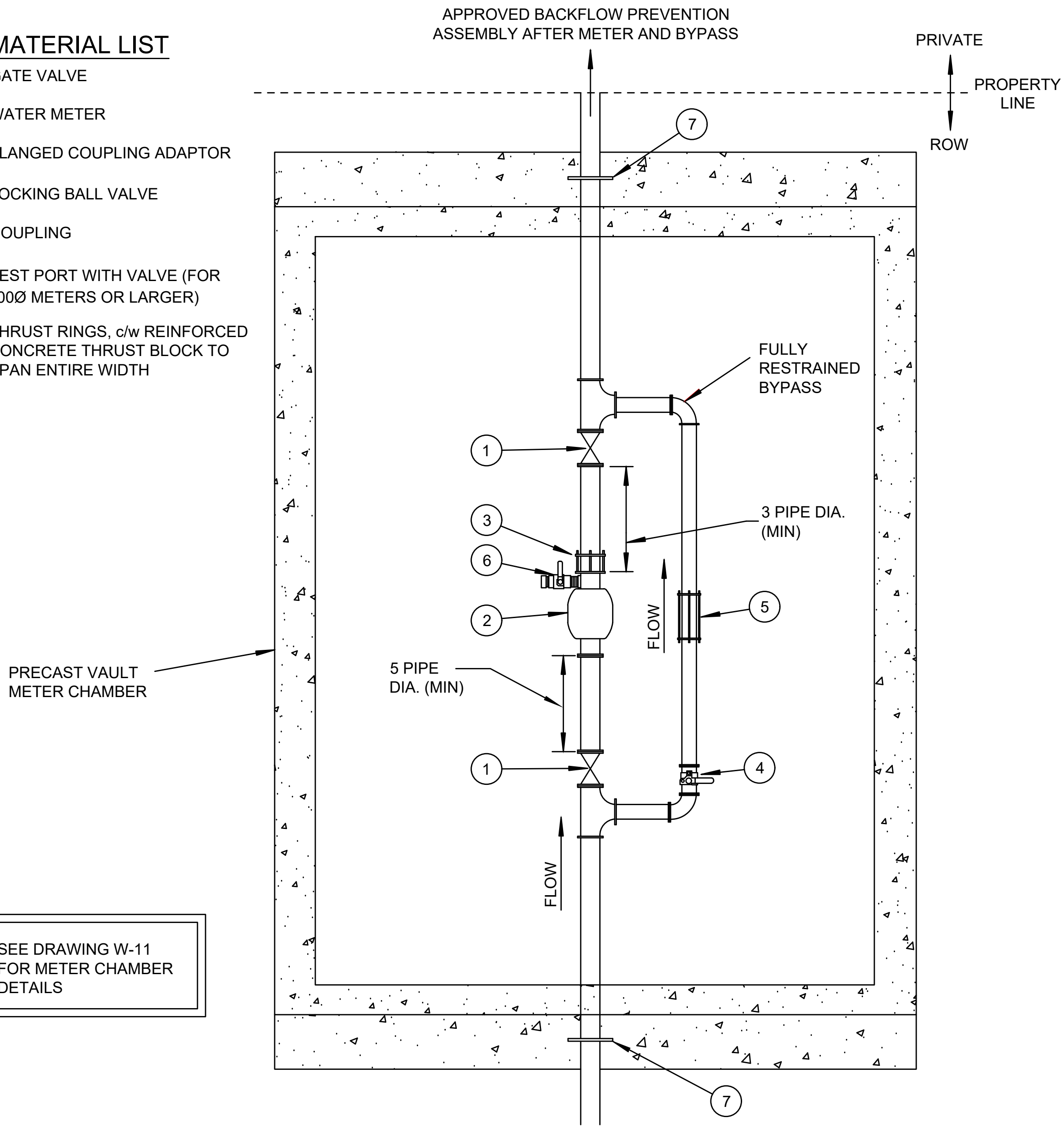
CITY OF NANAIMO
THE HARBOUR CITY

FIRE/DOMESTIC WATER METER PIPING LAYOUT (100Ø - 250Ø)

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	W-13

MATERIAL LIST

1. GATE VALVE
2. WATER METER
3. FLANGED COUPLING ADAPTOR
4. LOCKING BALL VALVE
5. COUPLING
6. TEST PORT WITH VALVE (FOR 100Ø METERS OR LARGER)
7. THRUST RINGS, c/w REINFORCED CONCRETE THRUST BLOCK TO SPAN ENTIRE WIDTH



SEE DRAWING W-11
FOR METER CHAMBER
DETAILS

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 CHAMBER SHALL BE D.I. GATE VALVES AS PER SECTION 5.24.
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.
6. PROVIDE APPROVED BACKFLOW PREVENTION ASSEMBLY AFTER THE METER AND BYPASS ACCORDING TO CITY OF NANAIMO CROSS CONNECTION CONTROL BYLAW.

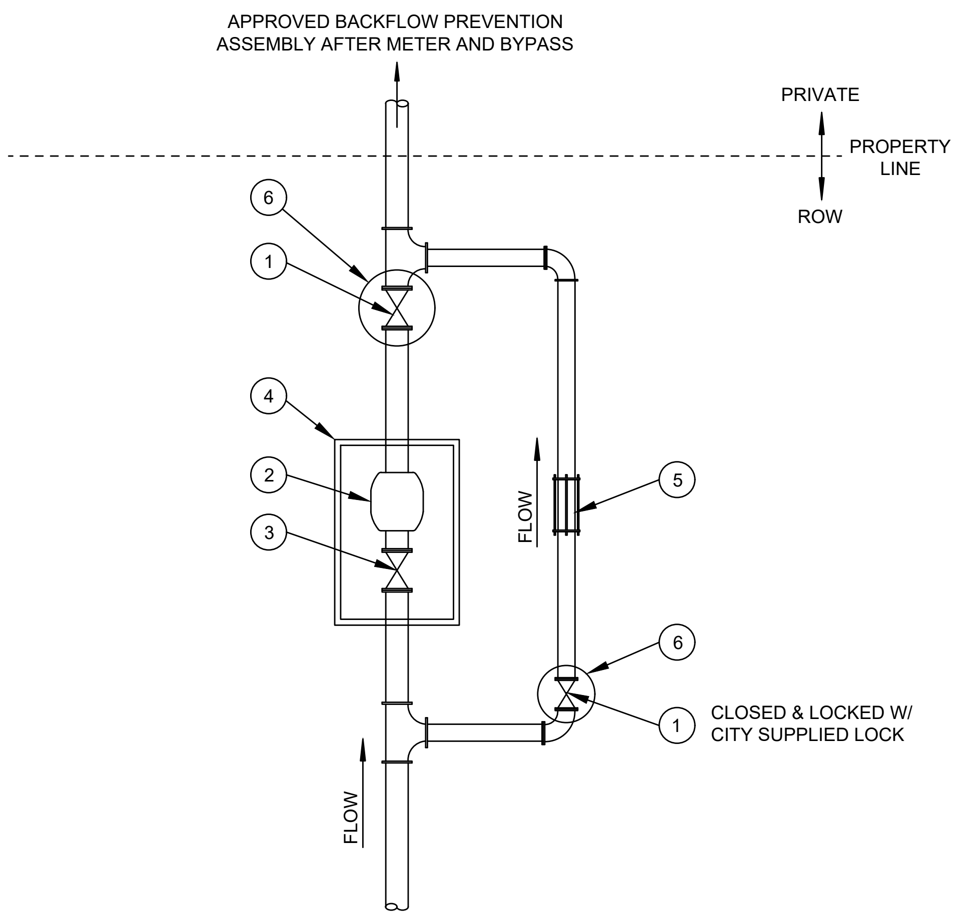
CITY OF NANAIMO
THE HARBOUR CITY

DOMESTIC WATER METER
PIPING LAYOUT (75Ø - 250Ø)

Scale:	NTS
Created:	MAY 2012
Rev Date:	MAY 2020
Dwg No:	W-14

MATERIAL LIST

1. GATE VALVE
2. WATER METER - DOMESTIC
3. CURB STOP
4. METER BOX
5. COUPLING
6. VALVE BOX



PLAN

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.
3. PROVIDE APPROVED BACKFLOW PREVENTION ASSEMBLY AFTER THE METER AND BYPASS ACCORDING TO CITY OF NANAIMO CROSS CONNECTION CONTROL BYLAW.

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3.6.2020

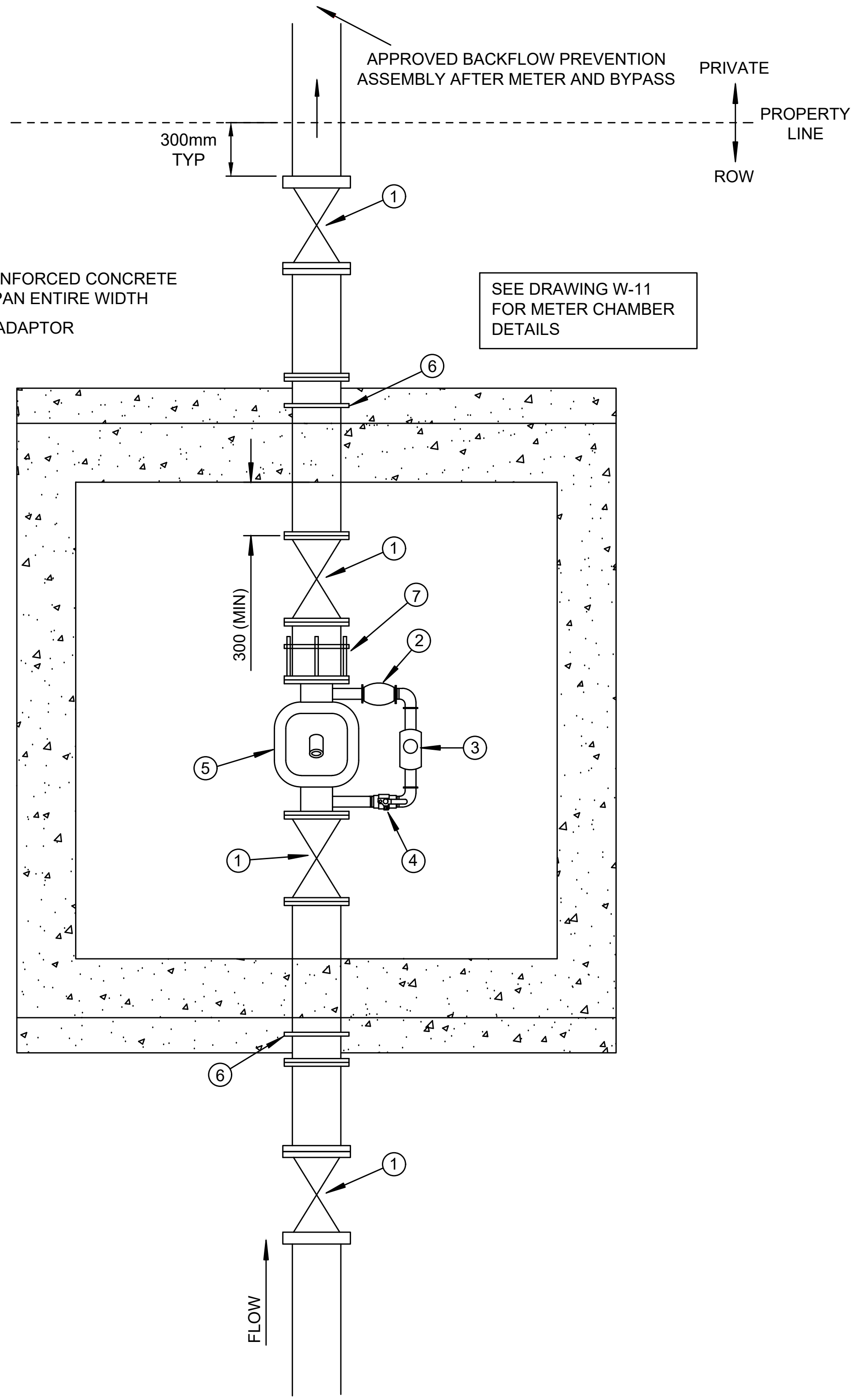
CITY OF NANAIMO
THE HARBOUR CITY

DOMESTIC WATER METER
PIPING LAYOUT (38Ø & 50Ø)

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	W-14A

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



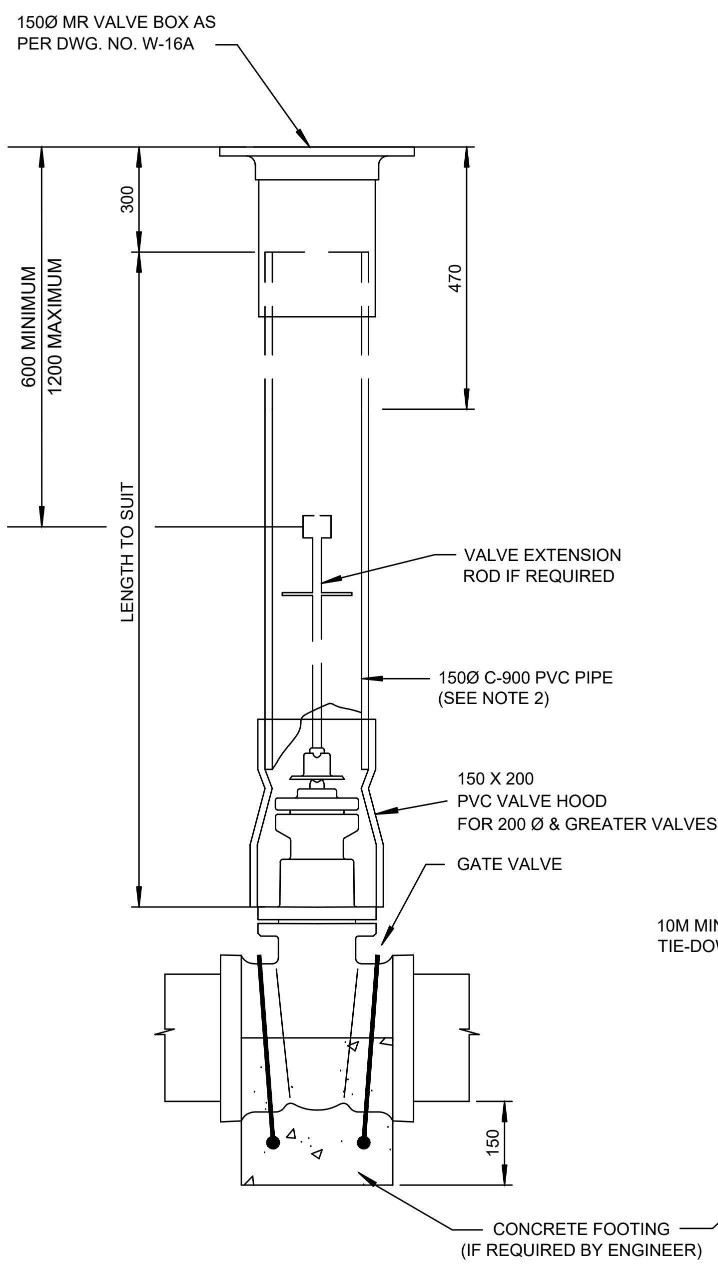
NOTES:

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.
4. PROVIDE APPROVED BACKFLOW PREVENTION ASSEMBLY AFTER THE METER AND BYPASS ACCORDING TO CITY OF NANAIMO CROSS CONNECTION CONTROL BYLAW.
5. SUBJECT TO APPROVAL BY THE CITY ENGINEER A METER AND BACKFLOW PREVENTION ASSEMBLY MAY BE INSTALLED IN A MECHANICAL ROOM.

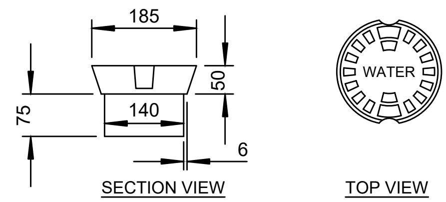
CITY OF NANAIMO
THE HARBOUR CITY

DETECTOR CHECK FIRE LINE SERVICE
PIPING LAYOUT (100Ø - 250Ø)

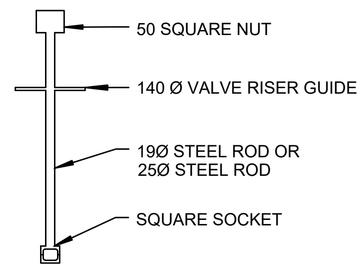
Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	W-15



ASSEMBLY WITH CONCRETE FOOTING

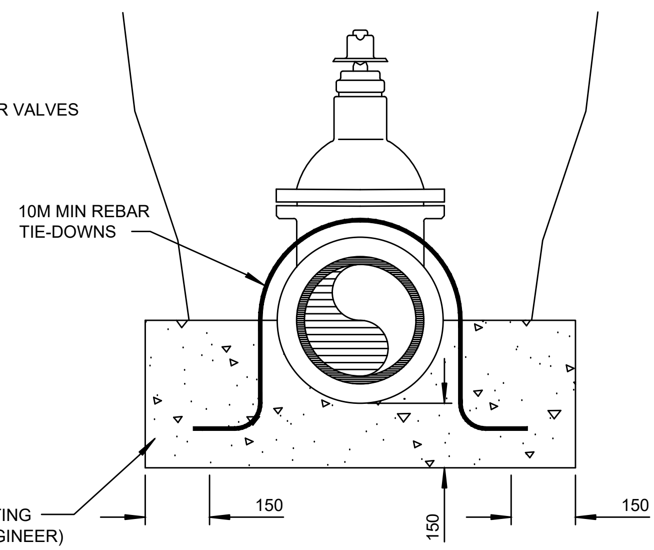


PARSONS LONG NECK LID
(NELSON + MR TYPE)



VALVE EXTENSION ROD

EXTENSION RODS REQUIRED WHEN BURY DEPTH EXCEEDS 1.2m FROM TOP OF VALVE TO GROUND LEVEL. TOP OF EXTENSION ROD NUT SHALL BE 600mm MINIMUM AND 1200mm MAXIMUM TO GROUND LEVEL.



SECTION OF CONCRETE FOOTING

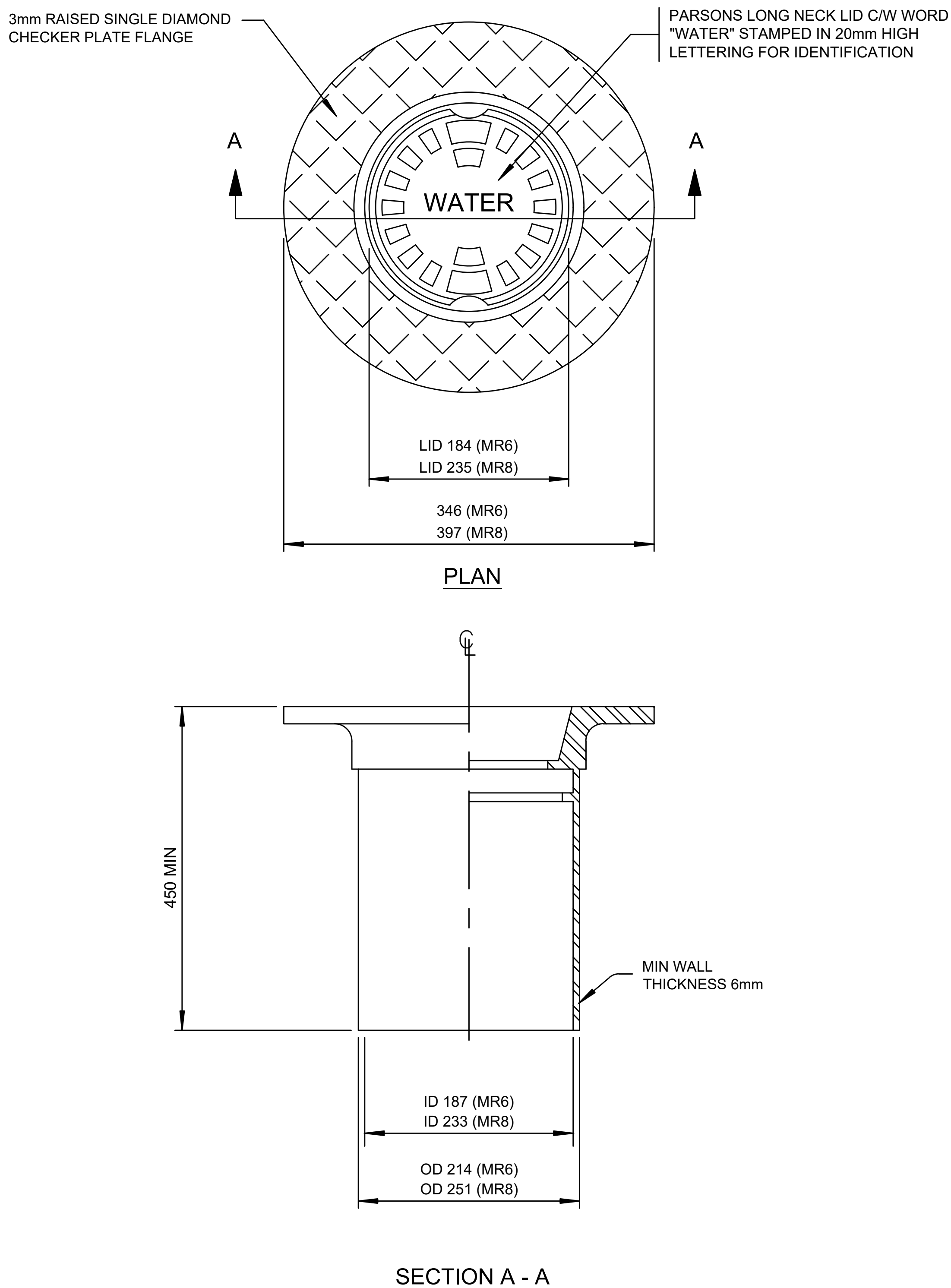
NOTES:

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.

CITY OF NANAIMO
THE HARBOUR CITY

GATE VALVE & VALVE NUT EXTENSIONS

Scale:	NTS
Created:	MAY 2013
Rev Date:	NOV 2016
Dwg No:	W-16



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.

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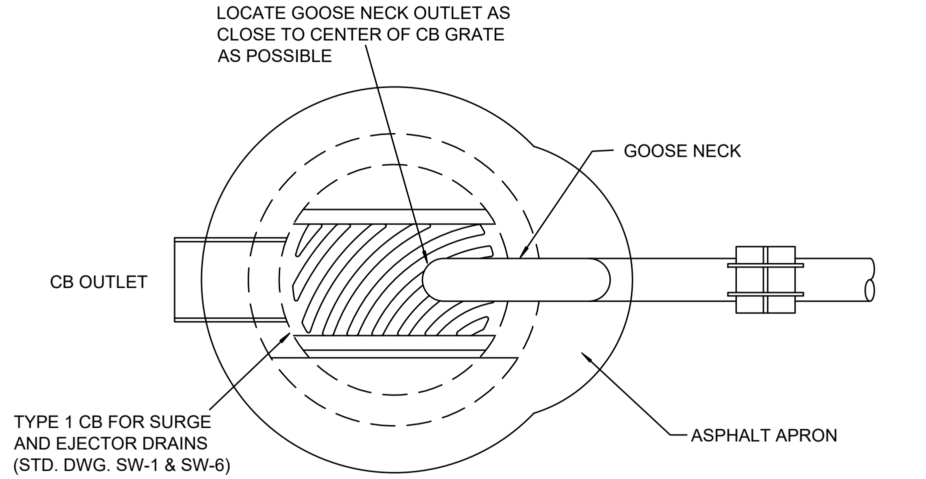
3.6.2020

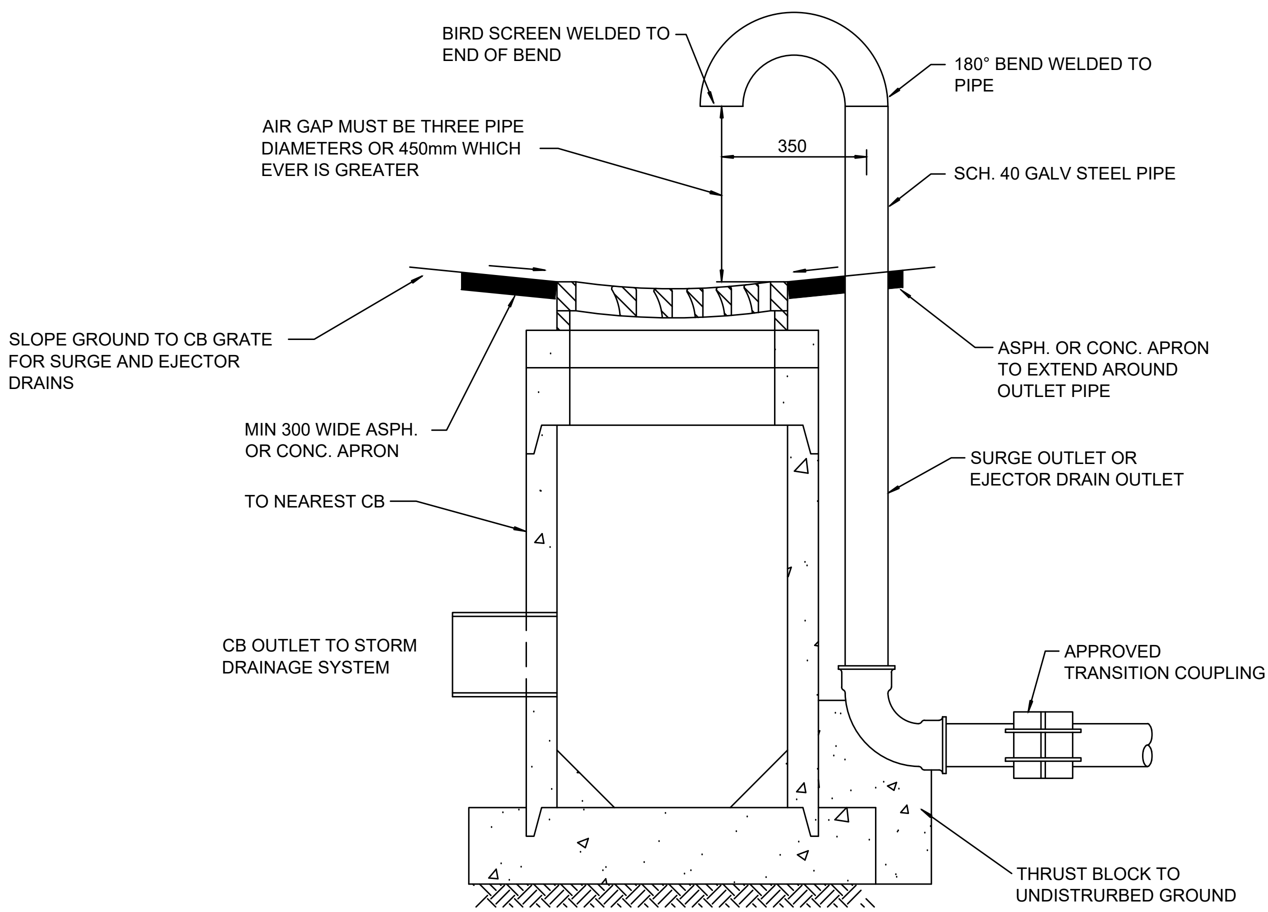
CITY OF NANAIMO
THE HARBOUR CITY

MR TYPE WATER VALVE BOX

Scale:	NTS
Created:	NOV 2009
Rev Date:	NOV 2016
Dwg No:	W-16A



PLAN VIEW



SIDE VIEW

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.

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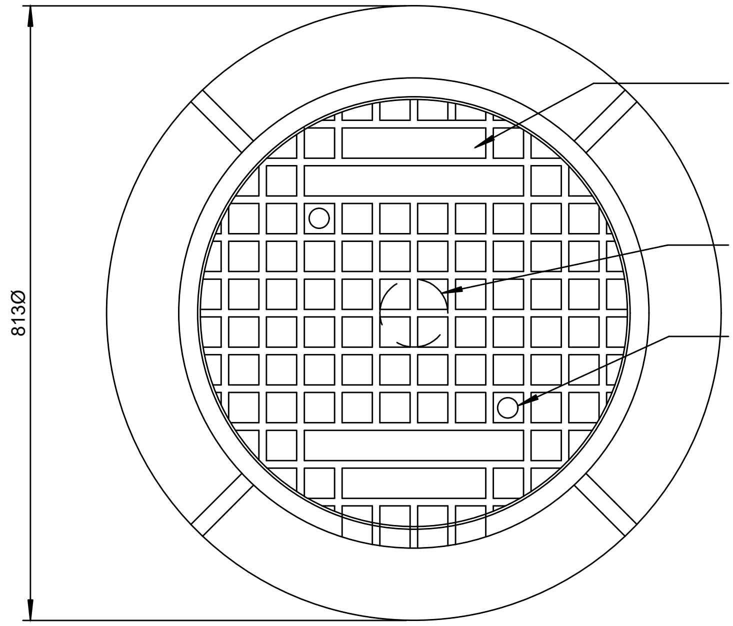
3.6.2020

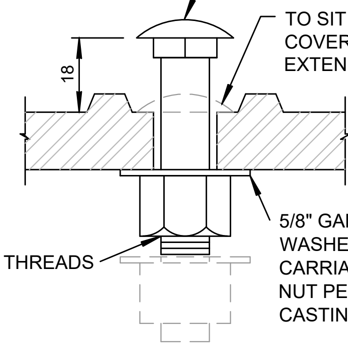
CITY OF NANAIMO
THE HARBOUR CITY

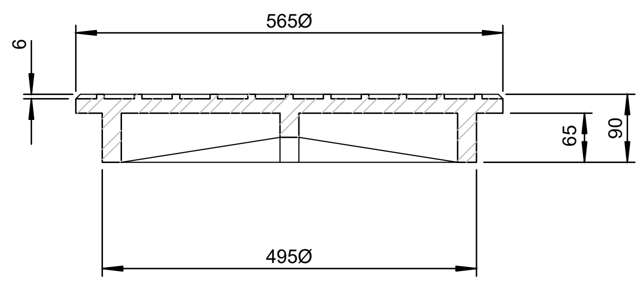
GOOSE NECK FOR PRESSURE REDUCING STATION DRAIN

Scale:	NTS
Created:	MAY 2012
Rev Date:	MAY 2020
Dwg No:	W-18

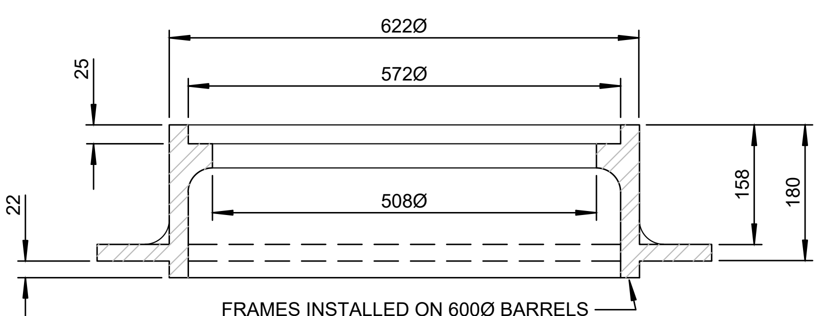


PLAN





COVER



FRAME

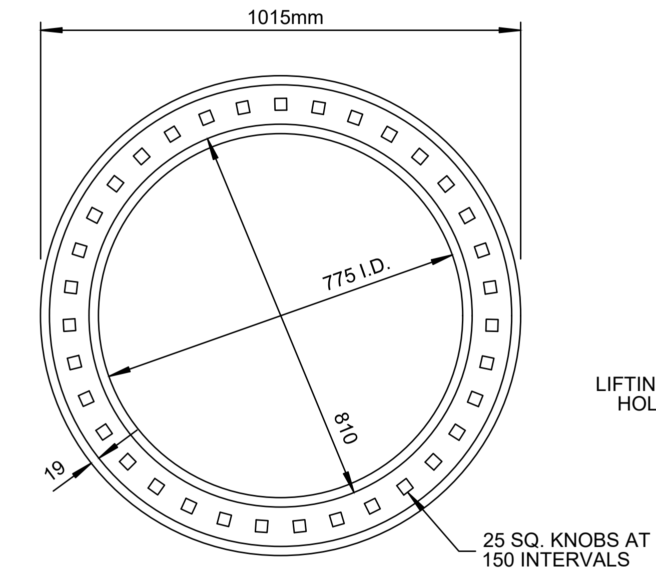
NOTES:

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.

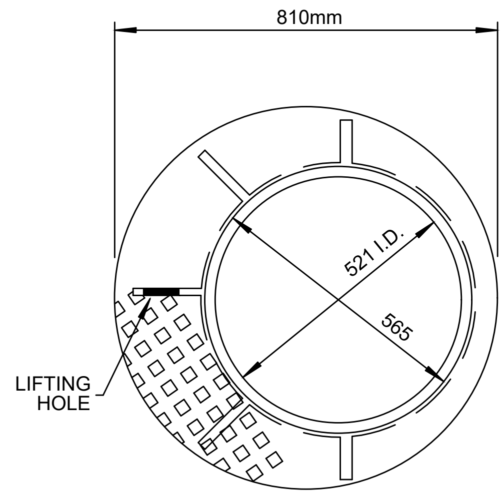
CITY OF NANAIMO
THE HARBOUR CITY

MANHOLE COVER AND FRAME

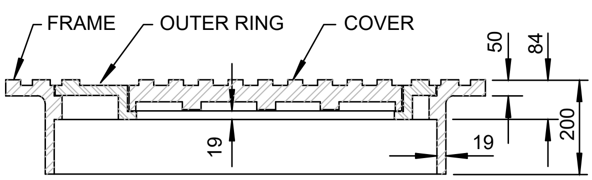
Scale:	NTS
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	W-19



PLAN OF FRAME



PLAN OF OUTER RING



SECTION OF FRAME, RING
AND COVER

NOTES:

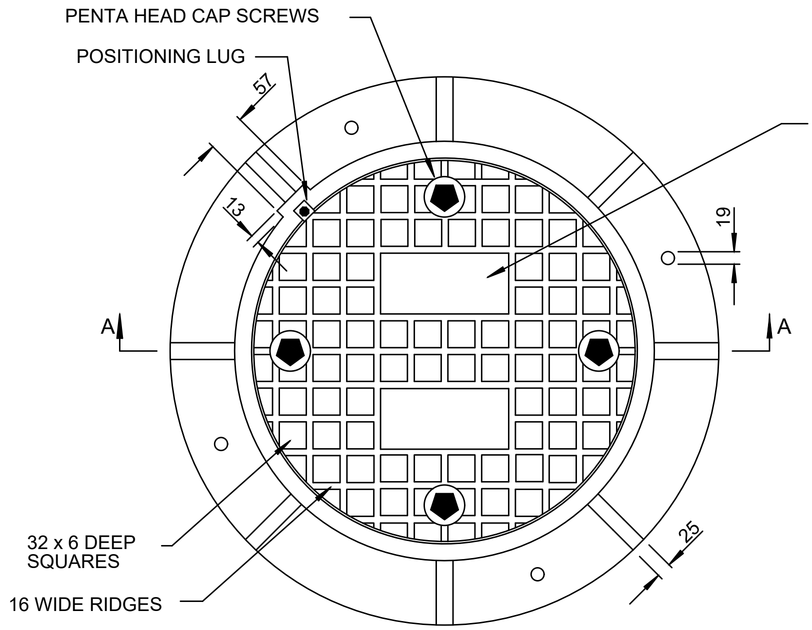
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 5.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. CASTINGS SHALL BE CERTIFIED TO MEET CS-600 LOADING.
3. THIS MANHOLE FRAME AND COVER IS TO BE USED FOR ACCESS TO UNDERGROUND UTILITY CHAMBERS, INCLUDING PUMPS STATIONS 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.

CITY OF NANAIMO
THE HARBOUR CITY

UTILITY CHAMBER
MANHOLE FRAME, RING
AND COVER

Scale:	NTS
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	W-20

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.

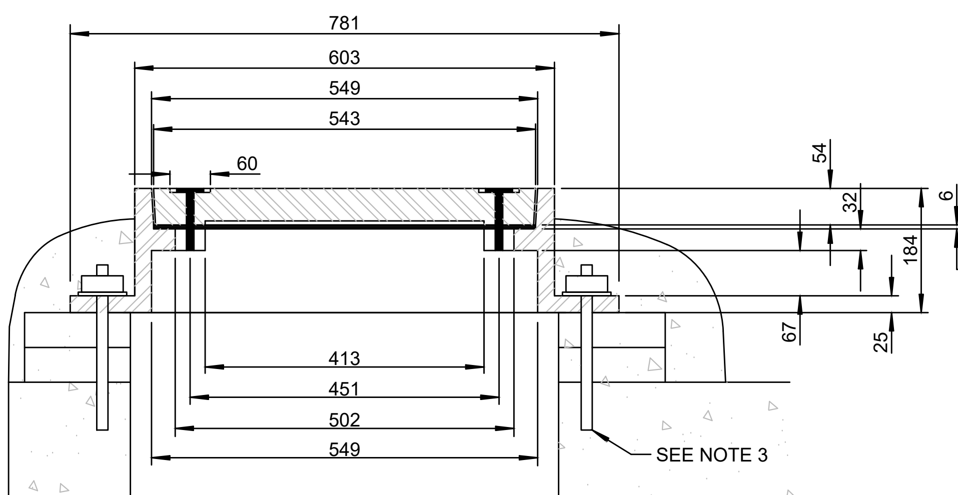


REFERRING TO "CITY OF NANAIMO WATER", LETTERING SHALL BE 25 FLATTENED FACE GOTHIC WITH FACE OF LETTERS RAISED TO THE SAME LEVELS AS THE TOP OF THE RIBS (IN STATUTORY RIGHTS-OF-WAY INCLUDE THE WORDING "DO NOT COVER" ON THE MANHOLE LID)

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.

PLAN



DIA. OF COVER ------ 543
THICKNESS OF COVER -- 54
DIA. OF FRAME ------ 781
DEPTH OF FRAME -----184

SECTION A-A

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.

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3.6.2020

CITY OF NANAIMO
THE HARBOUR CITY

WATERTIGHT MANHOLE
FRAME AND COVER

Scale:	NTS
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	W-21

SECTION 6 – SANITARY SEWER SYSTEM
CONTENTS

(REVISED MAY 2020)

SECTION 6 – SANITARY SEWER SYSTEM
CONTENTS

(REVISED MAY 2020)

SECTION 6 – SANITARY SEWER SYSTEM
CONTENTS

(REVISED MAY 2020)

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.

6.01A 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:

AREAS	POPULATION DENSITY
Single Family Dwellings	2.8 ppu or 36 pph
Low Density Multiple Family Dwellings	1.7 ppu or 48 pph
High Density Multiple Family Dwellings	1.7ppu or 120 pph
Industrial equivalent of	36 pph
Commercial equivalent of	90 pph (incl. parking)
Institutional equivalent of	50 pph (incl. parking, but not green space)

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:

$PF = 1 + 14/(4+P^{0.5})$ ***(REVISED MAY 2020)***

Where P is the design contributory population, in thousands.

Where the service population exceeds 100, a sanitary sewer model approved by the City Engineer shall be used. ***(REVISED MAY 2020)***

.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.

6.02 SEWAGE CHARACTERISTICS

.1 Sewage quality criteria shall be as follows:

Sewage Quantity (AWDF)
in the

Direct Service Area	Constituent	Normal Average	Maximum Short Duration
less than 50,000 L/d	BOD (Biological Oxygen Demand) 5 day 20°C	1000 mg/L	2000 mg/L
	TSS (Total Suspended Solids)	800 mg/L	2000 mg/L
	pH	4 – 10.5	3.5 – 11
	Temperature	79°C	95°C
50,000 to 450,000 L/d	BOD (Biological Oxygen Demand) 5 day 20°C	400 mg/L	1000 mg/L
	TSS (Total Suspended Solids)	300 mg/L	1000 mg/L
	pH	5 – 9.5	4 – 10.5
	Temperature	66°C	80°C
Over 450,000 L/d	BOD (Biological Oxygen Demand) 5 day 20°C	200 mg/L	500 mg/L
	TSS (Total Suspended Solids)	200 mg/L	500 mg/L
	pH	5.5 – 9.0	5 – 9.5
	Temperature	54°C	65°C

.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.

6.03 HYDRAULICS

.1 No gravity sewer shall be less than 200 mm in diameter except that in residential areas 150 mm 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 0.75 m/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. For new development, replace existing mains that front the proposed developments or are within areas of proposed road works if the flow exceeds 50% of diameter or it does not meet the minimum pipe diameter requirement. ***(REVISED MAY 2020)***

.5 Service connections shall be 100 mm in diameter minimum. Service connections to other than single family dwellings shall be minimum 150 mm 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 0.75 m/s, except for terminal sewers which are to be as follows:

(a)	Sewers servicing less than 10 houses	1.0% minimum grade
(b)	Sewers servicing less than 25 houses	0.6% minimum grade

6.04 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 1.5 m in travelled roads and 1.0m in untraveled areas. Unless otherwise approved by the City Engineer, the maximum cover depth over gravity sewers is 4.5 m.

(c) Minimum cover on service connections shall be 750 mm 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 Deflected Sewers: ***(REVISED MAY 2020)***

(a) Horizontal curves on sewers require approval from the City Engineer. ***(REVISED MAY 2020)***

(b) Horizontal curves will be considered where the configuration of the property lines requires curvature for a constant offset and where the design velocity exceeds 1 m per second. ***(REVISED MAY 2020)***

(c) Curvature will be achieved through joint deflection only, bending of the pipe barrel will not be permitted. Joint deflections shall not exceed 50% of the manufacturer's maximum recommended joint deflection. Radius of curvature shall be uniform throughout the curves. ***(REVISED MAY 2020)***

(d) 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. ***(REVISED MAY 2020)***

(e) 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 centreline from the watermain and at a constant offset from the property line.

(b) Sanitary sewers and service connections shall be located not less than 3.0 m horizontally and 0.45 m 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 300 mm.

(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. Low pressure sewer systems with a downstream connection to a gravity or pressure sewer in the public road fronting the property are preferred in place of gravity sewers crossing private lands. ***(REVISED MAY 2020)***
(b) Utilities following property boundaries across private lands shall generally be offset a minimum 2.0 m from the property boundary.
(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.
(f) For a sample statutory right-of-way condition sheet, refer to Appendix C, Standard Drawing No. RW-2.
(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 30 m shall require approval by the City Engineer. All inspection assemblies required for service connections in excess of 30 m 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.

.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.

6.04A MANHOLES

.1 Distances between manholes shall not exceed 120 m, 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.

.4 Minimum Drop in Invert Elevations Across Manholes: ***(REVISED MAY 2020)***

Alignment Change	Minimum Drop Across Manhole
Straight run	No drop required
Deflections up to 45 degrees	30 mm
Deflections 45 to 90 degrees	60 mm

(REVISED MAY 2020)

(a) Where the difference in elevation between incoming and outgoing sewers exceeds 600 mm, standard drops for pipe sizes 375 mm or less shall be used as shown in the Standard Drawings. Differences in elevation between 150 mm and 600 mm shall be avoided where possible. Inside drops into a 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 workings space with the manhole. ***(REVISED MAY 2020)***

.5 Precast manhole barrels shall be sized according to nominal inside pipe diameter and depth as detailed below:

Pipe Size (Nominal)	Depth of Manhole (Top of Cover to Inv.)	Barrel Size (Inside Dia.)
150 – 375 mm	0 - 5.9 m	1050 mm
150 – 375 mm	6.0 - 9.0 m	1200 mm
150 – 600 mm	9.0 m or greater	1500 mm
400 – 600 mm	0.0 - 8.9 m	1200 mm
675 – 1050 mm	All Depths	1500 mm

.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 and 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.).

.9 On trunk mains, as identified by City staff, manholes shall be designed to accommodate surcharging and shall include sealed lids fastened to the manhole. ***(REVISED MAY 2020)***

6.05 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 Bylaws.

.2 Sanitary sewer pumping stations shall be permitted only at locations where gravity connections from an existing or proposed trunk sewer, as identified by City staff, 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 MAY 2020)***

.3 Provisions for odour control are to be considered as part of pump station and force main design. ***(REVISED MAY 2020)***

6.06 FORCE MAINS

.1 All force mains shall be designed for a 1 m/s minimum velocity. If the sewage detention time at the minimum design ADWF, exceeds 12 hours, special consideration must be given for odour control. ***(REVISED MAY 2020)***

.2 Force mains 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 force main shall be below the hydraulic grade line at minimum pumping rate.

.4 Force mains shall be designed using a Hazen Williams roughness coefficient of 140 for PVC and HDPE pipe with minor losses accounted for separately with all fittings and valves. ***(REVISED MAY 2020)***

6.06A LOW PRESSURE SEWERS ***(REVISED MAY 2020)***

.1 General: ***(REVISED MAY 2020)***

(a) The City may consider low pressure sanitary sewer systems for areas which are beyond the reaches of the City gravity sewer system and not large enough to provide economic justification for a community sewage pump station, or where soil conditions or topography are not suitable for a gravity sewer system. A low pressure sanitary sewer system consists of on-site, privately owned and operated sewage pump unit with discharge pipes connected to either an inspection chamber at property, or City owned gravity sewer, or a City owned and operated low pressure sewage force main. ***(REVISED MAY 2020)***

(b) Systems in which private pump units discharge into a public gravity sewer or force main from a public community sewage pump station are not classified as low pressure sanitary sewer systems. Where specifically indicated herein, some of the items included in this Low Pressure Sewers section are applicable to such other pumped systems. ***(REVISED MAY 2020)***

(c) Pump unit details design and all ancillary components designed within the private property shall be certified by the Consultant, and the intent of this Section is to provide design guidelines to the Consultant. ***(REVISED MAY 2020)***

.2 Restrictive Covenant: ***(REVISED MAY 2020)***

(a) The land title for each legal lot served by a private pump unit located on the subject lot shall include a restrictive covenant, filed by the property owner, requiring the property owner to install a pump unit and service connection pipe to the City service box. The required format of the restrictive covenant will be provided by the City at the Building Permit stage. ***(REVISED MAY 2020)***

(b) The ownership and the responsibility for the operation and maintenance of the pump chamber and the service pipe on private property is that of the property owner. Ownership and responsibility for the operation and maintenance of the service box and service pipe on City property or right-of-way is that of the City. ***(REVISED MAY 2020)***

(c) The portion of service connection pipe and service box to be located on public property or right-of-way will be completed by the City at the Bylaw Rate for this type of service. ***(REVISED MAY 2020)***

.3 Codes and Standards: ***(REVISED MAY 2020)***

Low pressure sewer systems and the components therefore will be designed and constructed in conformance with the following codes and standards: ***(REVISED MAY 2020)***

(a) Canadian and British Columbia Electrical Code. ***(REVISED MAY 2020)***

(b) British Columbia Public Health Act and Sewage System Regulation. ***(REVISED MAY 2020)***

(c) British Columbia Plumbing Code. ***(REVISED MAY 2020)***

(d) City of Nanaimo Manual of Engineering Standards and Specifications. ***(REVISED MAY 2020)***

(e) WorkSafeBC Regulations. ***(REVISED MAY 2020)***

.4 System Layout: ***(REVISED MAY 2020)***

(a) The preliminary layout of a proposed low pressure sewer system should be approved by the Engineer before detailed design proceeds. ***(REVISED MAY 2020)***

.5 Preliminary Design: ***(REVISED MAY 2020)***

(a) The following information is required as part of the preliminary design submission: (REVISED MAY 2020)

(i) Plan of the entire area to be served by the proposed system, including adjacent lands that cannot be serviced by a gravity sewer system or community sewerage pump station; ***(REVISED MAY 2020)***

(ii) Topographic plan; ***(REVISED MAY 2020)***
(iii) Report on soil conditions; ***(REVISED MAY 2020)***
(iv) Preliminary layout; ***(REVISED MAY 2020)***
(v) Area development sequence and timetable, and ***(REVISED MAY 2020)***
(vi) Pump unit power requirements. ***(REVISED MAY 2020)***

.6 Detailed Design: ***(REVISED MAY 2020)***

(a) At the detailed design stage, the following information will be submitted to the Engineer for review and approval: ***(REVISED MAY 2020)***

(i) Hydraulic Grade Line (HGL) for the City force main; ***(REVISED MAY 2020)***
(ii) Location and elevation of each pump unit, valve chamber and service connection; ***(REVISED MAY 2020)***
(iii) Pump head and capacity requirements, plus recommended manufacturer and model, pump curve, and power requirements; ***(REVISED MAY 2020)***
(iv) Pump chamber diameter, depth, operation levels and configuration (simplex or duplex); ***(REVISED MAY 2020)***
(v) Location and direction of flow of each lateral, branch and main, plus details of the system discharge point. Sewer system should be designed to minimize the length of runs and avoid abrupt changes in direction; ***(REVISED MAY 2020)***
(vi) Location and elevation of system high points, where high points are unavoidable; ***(REVISED MAY 2020)***
(vii) Maintenance flushing volumes and frequency for each run; ***(REVISED MAY 2020)***
(viii) Qualifications of supplier of pump unit package as indicated under pump unit general requirements, and; ***(REVISED MAY 2020)***
(ix) Sample of Operation and Maintenance manual to be provided with pump unit. ***(REVISED MAY 2020)***

.7 System Hydraulic Design: ***(REVISED MAY 2020)***

(a) System hydraulic design will include complete hydraulic data for each section of the City force main including flows, heads, velocities and maximum retention times. Submission of this information will include a table showing all of the data for each anticipated stage of the system development. ***(REVISED MAY 2020)***

.8 Design Flows and Hydraulics: ***(REVISED MAY 2020)***

(a) Design flows for sizing pressure sewers, including Service Connections and City Force Mains, will be determined on the basis of the velocity and head criteria as summarized in these guidelines, and using one of the following procedures, depending upon the land use. ***(REVISED MAY 2020)***

(i) Single Family Residential Areas. ***(REVISED MAY 2020)***

1. For single family residential areas, estimate the number of pump units operating simultaneously as provided in Table: Low Pressure Pumps Operating Simultaneously. ***(REVISED MAY 2020)***

Table: Low Pressure Pumps Operating Simultaneously *(REVISED MAY 2020)*

Number of Single Family Residential Pumps Connected	Number of Pumps Operating Simultaneously
1	1
2 to 3	2
4 to 9	3
10 to 18	4
19 to 30	5
31 to 50	6
51 to 80	7
81 to 113	8
114 to 149	9

(REVISED MAY 2020)

(ii) Multi-Family, Non-Residential and Mixed Areas: ***(REVISED MAY 2020)***

1. The following formula may be used for any development in which pump capacities exceed those for single-family residences. For the upstream end of the system, where there are only one or two connections, assume the connected pumps are operating. Other approved hydraulic calculations may also be acceptable if approved by the City. ***(REVISED MAY 2020)***

Q_{design} = CP+F ***(REVISED MAY 2020)***

Where:

Q = Design flow in liters per second (L/s)
C = Coefficient based on land-use and peaking factor; standard value = 0.008.
P = Population or equivalent
F = Factor based on minimum flows; standard value = 2.10

.9 Hydraulic Calculations: ***(REVISED MAY 2020)***

(a) Criteria for hydraulic design calculations include the following: ***(REVISED MAY 2020)***

(i) Pipe flow formula: Hazen Williams, with friction coefficient C=130. ***(REVISED MAY 2020)***
(ii) Minimum velocity: V = 0.6 m/s; and ***(REVISED MAY 2020)***

(iii) Maximum operating head (total dynamic head, TDH): compatible with pumps and not to exceed 35 m (343 kPa) unless otherwise approved by the Engineer. ***(REVISED MAY 2020)***

(b) System test pressures will be 2.0 times the maximum operating head and not less than 700 kPa. ***(REVISED MAY 2020)***

.10 Pipe: ***(REVISED MAY 2020)***

(a) Minimum pipe sizes are as follows: ***(REVISED MAY 2020)***

(i) From pump unit to City low pressure force main: 38 mm ID; and ***(REVISED MAY 2020)***
(ii) City low pressure sewage force main: 50 mm Iron Pipe Size (IPS). Internal diameters will vary based on pipe wall thickness; the actual internal pipe diameter is to be used for hydraulic calculations. ***(REVISED MAY 2020)***

(b) Low pressure force mains shall be installed at a minimum depth of cover of 0.9 m when located within the City road right-of-way and 0.45 m on private property. The maximum depth shall not exceed 3.0 m unless approved by the Engineer. (REVISED MAY 2020)
(c) All joints on the force main shall be compatible with pipe material and fittings, and complete with appropriate thrust restraints. ***(REVISED MAY 2020)***
(d) The segment of force main between pump unit and City force main will include 150 mm wide Detectable Warning Tape placed above the Force Main at a depth of 150 mm below the ground surface. **(REVISED MAY 2020)**

.11 Cleanout and Pig Launching Manholes: ***(REVISED MAY 2020)***

(a) Cleanout and pig launching manholes are required on low pressure force mains at ends and at a maximum 300 m spacing. Details of the cleanouts are shown on the Standard Drawing No. S-18. ***(REVISED MAY 2020)***

.12 Air Valves: ***(REVISED MAY 2020)***

(a) Sewage air release valves may be required at system high points and major changes in grade (10% or greater) at the discretion of the City Engineer. Details of air valve assemblies are shown on the Standard Drawings. ***(REVISED MAY 2020)***

.13 Discharge: ***(REVISED MAY 2020)***

(a) Location and detail of low pressure sewer force main discharge will be subject to the Engineer's approval. Submerged outlets are not acceptable. Discharge details are shown on the Standard Drawings. ***(REVISED MAY 2020)***
(b) Refer to Standard Drawing No. S-17. ***(REVISED MAY 2020)***
(c) Refer to Standard Drawing No. S-19. ***(REVISED MAY 2020)***

.14 Service Connections: ***(REVISED MAY 2020)***

(a) Service connections to the City force main will include integral wye fittings oriented in the direction of flow. ***(REVISED MAY 2020)***

(b) Each service connection will include a valve chamber located on City property at the property line. Details of the valve chamber and fittings are shown on the Standard Drawings. Check valves will be bronze or stainless steel, full-ported, wye body ball check valves. ***(REVISED MAY 2020)***

(c) Refer to Standard Drawing No. S-16. ***(REVISED MAY 2020)***

.15 Pump Unit Requirements: ***(REVISED MAY 2020)***

(a) Pumps for low pressure systems will be submersible grinder pumps capable of discharging the design flow at the maximum operating head. Pump design flow will be the greater of PDWF or the flow required to achieve the minimum flow velocity. ***(REVISED MAY 2020)***

(b) General requirements include the following: ***(REVISED MAY 2020)***

(i) Pump unit package design, including the service connection, shall be sealed by the Consultant. ***(REVISED MAY 2020)***

(ii) All pump and control equipment will be certified by CSA, or an equivalent certification agency approved by the Engineer. ***(REVISED MAY 2020)***

(iii) Pump unit specifications are subject to approval by the Engineer. ***(REVISED MAY 2020)***

(iv) A building permit is required for a pump unit. ***(REVISED MAY 2020)***

(v) Duplex (two pump) units are required for multi-family and non-residential properties. ***(REVISED MAY 2020)***

(vi) The pump unit will be installed outside of the building in a location convenient for maintenance. The control/alarm panel will be located in close proximity to the chamber either outside or inside the building. ***(REVISED MAY 2020)***

(vii) Detailed, concise manufacturer’s operating and maintenance instructions will be submitted to the City as part of the permitting application process. A copy of these instructions will be fastened to the inside of the control panel door. ***(REVISED MAY 2020)***

(viii) Pump unit suppliers will have documented experience and ability in design, supply and servicing of pump unit packages, including pump(s), chamber, piping and controls. ***(REVISED MAY 2020)***

(c) Grinder pumps will be either centrifugal or semi-positive displacement pumps. The grinder assembly will consist of hardened steel components designed to grind sewage solids into fine particles, which can pass easily through 32 mm diameter pump and piping passages. The electrical and control cable(s) from the pump shall have a minimum 30 m whip length. ***(REVISED MAY 2020)***

(d) Pump units discharging through 100 mm diameter or larger service connections into 150 mm diameter or larger low pressure force mains or gravity sewers may be solids-handling submersible centrifugal pumps. ***(REVISED MAY 2020)***

(e) Pump curves will be "steep" within the design operating range, where total head is below the maximum operating head, such that the reduction of capacity with increasing head does not exceed 0.03 l/s/m. ***(REVISED MAY 2020)***

(f) Pumps will be manufactured using durable, non-corrosive metallic components. ***(REVISED MAY 2020)***

.16 <u>Pump Chamber Details:</u> ***(REVISED MAY 2020)***

(a) Criteria for pump chamber design will include the following:

(i) Material and Construction: Fibreglass reinforced polyester (FRP) or high density polyethylene (HDPE) with smooth interior, bottom shaped to avoid solids build-up, walls and bottom or sufficient thickness or with exterior corrugations to withstand soil pressure, and base to include flange for concrete collar to prevent floatation; ***(REVISED MAY 2020)***

(ii) Chamber lid and connections (inlet, discharge, ventilation and electrical) will be factory installed and watertight. The lid will have structural capacity sufficient of the expected design load and will provide access to the full diameter of the tan; ***(REVISED MAY 2020)***

(iii) A minimum chamber diameter of 750 mm is required to provide for convenient operating and maintenance access; ***(REVISED MAY 2020)***

(iv) Depth to accommodate inlet and discharge pipe elevations and to provide sufficient operating and storage volumes; ***(REVISED MAY 2020)***

(v) Chamber volume between pump on and off level to be based on pup cycle times between 5 and 30 minutes, with preference for normal operating depth ranging from 150 mm to 200 mm. A typical operating volume for a single family residential unit is 200 litres; and ***(REVISED MAY 2020)***

(vi) Chamber volume for emergency storage (above normal pump on level) may be required based on the Engineer's review. Subject to approval by the Engineer, emergency storage or standby power may be required. ***(REVISED MAY 2020)***

.17 <u>Piping Details:</u> ***(REVISED MAY 2020)***

(a) Piping design criteria for the inside of the pump chamber is as follows: **(REVISED MAY 2020)**

(i) Pump chamber piping will be designed to accommodate easy pump removal and replacement. Unless an approved equivalent system is provided, pump chambers 1050 mm in diameter or greater, or with a depth of 1.8 m or greater, are to include a pump liftout coupling and slide rail system. ***(REVISED MAY 2020)***

(ii) Pump discharge piping is to include full ported check valve and ball valve. Where a slide rail system is not provided, a union is to be installed before the two valves, with the union, a check valve, and ball valve installed in that sequence in the direction of flow. ***(REVISED MAY 2020)***

(iii) An anti-siphon valve is required where a pump is located higher than any part of the low pressure system. ***(REVISED MAY 2020)***

.18 Pump Chamber Ventilation: ***(REVISED MAY 2020)***

(a) Each pump chamber is to include a vent pipe meeting the requirements of the BC Plumbing Code, and installed in accordance with the BC Plumbing Code. ***(REVISED MAY 2020)***

(b) Unless otherwise approved by the Engineer or Plumbing Inspector, the vent discharge is to be installed with a minimum of 450 mm cover below ground level, at a positive slope draining towards the pump chamber, to the building wall. At the building exterior, the vent should extend at least 1.8 m above ground, anchored to the building, and not within 3.0 m of doors or windows. ***(REVISED MAY 2020)***

(c) If approved by the Engineer or Plumbing Inspector, the vent discharge may be located either on the building exterior wall or attached to a post in a secure location if the pump chamber is remote from the building. ***(REVISED MAY 2020)***

.19 Electrical: ***(REVISED MAY 2020)***

(a) All materials and installation are to comply with the BC Electrical Code and City requirements. ***(REVISED MAY 2020)***

(b) Power supply will be from the building served by the pump unit. The following nominal service voltages will be acceptable:

(i) For residential installation: 120/208 V or 120/240 V, single-phase, and ***(REVISED MAY 2020)***

(ii) For industrial/commercial installations: as above, or 120/208 V, or 347/600 V, thee-phase. ***(REVISED MAY 2020)***

(c) Wiring from the building to the pump chamber will be underground and continuous, with no splices, whereby the installed length of wiring (horizontal plus vertical grade difference) between the control cabinet pump shall be less than the minimum whip length required for the pump. ***(REVISED MAY 2020)***

(d) Where a building electrical system includes emergency standby power, the pump unit power supply shall be connected to the emergency power. ***(REVISED MAY 2020)***

.20 Pump Chamber Classification: ***(REVISED MAY 2020)***

(a) Pump chambers for single-family and duplex residential service are not considered to be "hazardous locations" for electrical code purposes. ***(REVISED MAY 2020)***

(b) Pump chambers for multi-family and non-residential service are considered as Hazardous, Class 1 locations. Material and installation requirements for these locations are further classified as either Zone 1 or Zone 2, depending upon the standard of ventilation, as follows: ***(REVISED MAY 2020)***

(i) Zone 1: No mechanical (forced air) ventilation: ***(REVISED MAY 2020)***

- Motors must be "explosion-proof"; ***(REVISED MAY 2020)***

- Motors must have over-temperature protection, and ***(REVISED MAY 2020)***
- Float switches must have "intrinsic safe barriers". ***(REVISED MAY 2020)***

(ii) Zone 2: "Adequate" (forced air) ventilation: ***(REVISED MAY 2020)***

- 3 – phase submersible motors must remain fully submerged; ***(REVISED MAY 2020)***
- Single-phase submersible motors must remain fully submerged if they have no spark-producing devices. If they have spark-producing devices, these motors must be "explosion-proof", and ***(REVISED MAY 2020)***
- Float switches must have "intrinsic safe barriers". ***(REVISED MAY 2020)***

.21 <u>Controls:</u> ***(REVISED MAY 2020)***

(a) Pump controls will automatically start and stop the pump(s) and provide a high-level alarm. ***(REVISED MAY 2020)***
(b) Level switches will be either pressure switches, if approved by the Engineer, or float switches. ***(REVISED MAY 2020)***
(c) Power and control wiring will be continuous from the pump unit and level switches to junction boxes located above grade on the exterior of the building. Where the pump chamber is classified as hazardous, a conduit seal will be provided between the junction box and the control cabinet. ***(REVISED MAY 2020)***
(d) Subject to approval by the Engineer, or Building Inspector, the control cabinet will be installed in one of the following locations: ***(REVISED MAY 2020)***

(i) On an exterior building wall closest to the pump chamber; ***(REVISED MAY 2020)***
(ii) Inside The building near an outside door which is close to the pump chamber; or ***(REVISED MAY 2020)***
(iii) On a post adjacent to the pump chamber if the chamber is located 25 m or more away from the building. ***(REVISED MAY 2020)***

(e) If located outdoors, the control cabinet will be lockable and weatherproof (EEMAC Type 3) and made from non-corrosive materials. Junction boxes will be non-corrosive Type 4x, or NEMA 4 painted steel enclosure. ***(REVISED MAY 2020)***

(f) The control panel shall include the following features: ***(REVISED MAY 2020)***

(i) Control voltage limited to maximum 120 VAC; ***(REVISED MAY 2020)***
(ii) "Power on" light; ***(REVISED MAY 2020)***
(iii) Float switch indication lights; ***(REVISED MAY 2020)***
(iv) Green "pump on" light; ***(REVISED MAY 2020)***
(v) Red "motor overload" light; ***(REVISED MAY 2020)***
(vi) Manual reset of fault conditions; ***(REVISED MAY 2020)***
(vii) High level alarm light ("red" and buzzer); ***(REVISED MAY 2020)***
(viii) Pump disconnect switch; ***(REVISED MAY 2020)***
(ix) Motor starter; ***(REVISED MAY 2020)***
(x) Hand-Off-Auto (HOA) selector switch; ***(REVISED MAY 2020)***

(xi) Control transformer, if required to suit voltage; ***(REVISED MAY 2020)***
(xii) Automatic alternator for multiple pump units; ***(REVISED MAY 2020)***
(xiii) Control fuse; ***(REVISED MAY 2020)***
(xiv) Terminal strip, and; ***(REVISED MAY 2020)***
(xv) Form "C" (SPD) alarm contact, rated minimum 3A, 120 VAC, wired to a set of isolated Terminal blocks. ***(REVISED MAY 2020)***

(g) The alarm circuit will include an alarm light and signal/buzzer with a test/silence switch. If the control cabinet is mounted outside, the alarm light will be located outside and the alarm signal will be transmitted to an alarm box installed inside the building. ***(REVISED MAY 2020)***
(h) In non-residential and multi-family installations, a remote alarm using telephone auto-dialer or other suitable technology should be considered. ***(REVISED MAY 2020)***

6.07 <u>SIPHONS</u>

.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 0.9 m/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 1200 mm 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 200 mm 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 4.0 –Excavation, Trenching and Backfill for related specifications. ***(REVISED MAY 2020)***

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 70 kPa 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 a maximum amount recommended by the manufacturer. 35 kPa 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 1.2 m shall be loaded no more than the amount computed for a 1.2 m length. While under this load, stressed joints shall show no leakage under 35 kPa 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 600 mm 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 600 mm 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 675 mm diameter shall be DR35. Pipe and fittings shall have a minimum pipe stiffness of 320 kPa at 5.0% deflection when tested in accordance with ASTM D2412.
(b) Pipe and fittings shall be manufactured to the following specifications:

100 mm – 375 mm dia. to ASTM D3034 and CSA B182.2
450 mm – 675 mm 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 100 mm 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 100 mm diameter shall be as specified for PVC (smooth profile) mainline pipe.

.6 High Density Polyethylene (HDPE) Pipe (Smooth Profile):

(a) Pipe shall conform to AWWA C906. All pipes to be certified by Canadian Standards Association – CSA B137.1. ***(REVISED MAY 2020)***
(b) Minimum acceptance pipe class shall be DR26 with hydrostatic design stress of 10 MPa.
(c) All pipe shall bear the pipe series and manufacturer's name.
(d) Fabricated HDPE mitred fittings shall conform to AWWA C906 and certified by Canadian Standards Association – CSA B137.1. Moulded HDPE fittings shall conform to ASTM D3261 suitable for pressure rating specified and fusion to main pipe. 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. ***(REVISED MAY 2020)***

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 and certified to the following specifications: ***(REVISED MAY 2020)***

100 mm – 900 mm dia. to AWWA C900 and CSA B137.3 ***(REVISED MAY 2020)***

(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 D3139 with single elastomeric gasket conforming to ASTM F477.
(e) All PVC sanitary force main pipe shall be white in colour.

.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.

6.22B LOW PRESSURE SEWERS *(REVISED MAY 2020)*

.1 Low pressure sewers are to follow the specifications identified for force mains as per Section 6.22A – Force Mains. ***(REVISED MAY 2020)***

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 full face neoprene gasket bonded to one of the flange faces. Neoprene for flange gaskets shall be 3 mm thick with holes drilled for flange bolts and size equal to flange diameter. ***(REVISED MAY 2020)***
(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 CONNECTION JUNCTIONS ***(REVISED MAY 2020)***

.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 shall be at 45° to the centreline of the mainline pipe for pipe diameter less than 1050 mm (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 1050 mm or larger (at 3 o'clock and 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.
(c) For connections more than two pipe sizes smaller than the mainline, prefabricated service saddle connections may be approved. ***(REVISED MAY 2020)***

.3 PVC Pipe (Ribbed Profile):

(a) Ribbed pipe shall only be used if repairing an existing ribbed pipe section.
(b) Service connections to ribbed PVC mainline pipe shall be made with extrusion molded or fabricated PVC fittings manufactured to ASTM D3034, CSA B182.1 and CSA B182.2. ***(REVISED MAY 2020)***
(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 C478. ***(REVISED MAY 2020)***

.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 H-20 loading conditions. Precast tops shall conform to ASTM C478 with approved offset opening for frame and cover. ***(REVISED MAY 2020)***

6.27 MANHOLE COVERS AND FRAMES

.1 Covers and frames shall be cast iron and certified to meet H-20 loading requirements with the bearing faces of the cover to be frame machined for a non-rocking fit. ***(REVISED MAY 2020)***

.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:
19 mm diameter aluminum allow conforming to CSA S157.

.2 Refer to Section 6.54 for manhole steps installation.

6.29 -NOT USED-

6.30 CONCRETE

.1 Concrete for cast in place manhole bases shall conform to Section 11.0 – Cast In Place Concrete Works. ***(REVISED MAY 2020)***

6.31 PRECAST CONCRETE GRADE RING

.1 Precast concrete grade rings conforming to ASTM C478 shall be used.

.2 For roads with steep grades, concrete grade rings are to be used in conjunction with an adjustable manhole frame assembly. ***(REVISED MAY 2020)***

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.

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 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 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 500 mm 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 750 mm concrete boxes complete with steel traffic cover marked “Sewer” and concrete extension sections as required.

6.37 <u>PUMPING STATIONS</u>

.1 The specifications shall be determined on a site specific basis at the discretion of the City Engineer.

6.40 TRENCH EXCAVATION, BEDDING AND BACKFILL

.1 Refer to Section 4.0 –Excavation, Trenching and Backfill for installation requirements. ***(REVISED MAY 2020)***

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 check for line and grade as it is installed.

.2 Unless otherwise direct for the Engineer, tolerances for pipe alignment and grade shall be:

Alignment	=	± 50 mm
Grade	=	± 10 mm

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 though soil displacement or floatation doe 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.

6.42B LOW PRESSURE SEWERS INSTALLATION ***(REVISED MAY 2020)***

.1 Low pressure sewers shall be installed according to requirements in Section 6.42 – Pipe Installation. ***(REVISED MAY 2020)***

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 couplings. ***(REVISED MAY 2020)***

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. For acceptable curvature, refer to Section 6.04.2. Horizontal and vertical curves are only permitted where approved by the City Engineer. ***(REVISED MAY 2020)***

6.45 DEFLECTION

.1 The amount of pipe deflection at joints and couplings shall be the limit as specified in Section 6.04.2. ***(REVISED MAY 2020)***

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 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 coupling designed for the types of pipes to be connected. ***(REVISED MAY 2020)***

.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 with stainless steel anti shear band encased in concrete. Only those products approved by the City Engineer will be accepted for installation. ***(REVISED MAY 2020)***

.5 Slip coupler 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 end stub pipe with integral bell.
(ii) Break into the pipe by coring to within 40 mm of 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 manufacturer's specifications.

(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

.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 4.0 –Excavation, Trenching and Backfill. ***(REVISED MAY 2020)***

.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 4.0 –Excavation, Trenching and Backfill. ***(REVISED MAY 2020)***

.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 150 mm 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 No. S-1 or as shown on the construction drawings. Channeling shall be constructed to have a minimum 0.3 m straight section before the change in direction within the manhole.

.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.

.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.

.10 Benching in manholes shall be sloped to drain. While the concrete cures, the concrete benching shall be given at broom finish to produce a non-skid surface. ***(REVISED MAY 2020)***

6.49A <u>PRECAST MANHOLE BASES</u>

.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 150 mm thick base of 38 mm drainrock.

.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-

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 Cast In Place concrete work shall conform to Section 11.0 – Cast In Place Concrete Works. ***(REVISED MAY 2020)***

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 50 mm thick and to a maximum of 100 mm 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.

(a) Fine grade elevation adjustments of frames shall be done with adjustable height manhole frame, or a minimum of 3 steel shims equally spaced. ***(REVISED MAY 2020)***

.2 Manhole covers shall be installed:

(a) for unpaved areas, covers shall have a 1.5 m x 1.5 m, 50 mm 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 6 mm when measured with a 3 m straight edge in any direction. ***(REVISED MAY 2020)***

.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 WorkSafeBC requirements.

.3 All steps shall be complete with approved polyethylene anchor insulating sleeves and installed in 25 mm to 26 mm 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.

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-

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 MAY 2020)***

6.59 SERVICE CONNECTIONS 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 2 m, the service shall be extended into the property the same distance as the depth of the service, up to a maximum distance of 4 m. 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 <u>Grade and Alignment of Service Connections:</u>

(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.

.3 <u>Sanitary Sewer Service Connection Installation:</u>

(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 4.0 –Excavation, Trenching and Backfill. ***(REVISED MAY 2020)***

(d) The trench shall be excavated to provide a minimum cover of 0.75 m over the service connection pipe at property line.

(e) In rock, the trench is to be extended 3 m 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 38 mm x 89 mm 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 600 mm above ground to the cap 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 MAY 2020)***

(j) Inspection assemblies shall be installed as shown on the Standard Drawings.

(k) The service box shall be installed plumb with the lid 25 mm above finished grade in unpaved areas, and 0 – 6 mm 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.

6.60 CLEANING AND FLUSHING

.1 The pipes shall be cleaned upon completion of the sewer pipe installation and within one month prior to the end of the maintenance period to the satisfaction of the Engineer and the City of Nanaimo Inspector. Cleaning shall be completed by power flushing with water to remove all foreign matter. ***(REVISED MAY 2020)***

.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 Inspector, or by the City of Nanaimo CCTV contract administrator. ***(REVISED MAY 2020)***

.4 Manholes shall be cleaned after the upstream section of pipe has been successfully cleaned and approved by the Engineer, the City of Nanaimo Inspector or by the City of Nanaimo CCTV contract administrator. ***(REVISED MAY 2020)***

.5 Pipes shall be cleaned in the direction of the flow and shall not be flushed in a backflush direction unless approved by the City Engineer, by the City of Nanaimo Inspector or by the City of Nanaimo CCTV contract administrator. ***(REVISED MAY 2020)***

.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 hours unless approved by the City Engineer.

6.61 NOTIFICATION TO CITY OF NANAIMO

.1 The City of Nanaimo shall be given 48 hours' notice of all tests. ***(REVISED MAY 2020)***

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 of 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, including hydro/tel/cable. ***(REVISED MAY 2020)***

(d) Copies of all test results must be forwarded to the City of Nanaimo Inspector. ***(REVISED MAY 2020)***

.3 Testing Equipment:

(a) The Contractor shall furnish all 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 WorkSafeBC 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 to the greater of, the maximum hydraulic grade line of the pipe, or such that a minimum hydrostatic head of 600 mm is placed on the pipe at its upper extremity. The head of the 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 600 mm 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 3 m 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. ***(REVISED MAY 2020)***

(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 evidences 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 used 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 the 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 or 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 28 kPa 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 1.0 kPa for each 100 mm of groundwater above the invert.

(d) The air supply is throttled to maintain the internal pressure above 20 kPa for a minimum of 5 minutes to stabilize the temperature in the pipe. After stabilization, the air pressure is adjusted to 24.0 kPa and the air supply shut off or disconnected. Timing commences and the time required for the line pressure to drop to 20.5 kPa is noted.

(e) If the time required to drop from 24.0 to 20.5 kPa 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:

Time Requirements for Air Testing

(Millimetres)	Min	Sec.
100	2	32
150	3	50
200	5	6
250	6	22
300	7	39
375	9	35
450	11	34
525	13	30
600	15	24

(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.

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 The contractor shall arrange for a video inspection upon completion of the sewer pipe installation and within one month prior to the end of the maintenance period to the satisfaction of the Engineer and the City of Nanaimo Inspector. ***(REVISED MAY 2020)***

.3 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. Where a new sewer pipe crosses an existing sewer pipe, the contractor shall also arrange for a video inspection of the existing sewer pipe at the location of the crossing. ***(REVISED MAY 2020)***

(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 m). 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 of 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 the 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 centreline 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) 0.1 m/s for pipeline of diameter less than 200 mm.
(ii) 0.15 m/s for diameters 200 mm and larger but not exceeding 310mm: and
(iii) 0.20 m/s for diameters exceeding 310 mm.

.4 The inspection shall include the preparation of:

(a) an HDSD 32 GB Class 10 regular card. Picture size: NTSC ***(REVISED MAY 2020)*** 640x480 pixels, aspect ratio 4:3, 29.97 frames per second @ 8 megabits per second capture rate. Individual MPEG4 video files shall not exceed 1.7 GB in size. ***(REVISED MAY 2020)***
(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.

.5 The Engineer shall review the 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. ***(REVISED MAY 2020)***

.6 The pipe condition report and certification shall become the property of the City of Nanaimo. ***(REVISED MAY 2020)***

.7 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.

.8 During this test, manhole construction and invert elevations shall be checked and any variations from the established grade, drawings, or specifications, shall be rectified.

.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 Inspector. ***(REVISED MAY 2020)***

.2 The Engineer shall provide as-built service location information to the City of Nanaimo Inspector prior to smoke testing. ***(REVISED MAY 2020)***

.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.

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 to the construction drawings, or if available, City of Nanaimo pipe and manhole numbers. Reports shall be submitted in both digital and hardcopy formats. ***(REVISED MAY 2020)***

.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	
DEFECT CODE NO.	TYPE OF DEFECTS	POINT SCORES
1	Open Joints	1 to 2
2	Displaced Joints	1 to 2
3	Cracks	10 to 40
4	Fracture	40 to 80
5	Broken	80
6	Hole	80 to 165
7	Collapsed	165
8	Spalling	5 to 120
9	Wear	5 to 120
10	Deformation	20 to 165

Every video inspected sewer will be assigned a composite grade based on the sum of its defect point scores, as per the following table: ***(REVISED MAY 2020)***

WRc – SEWER RATING COMPOSITE GRADE *(REVISED MAY 2020)*		
COMPOSITE GRADE ***(REVISED MAY 2020)***	PEAK SCORE RANGE (SUM OF THE SCORES FROM THE ABOVE TABLE)	TYPICAL DEFECT DESCRIPTION
1 (least defective)	1 to 9	No observable structural defects
2	10 to 39	Circumferential crack. Moderate joint defects, i.e. open joint (medium) or joint displaced (medium), spalling slight and wear slight.
3	40 to 79	Fracture with deformation <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.
4	80 to 164	Broken, deformation up to 10% and broken fracture with deformation 5 - 10%. Multiple fractures. Serious loss of level. Spalling large. Wear large.
5 (most defective)	165+	Already collapsed. Deformation >10% and broken. Extensive areas of fabric missing. Fracture with deformation >10%.

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 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:

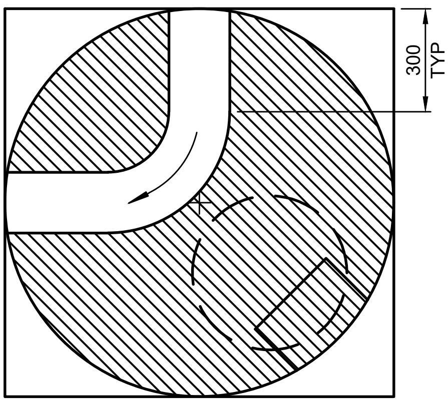
(a) Manhole and catch basin locations with labels.
(b) City of Nanaimo drawing numbers.
(c) Manhole ID numbers (as per the City of Nanaimo GIS numbering system).
(d) Catch basin ID numbers (as per the City of Nanaimo GIS numbering system).

.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.

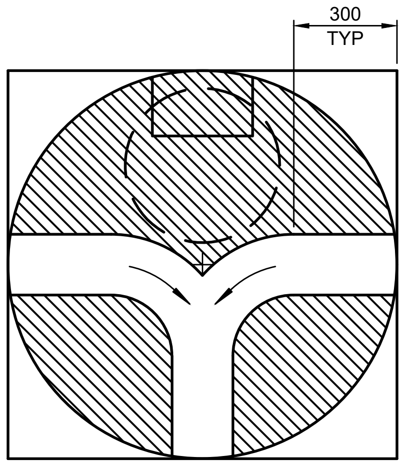
.6 All pipe video inspection operators shall be thoroughly trained with current Canadian certification by a City approved agency.

.7 Manhole video inspection is not required. Manholes shall be rate as per the following table and form part of the video inspection report.

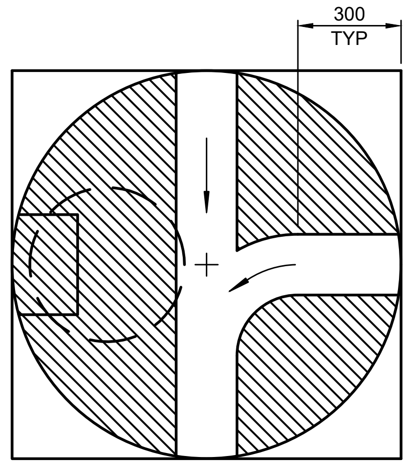
MANHOLE RATING SYSTEM	
INTERNAL CONDITION GRADE	TYPICAL DEFECT DESCRIPTION
1 (least defective)	-no observable structural defects -no observable signs on infiltration
2	-minor cracks, chips, spalling. -signs of minor staining, but no infiltration
3	-fractures, medium spalling, defective pipe/MH joints -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



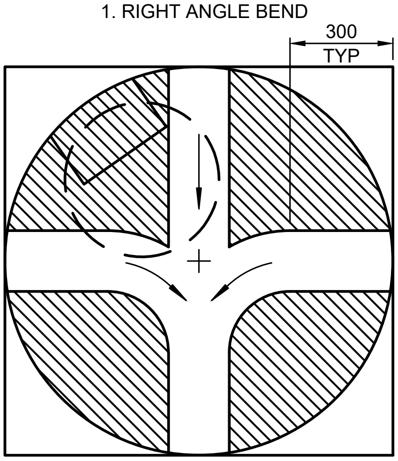
1. RIGHT ANGLE BEND



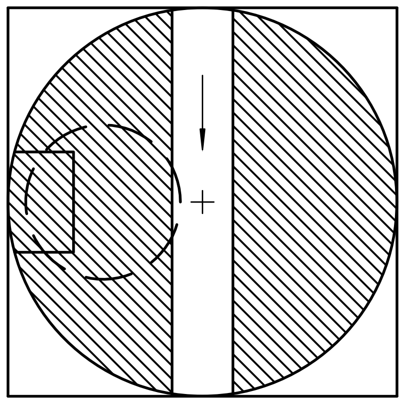
2. TEE CONNECTION



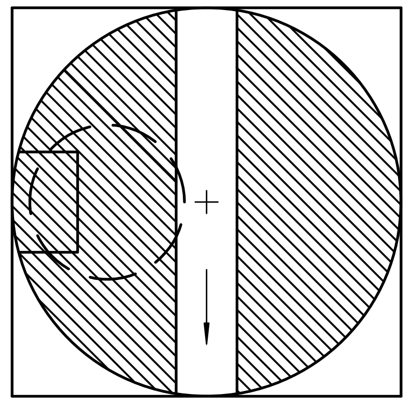
3. THREE WAY JUNCTION



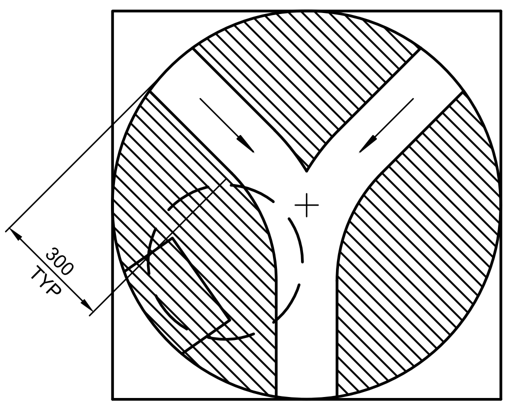
4. FOUR WAY JUNCTION



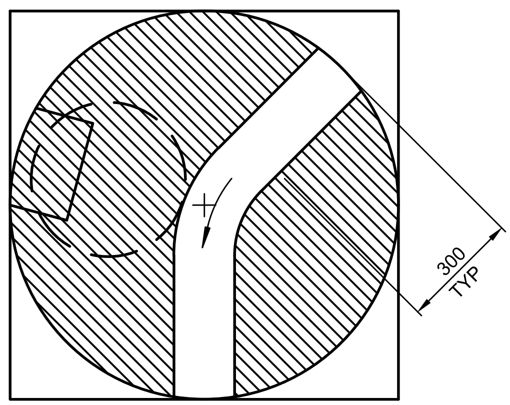
5. STRAIGHT THROUGH



6. DEAD END



7. WYE CONNECTION



8. 45° BEND

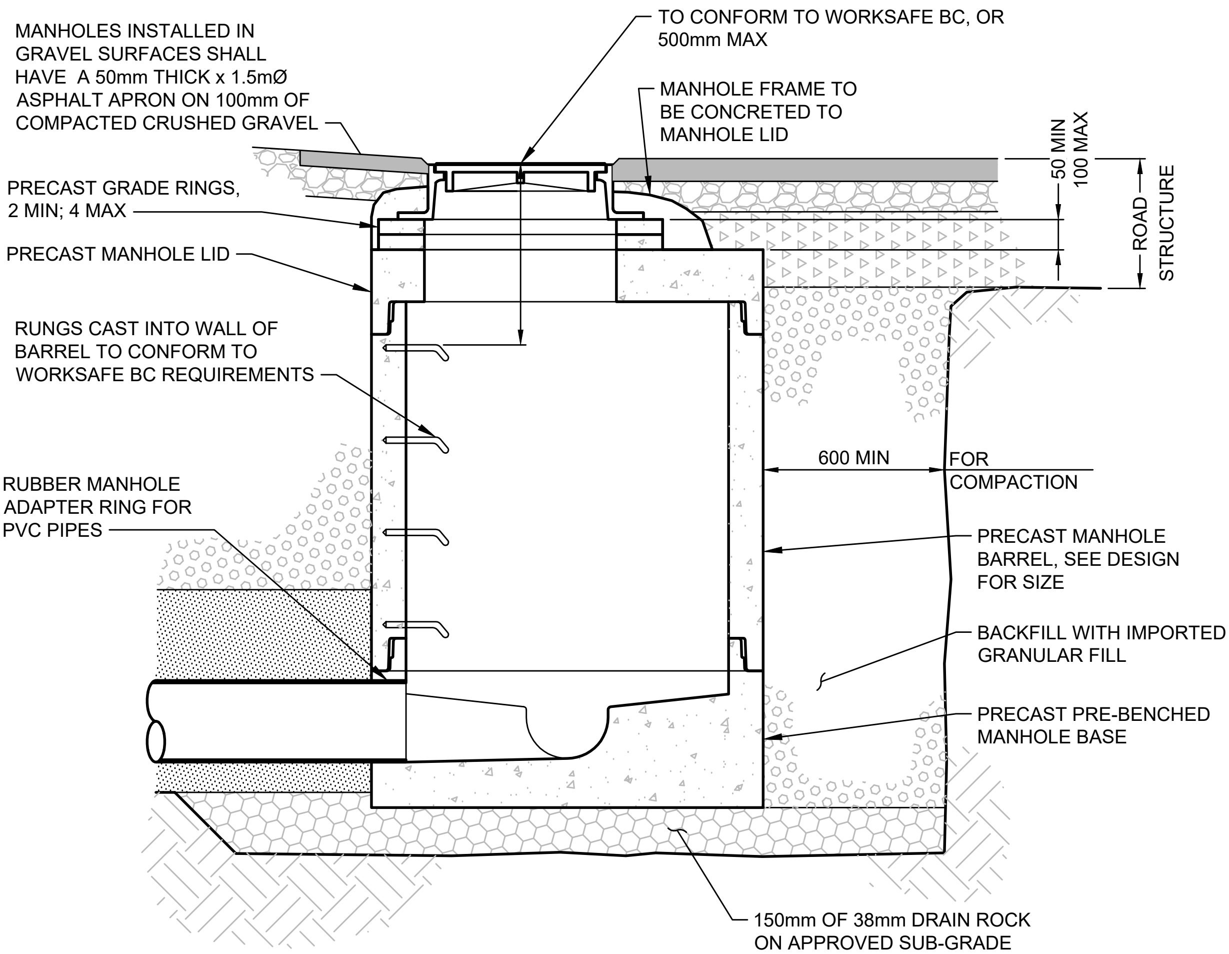
NOTES:

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.

CITY OF NANAIMO
THE HARBOUR CITY

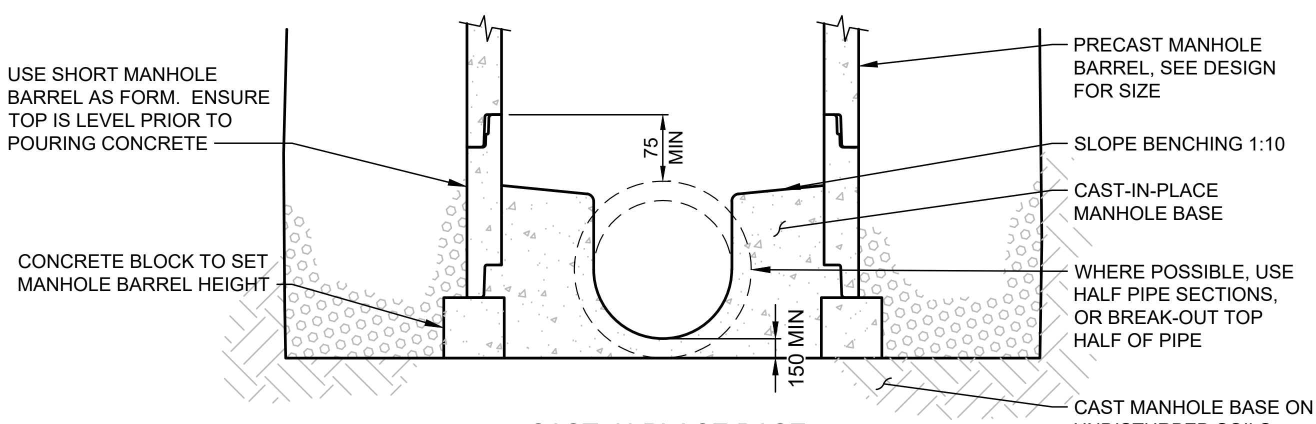
SANITARY MANHOLE BENCHING DETAILS

Scale:	NTS
Created:	MAY 2012
Rev Date:	NOV 2016
Dwg No:	S-1



TYPICAL SECTION

1:25



CAST-IN-PLACE BASE

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.
6. LOW PROFILE FRAMES NOT PERMITTED IN ROADS UNLESS APPROVED BY CITY ENGINEER.
7. CASTING TO BE SET FLUSH WITH TRAVELLED SURFACE SUCH THAT THERE ARE NO IRREGULARITIES GREATER THAN 6mm WHEN CHECKED WITH A 3m STRAIGHT EDGE IN ANY DIRECTION.

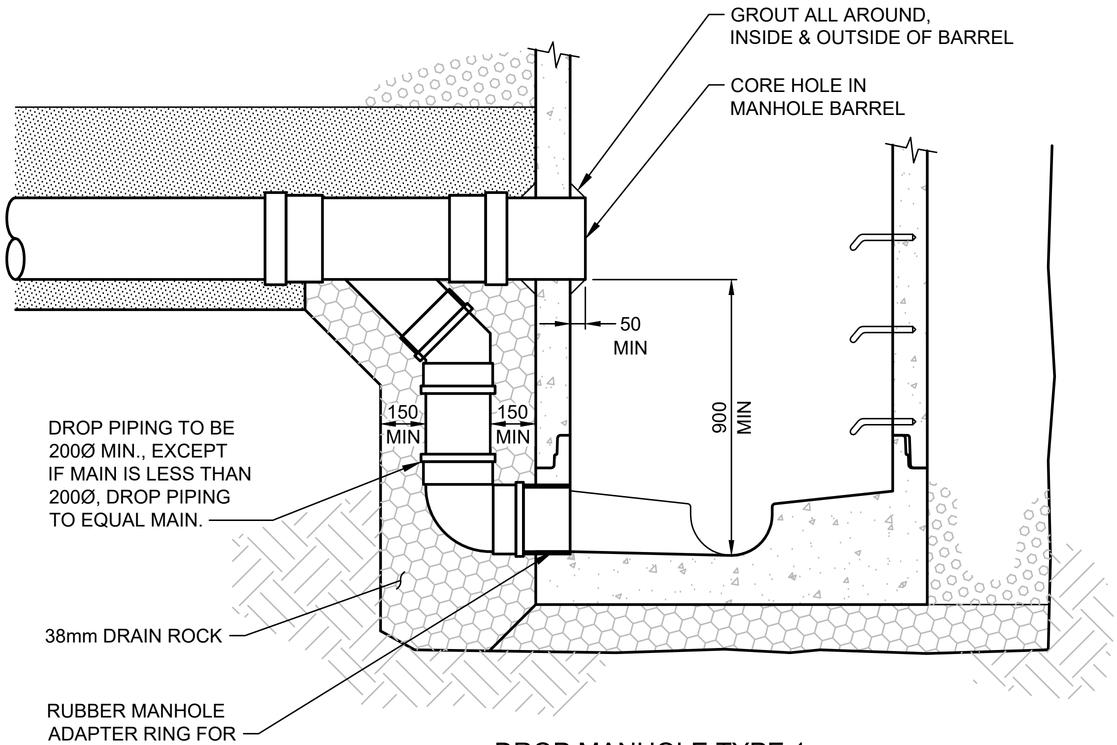
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 6 DWGS\S-2

2.28.2020

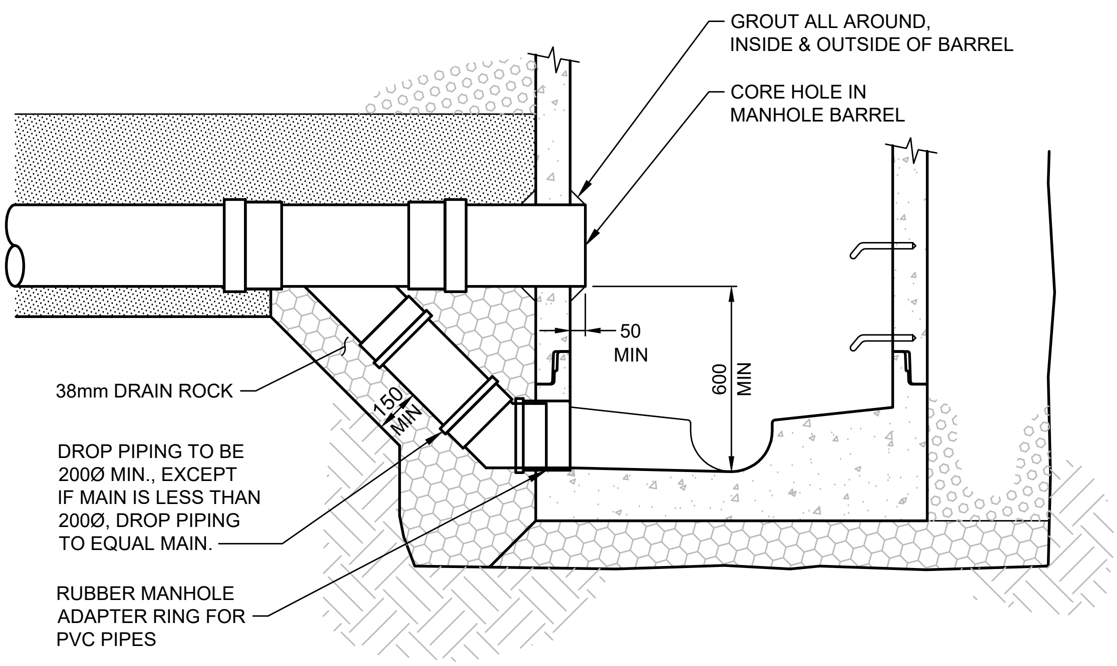
CITY OF NANAIMO
THE HARBOUR CITY

SANITARY MANHOLE

Scale:	1:25
Created:	MAR 2016
Rev Date:	MAY 2020
Dwg No:	S-2



DROP MANHOLE TYPE 1
1:25



DROP MANHOLE TYPE 2
1:25

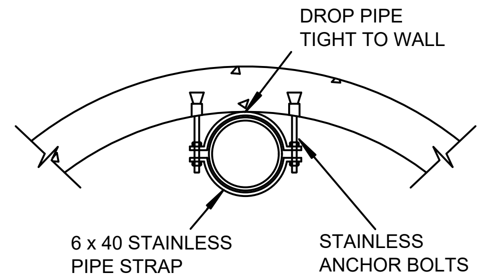
NOTES:

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.

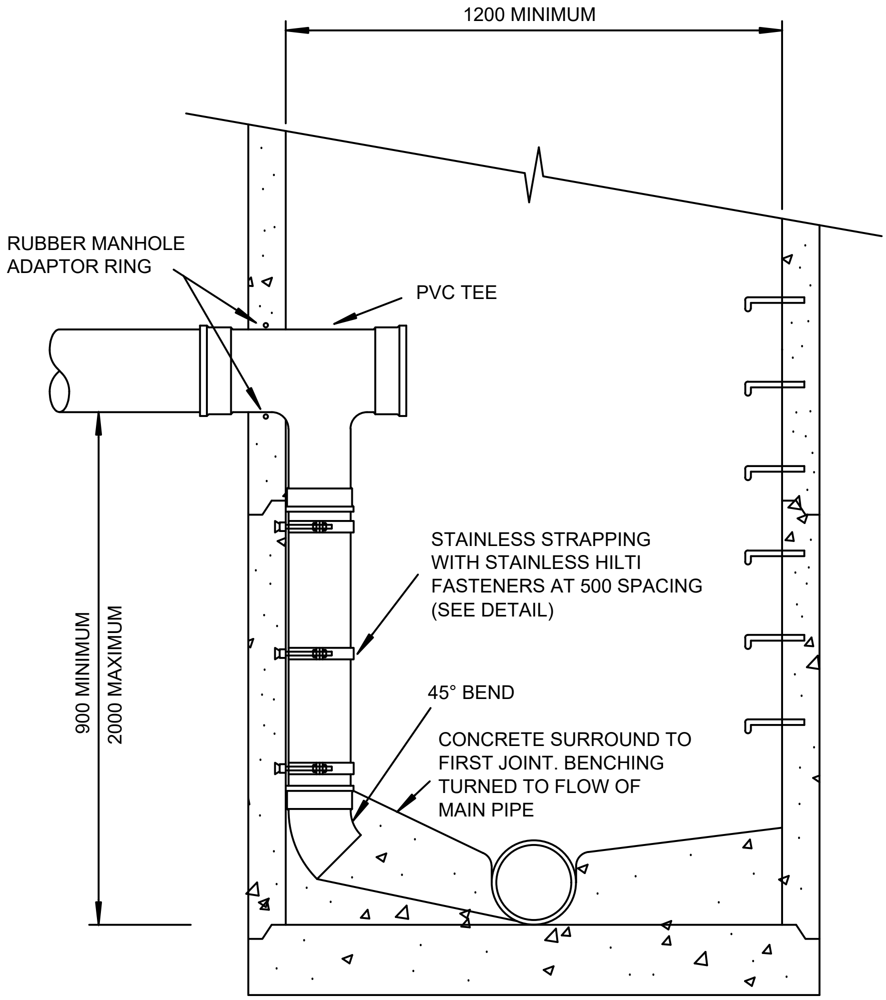
CITY OF NANAIMO
THE HARBOUR CITY

SANITARY DROP MANHOLE

Scale:	1:25
Created:	MAR 2016
Rev Date:	MAY 2020
Dwg No:	S-3



BRACKET DETAIL



DROP MANHOLE - TYPE III

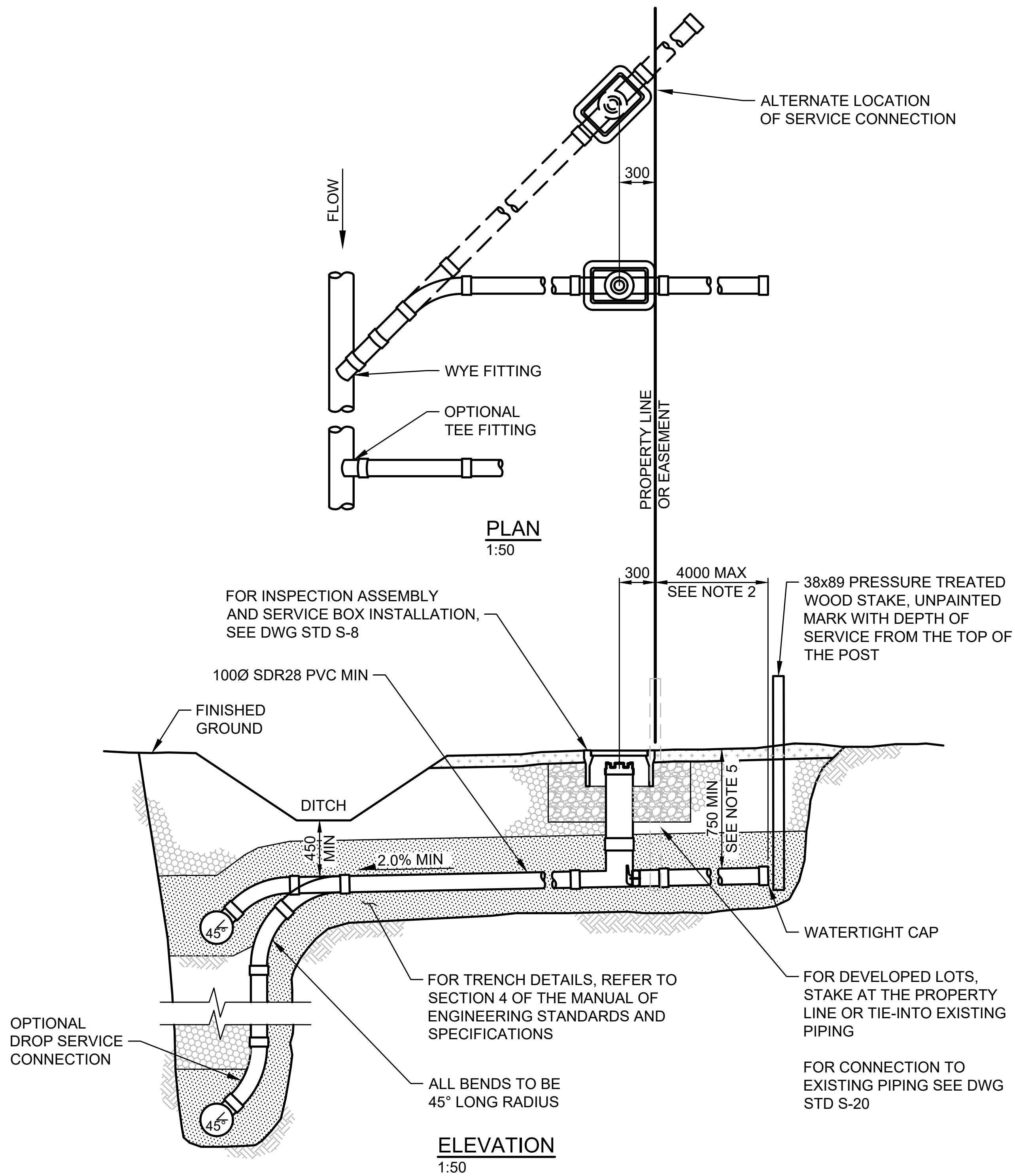
NOTES:

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.

CITY OF NANAIMO
THE HARBOUR CITY

INSIDE DROP MANHOLE
DETAIL FOR 200Ø SEWERS

Scale:	NTS
Created:	MAY 2012
Rev Date:	NOV 2016
Dwg No:	S-3A



NOTES:

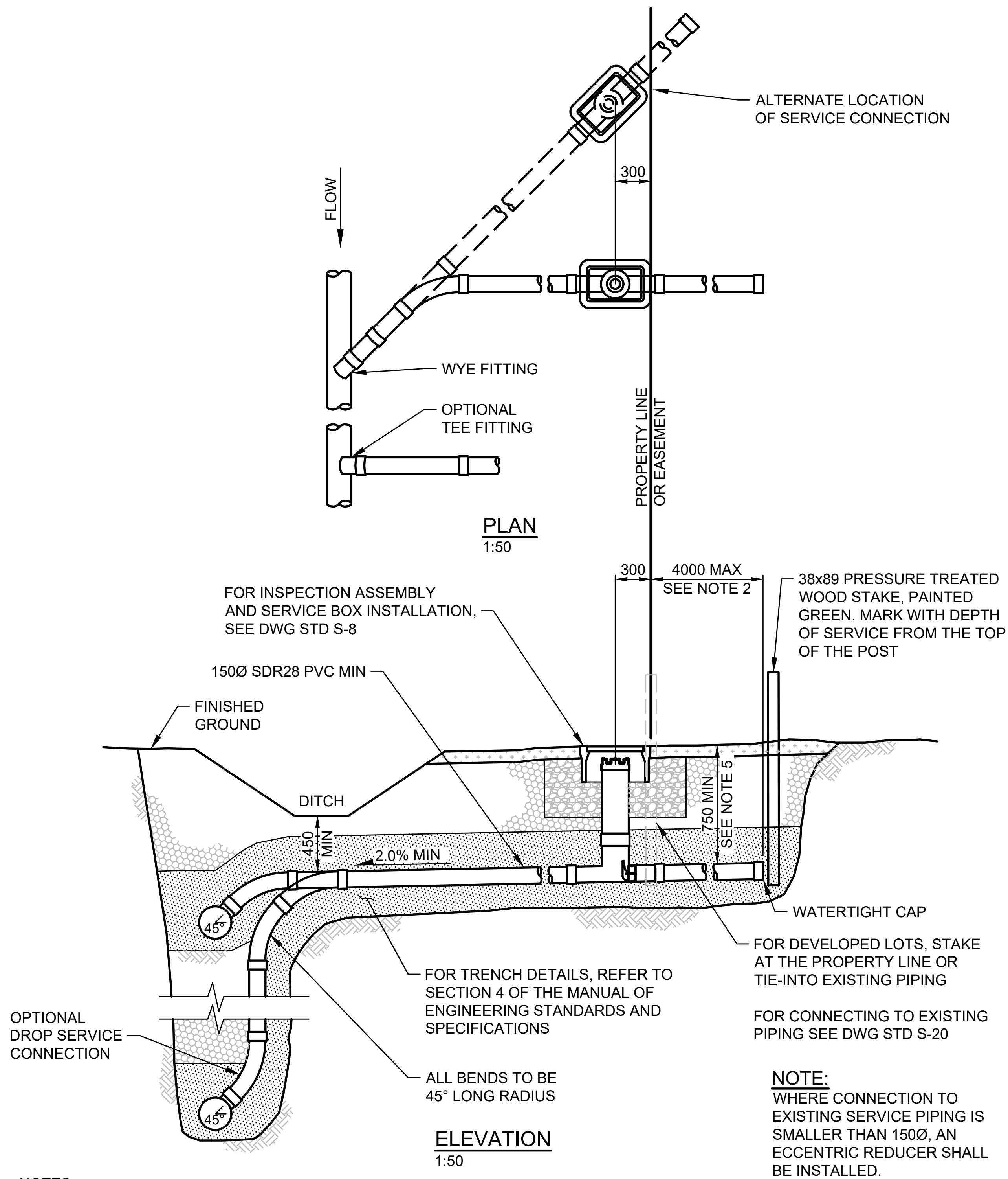
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 6.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. WHERE DEPTH OF SERVICE AT PROPERTY LINE IS GREATER THAN 2.0m, EXTEND THE SERVICE PAST THE PROPERTY LINE EQUAL TO ITS DEPTH, TO MAXIMUM OF 4.0m.
3. WHERE SERVICE IS 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.

2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

GENERAL SANITARY SERVICE CONNECTION DETAIL
RISER AND NON-RISER TYPES

Scale:	1:50
Created:	MAR 2015
Rev Date:	MAY 2020
Dwg No:	S-5



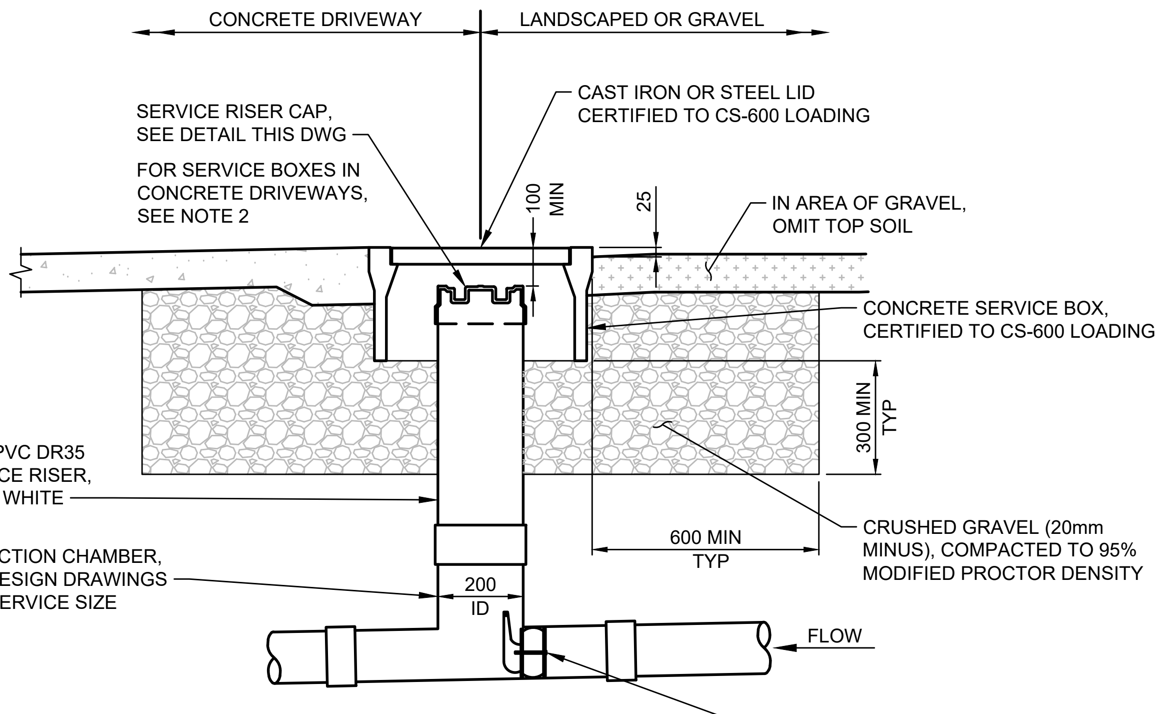
NOTES:

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.

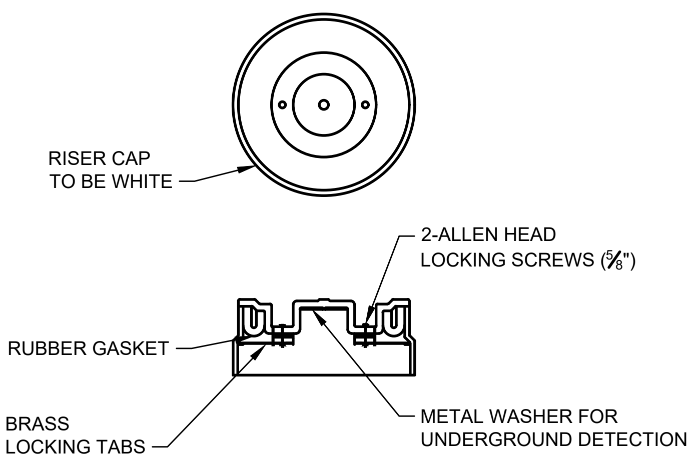
CITY OF NANAIMO
THE HARBOUR CITY

COMMERCIAL AREAS SANITARY
SERVICE CONNECTION DETAILS
RISER AND NON-RISER TYPES

Scale:	1:50
Created:	MAR 2016
Rev Date:	MAY 2020
Dwg No:	S-7



ELEVATION
1:20



RISER CAP DETAIL
NTS

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.

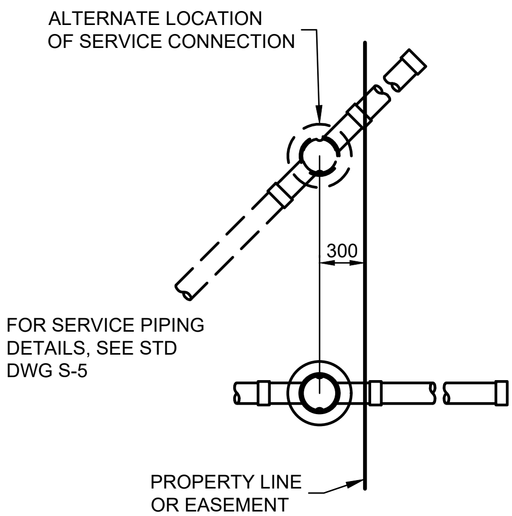
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 6 DWGS\S-8

2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

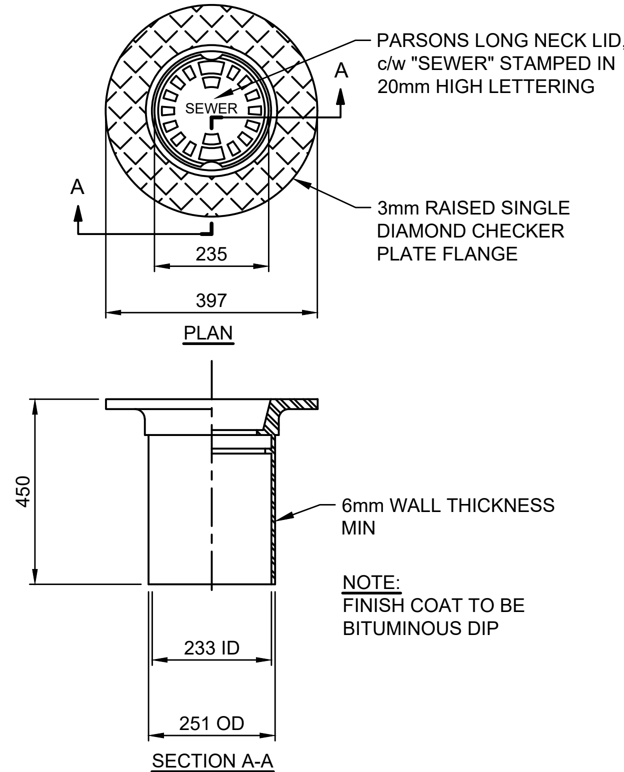
SANITARY SERVICE BOX AND
INSPECTION ASSEMBLY INSTALLATION

Scale:	1:20
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	S-8



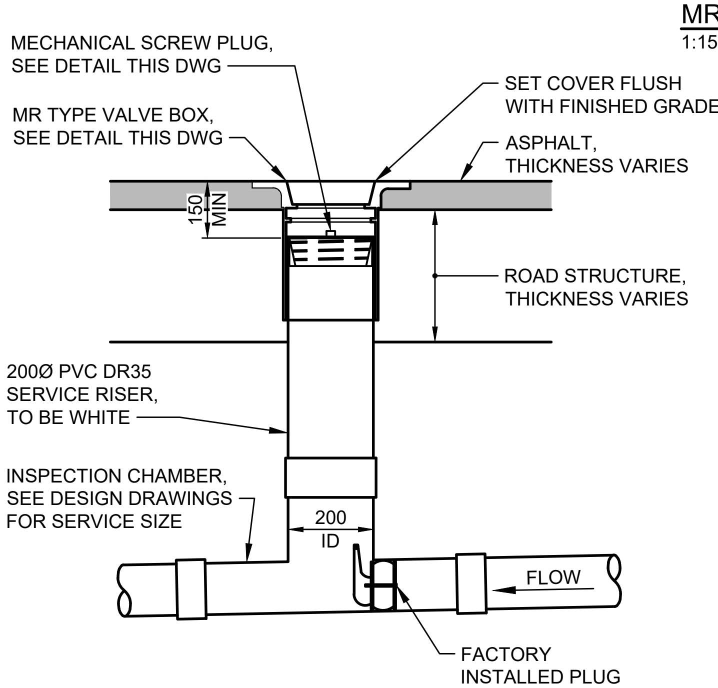
PLAN - VALVE BOX LOCATIONS

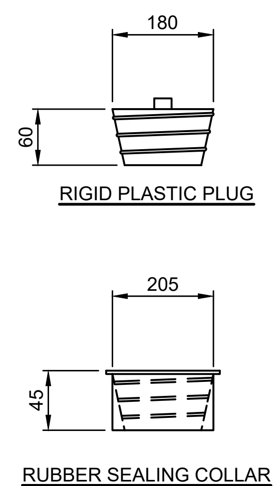
NTS



MR STYLE VALVE BOX

1:15





INSPECTION ASSEMBLY ELEVATION

1:20

MECHANICAL SCREW PLUGS

1:10

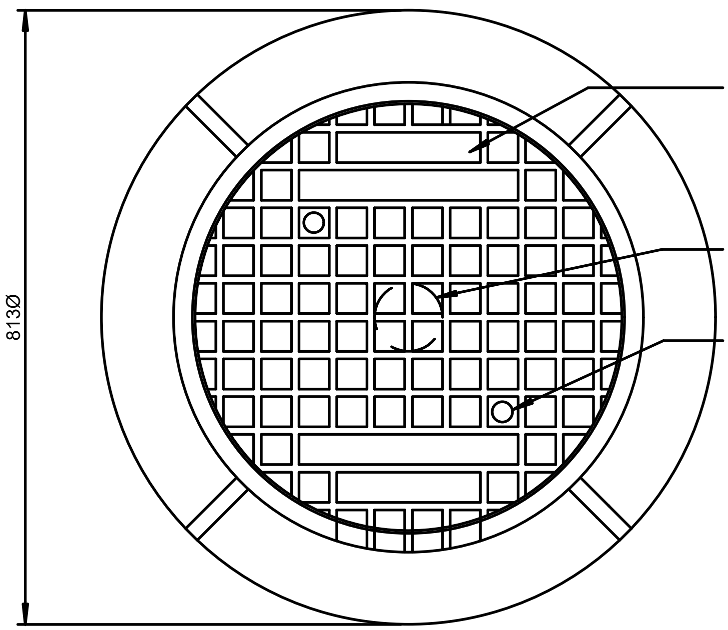
NOTES:

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.

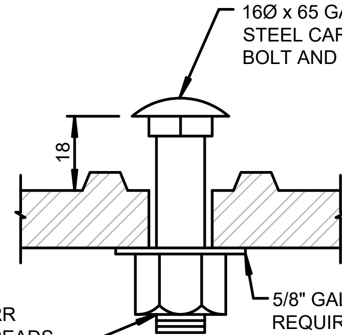
CITY OF NANAIMO
THE HARBOUR CITY

SANITARY SERVICE BOX AND INSPECTION ASSEMBLY
INSTALLATION IN PAVED LANES AND ROADWAYS

Scale:	AS NOTED
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	S-8A

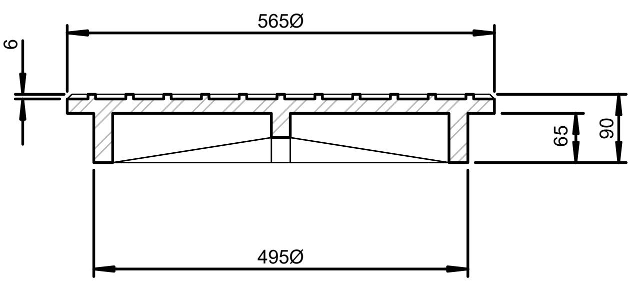


PLAN

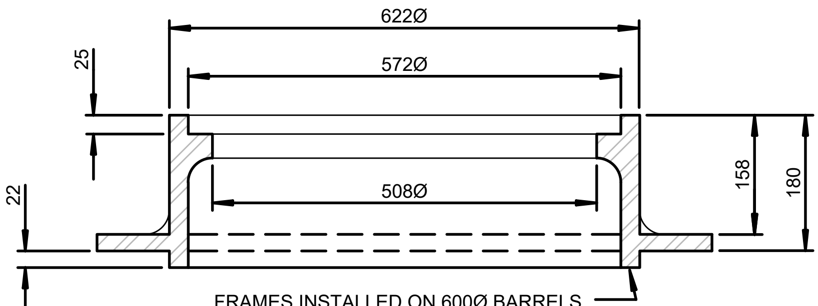


IMPORTANT:
CARRIAGE BOLT TO EXTEND
EXACTLY 18mm ABOVE CASTING.

CARRIAGE BOLT DETAIL



COVER



FRAME

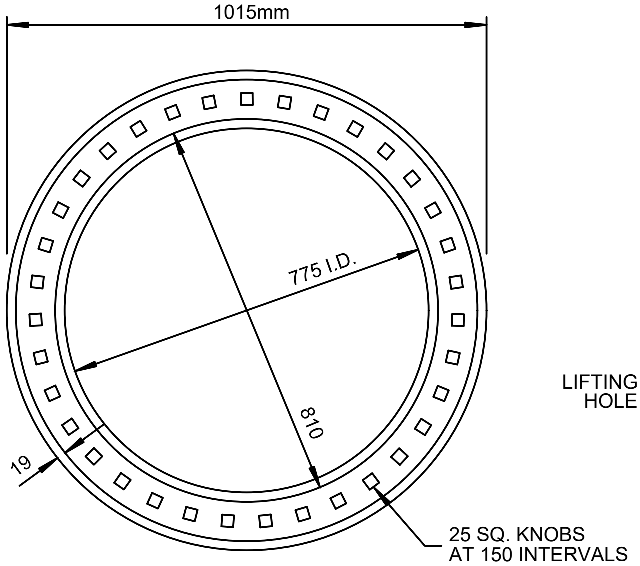
NOTES:

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.

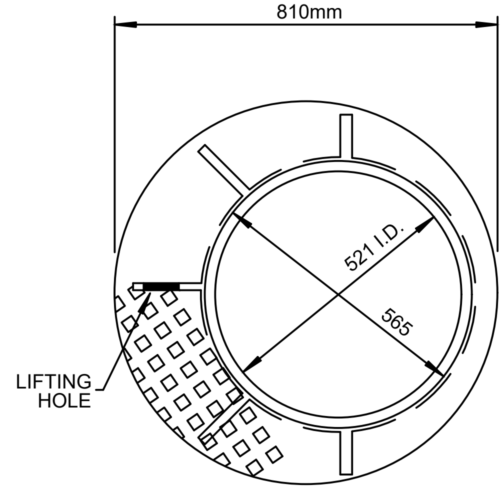
CITY OF NANAIMO
THE HARBOUR CITY

SANITARY MANHOLE
FRAME AND COVER

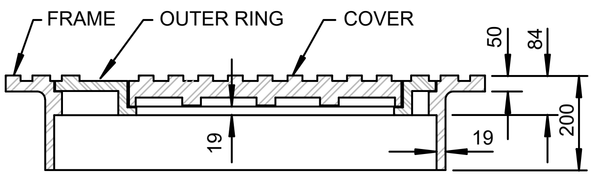
Scale:	NTS
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	S-9



PLAN OF FRAME



PLAN OF OUTER RING



SECTION OF FRAME, RING AND COVER

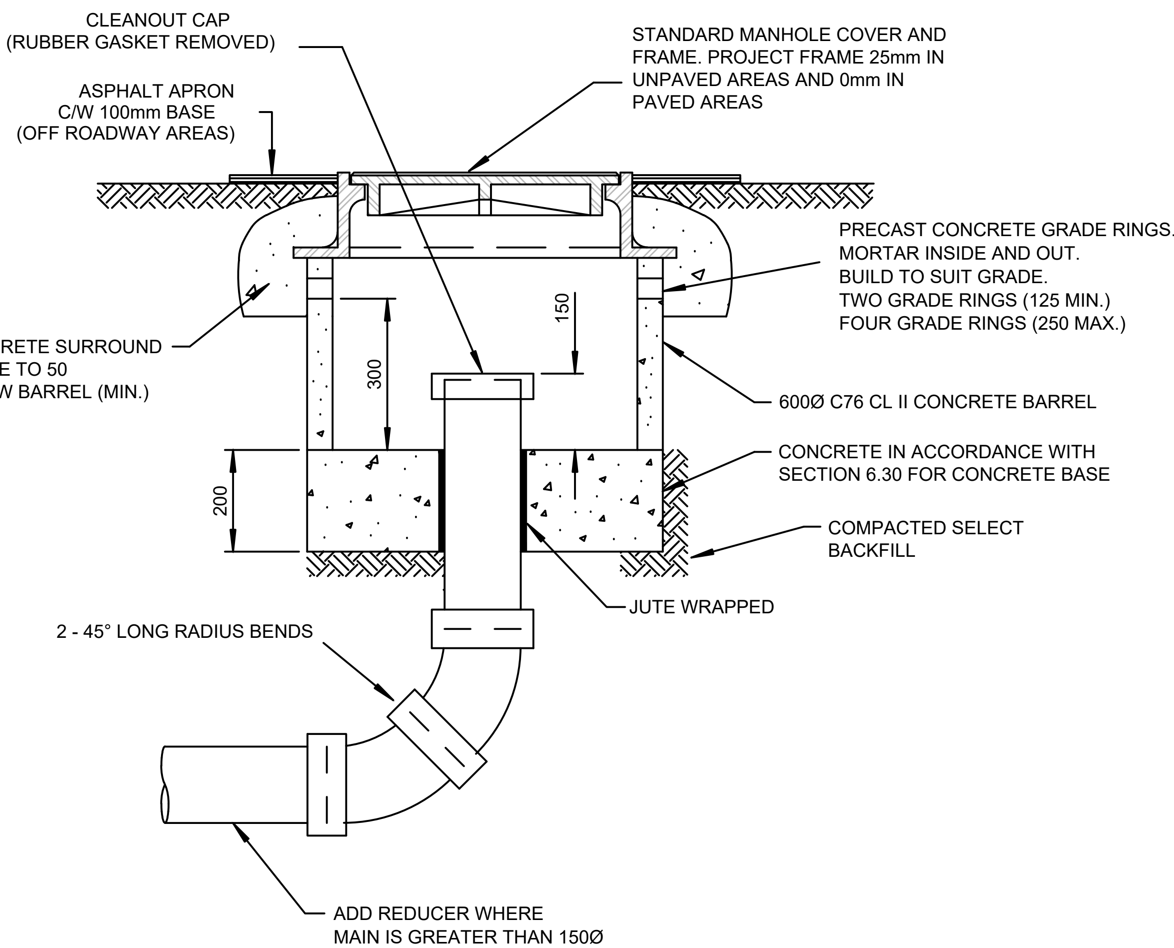
NOTES:

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.

CITY OF NANAIMO
THE HARBOUR CITY

UTILITY CHAMBER SANITARY MANHOLE
FRAME, RING AND COVER

Scale:	NTS
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	S-10



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 1.5 m X 1.5 m 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.

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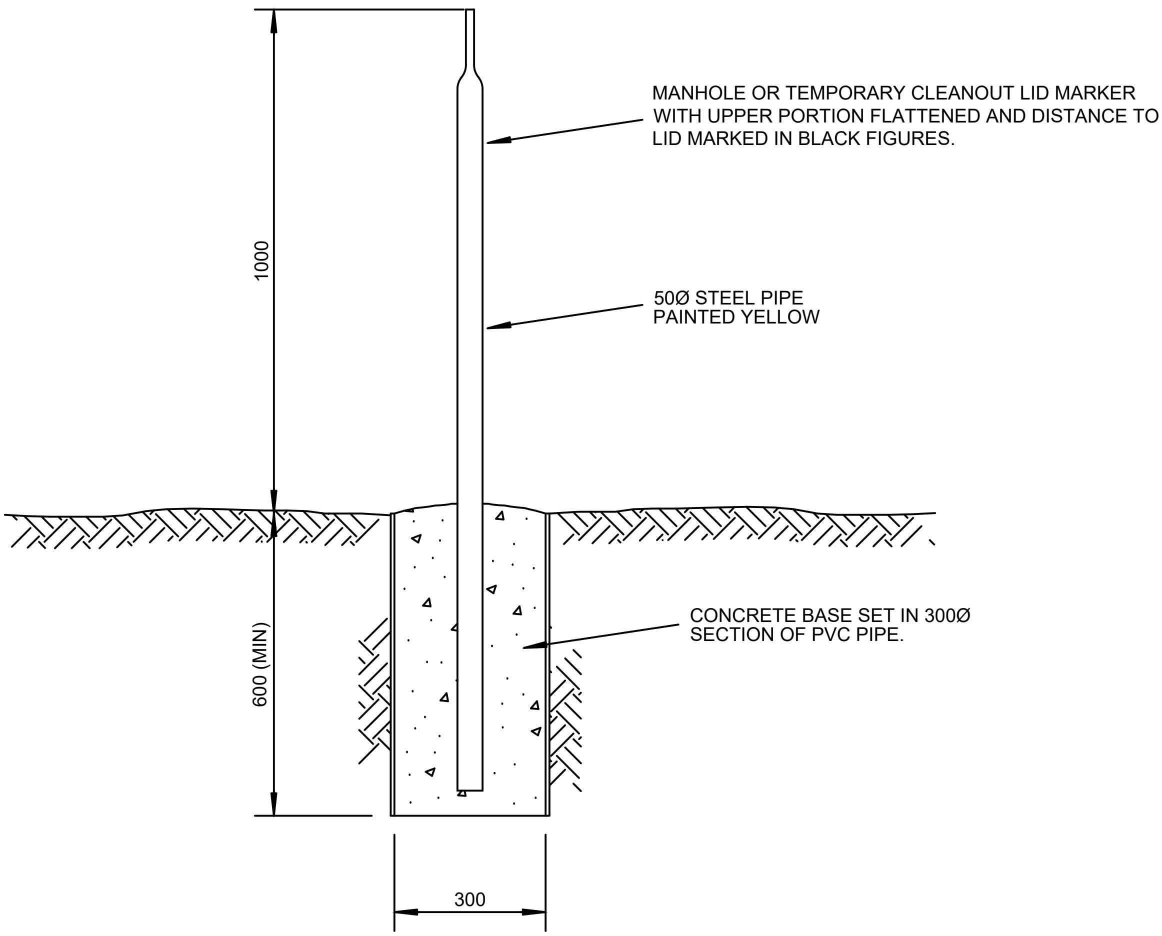
3.20.2020

CITY OF NANAIMO
THE HARBOUR CITY

TEMPORARY SANITARY CLEANOUT STRUCTURE

Scale:	NTS
Created:	JUNE 2013
Rev Date:	NOV 2016
Dwg No:	S-12



NOTES:

1. FOR USE ONLY WHERE MANHOLE OR TEMPORARY CLEANOUT LIDS ARE LOCATED OUTSIDE THE PAVED PORTION OF A STREET.
2. THE MARKER SHALL BE LOCATED ON SITE BY THE ENGINEER WITH THE FLATTENED END AND MARKED DISTANCE FACING THE LID.
3. ALL DIMENSIONS IN MILLIMETERS UNLESS SHOWN OTHERWISE.

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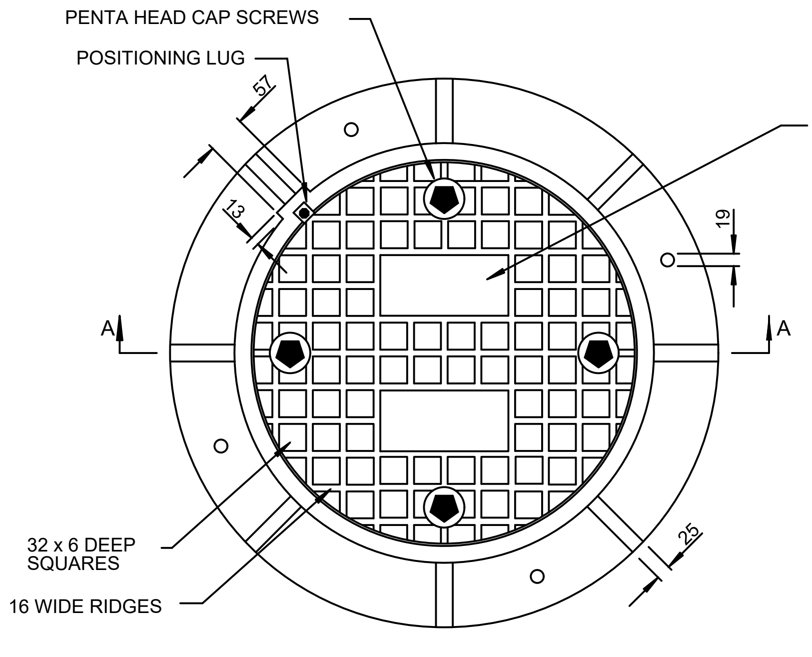
3.20.2020

CITY OF NANAIMO
THE HARBOUR CITY

SANITARY MANHOLE AND TEMPORARY CLEANOUT LID MARKER

Scale:	NTS
Created:	JUNE 2013
Rev Date:	NOV 2016
Dwg No:	S-14

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.

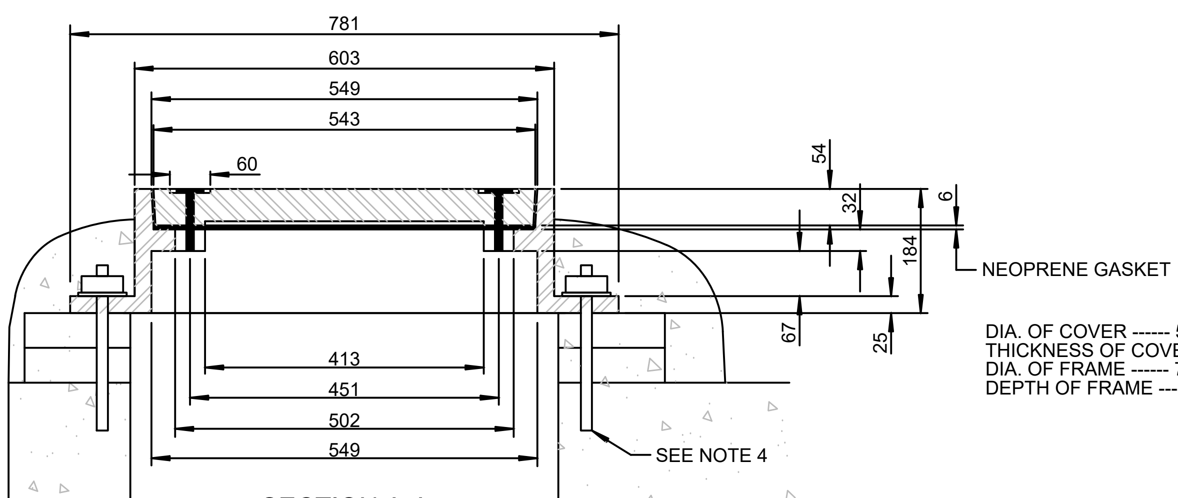


REFERRING TO "CITY OF NANAIMO SANITARY SEWER", LETTERING SHALL BE 25 FLATTENED FACE GOTHIC WITH FACE OF LETTERS RAISED TO THE SAME LEVELS AS THE TOP OF THE RIBS (IN STATUTORY RIGHTS-OF-WAY INCLUDE THE WORDING "DO NOT COVER" ON THE MANHOLE LID)

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.

PLAN



DIA. OF COVER ------ 543
THICKNESS OF COVER -- 54
DIA. OF FRAME ------ 781
DEPTH OF FRAME -----184

SECTION A-A

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.

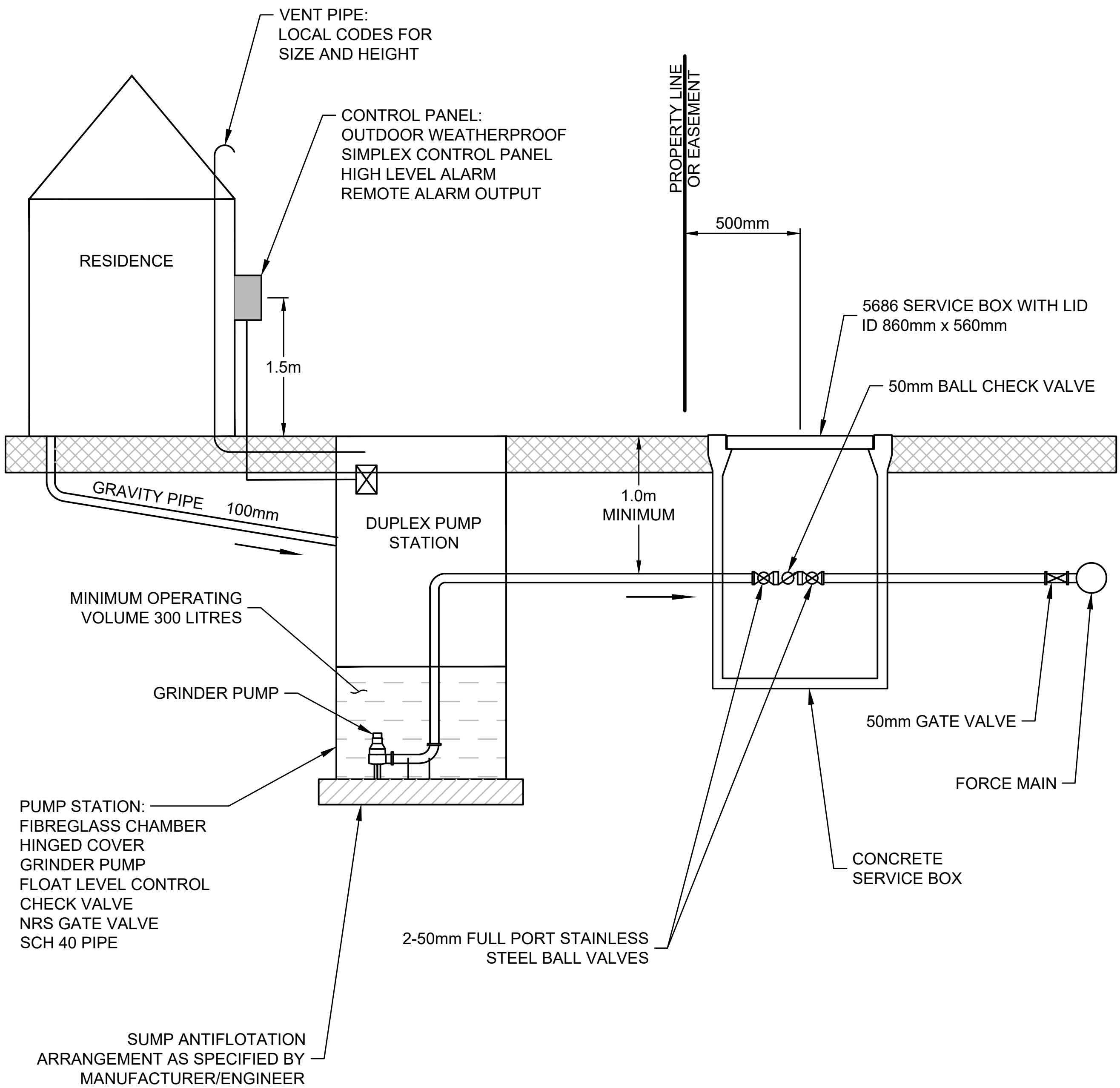
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 6 DWGS\S-15

2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

WATERTIGHT SANITARY MANHOLE FRAME AND COVER

Scale:	NTS
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	S-15



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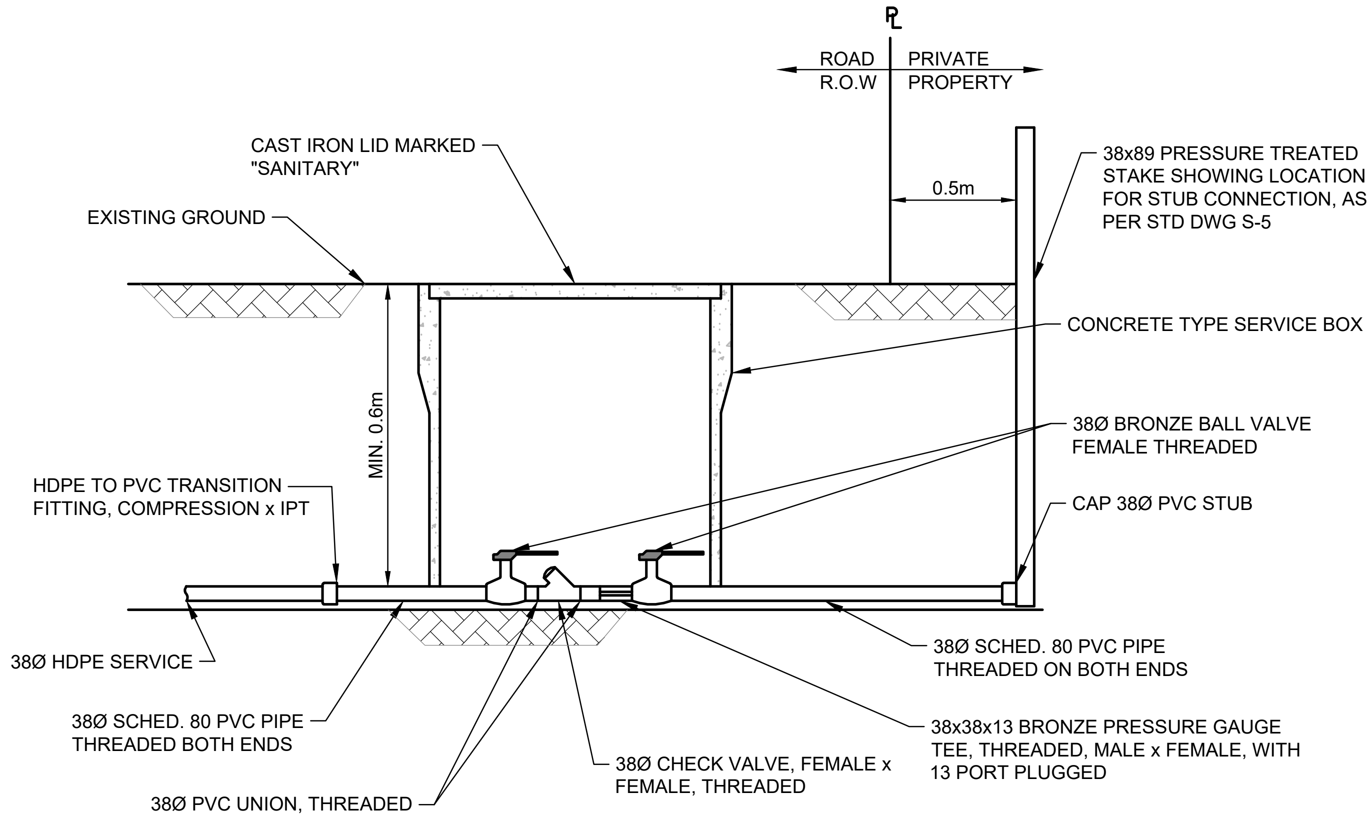
3.20.2020

CITY OF NANAIMO
THE HARBOUR CITY

LOW PRESSURE SEWER
SERVICE CONNECTION

Scale:	NTS
Created:	AUG 2019
Rev Date:	MAY 2020
Dwg No:	S-16



ELEVATION
NTS

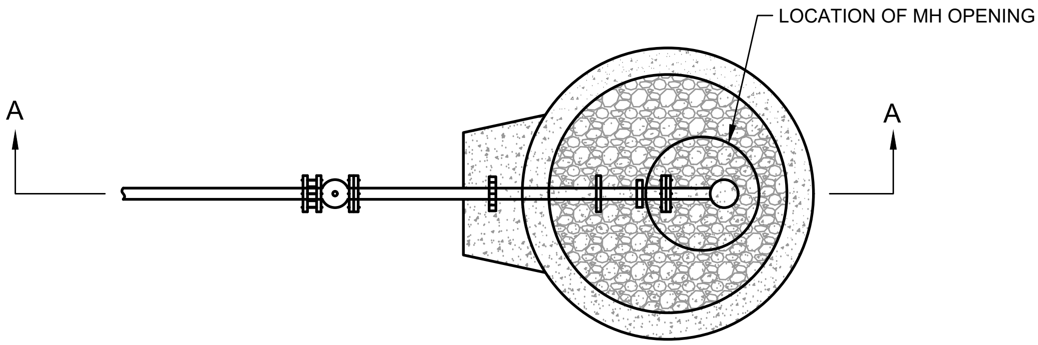
\\TENTIE&PW\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2020-08-31 FINAL MOESS EDITION NO13 DOCUMENT\2020 DRAWING SECTIONS\SECTION 6 DWGS\S-17

2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

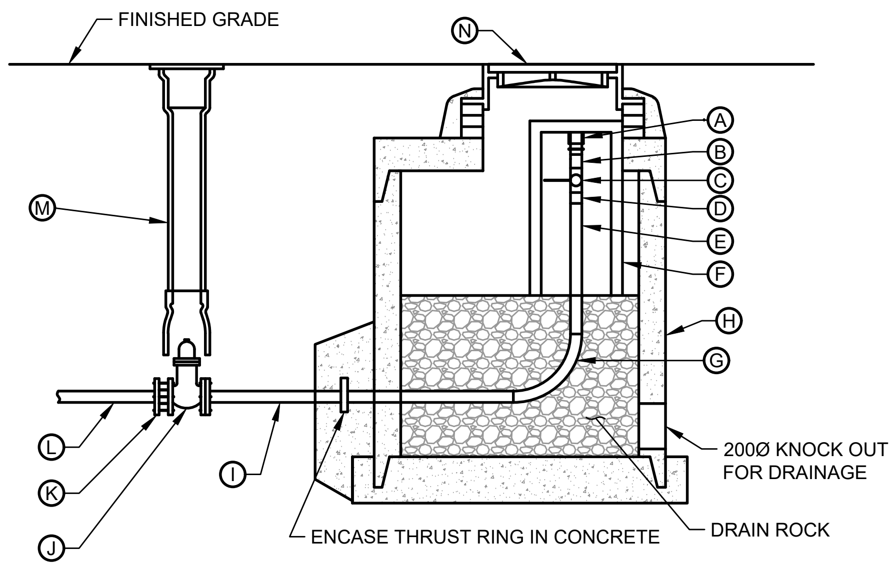
LOW PRESSURE SEWER
SERVICE BOX

Scale:	NTS
Created:	NOV 2019
Rev Date:	MAY 2020
Dwg No:	S-17



PLAN VIEW

LPS END OF LINE FLUSHOUT MH LIST OF MATERIALS	
ITEM	DESCRIPTION
A	65Ø FIRE HOSE CONNECTION PER C.O.N. SPECIFICATIONS
B	65X50 REDUCER, MALE x MALE IPT
C	50Ø BRONZE BALL VALVE, FEMALE x FEMALE IPT
D	50Ø PVC SCHED. 80 ADAPTER, MALE x MALE IPT
E	50Ø S.S, PIPE, THREADED TO FIT BEND AND PVC ADAPTER
F	50mm THICK HIGH DENSITY STYROFOAM INSULATION
G	50Ø S.S, LONG RADIUS 90° BEND, IPTxIPT
H	1050Ø MANHOLE TO C.O.N. SPECIFICATIONS
I	50Ø S.S. SPOOL PIECE c/w 100Ø x 13mm THRUST RING, FxIPT
J	50Ø BALL VALVE, FxF
K	50Ø HDPE STUB END WITH METAL BACKING FLANGE
L	50Ø HDPE DR11 PIPE
M	150x200 VALVE HOOD, 150Ø PVC RISER & 150Ø MR VALVE BOX
N	HEAVY DUTY MH FRAME AND COVER AS PER C.O.N. STD. DWG. No. S-9



SECTION A
NTS

NOTES:

1. S.S. = STAINLESS STEEL TYPE 316 SCHEDULE 40.
2. FIRE HOSE EQUIPMENT CONNECTION TO BE DIRECTLY ACCESSIBLE THROUGH MANHOLE ACCESS.

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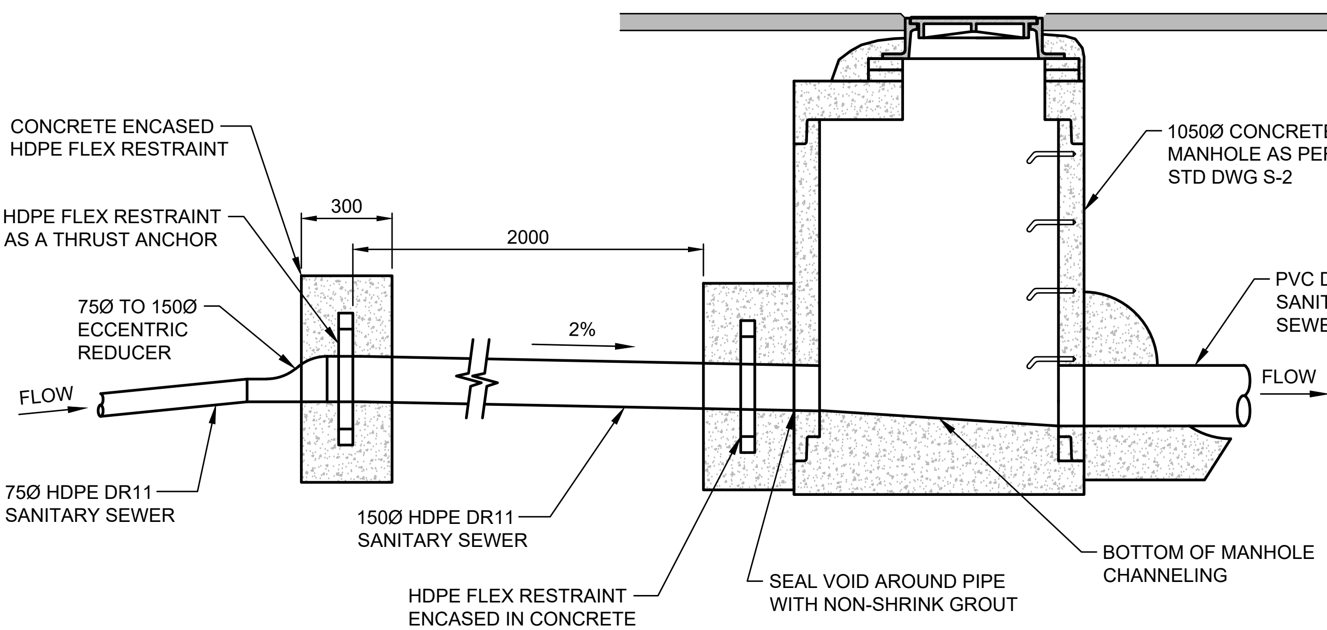
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

LOW PRESSURE SEWER
FLUSHOUT MANHOLE

Scale:	NTS
Created:	NOV 2019
Rev Date:	MAY 2020
Dwg No:	S-18



SCALE: NTS

NOTES:

1. REFER TO STD DWG S-2 FOR GENERAL NOTES AND CONCRETE REQUIREMENTS.
2. ALL HDPE JOINTS TO BE HEAT BUTT FUSED.

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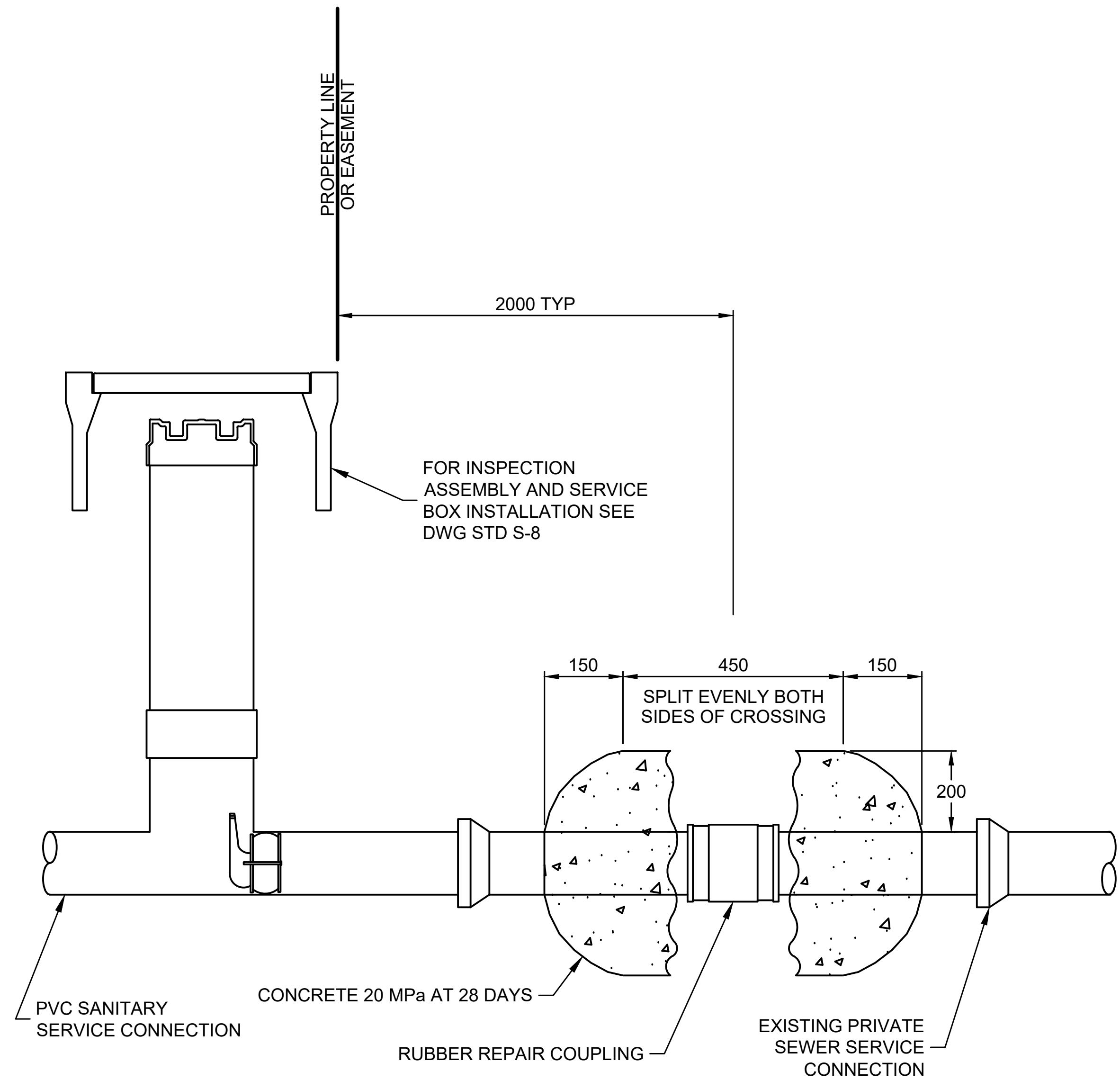
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

LOW PRESSURE SEWER
TO GRAVITY MANHOLE

Scale:	NTS
Created:	NOV 2019
Rev Date:	MAY 2020
Dwg No:	S-19



ELEVATION

NOTES:

1. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
3. SPIGOTS IF PRESENT SHALL BE REMOVED BEFORE COUPLING IS INSTALLED.

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3.20.2020

CITY OF NANAIMO
THE HARBOUR CITY

CONCRETE ENCASEMENT FOR
CONNECTIONS TO EXISTING
SEWER SERVICE CONNECTIONS

Scale:	NTS
Created:	AUG 2019
Rev Date:	MAY 2020
Dwg No:	S-20

SECTION 7 – STORMWATER MANAGEMENT
CONTENTS

SECTION 7 – STORMWATER MANAGEMENT
CONTENTS

SECTION 7 – STORMWATER MANAGEMENT
CONTENTS

(REVISED MAY 2020)

7.01 INTRODUCTION

.1 Scope:

Stormwater management is the term traditionally used when referring to managing rainfall runoff based on using design storms and sizing drainage facilities. Rainwater management refers to rainfall runoff source control under frequently occurring events. In this section, the term stormwater management is used and is intended to include the scope of rainwater management. ***(REVISED MAY 2020)***

.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 runoff with overland and piped flow to suitable receiving bodies. ***(REVISED MAY 2020)***
(c) Minor System – To safely contain the 1:5 year storm runoff within the minor system. ***(REVISED MAY 2020)***
(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) Downstream Environmental Protection – To ensure that the quality and quantity of flows do not adversely affect the receiving waters. ***(REVISED MAY 2020)***

.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, conveyance, riparian preservation, and watercourse protection. ***(REVISED MAY 2020)***

Post-development runoff release rates must be designed to consider the capacity of the downstream drainage system and the protection of any downstream watercourses from erosion. 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. ***(REVISED MAY 2020)***

For new developments and re-developments that drain to watercourses, frequently occurring post-development runoff 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. ***(REVISED MAY 2020)***

For developments and re-developments that do not drain into a creek, river or wetland system, but discharge directly into the ocean through pipes, ditches or overland flow paths, rainfall volume and runoff rate control 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. ***(REVISED MAY 2020)***

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 single or duplex residential lots and for all multi-family, commercial, industrial, and institutional developments, or at the discretion of the City Engineer. The Stormwater Management Plans shall be presented in a report which includes: ***(REVISED MAY 2020)***

(i) A tributary area plan outlining all areas included in the stormwater calculations, tributary to the rainwater management measures and the associated minor and major systems. ***(REVISED MAY 2020)***

(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 in pipes and open channels shall be presented in a tabular format. ***(REVISED MAY 2020)***

(iii) Detailed design drawings for the proposed minor and major systems and rainwater management measures. The drawings should show the routing of flows and hydraulic grade lines under both the 5 year and 100 year design conditions. ***(REVISED MAY 2020)***

(iv) A plan showing the pre and post-development topography that adequately describes the terrain.

(v) A rationale explaining which method is chosen and why the method is chosen for hydrological analysis. ***(REVISED MAY 2020)***

(vi) Summary tables that provide the follow key design information:

(a) Total and sub catchment areas. ***(REVISED MAY 2020)***
(b) Percent imperviousness values of the catchment under both pre and post development conditions. ***(REVISED MAY 2020)***

(c) Hydrological parameters (e.g. runoff coefficients, time of concentration values, infiltration parameters etc.) used for flow and HGL calculation. ***(REVISED MAY 2020)***

(vii) Design calculations including:

(a) Where applicable as described in Section 7.03.7 – Peak Flow and Runoff Volume Control features and the infrastructure to convey the runoff from the proposed development site and associated contribution catchments, 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. ***(REVISED MAY 2020)***
(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 required storage volume, design size and flow control considerations. ***(REVISED MAY 2020)***
(d) Design calculations for rainwater management best practices including the design volume and facility size. ***(REVISED MAY 2020)***
(e) Time of concentration design calculations including a rationale explaining which method was chosen and why that method was chosen.

(viii) The report shall include details regarding the provisions included to address water quality leaving the suite and entering the minor system.
(ix) For systems which include works or facilities which require ongoing maintenance, an operation and maintenance plan shall be provided detailing the inspection and maintenance, an operation and maintenance plan shall be provided detailing the inspection and maintenance requirements.
(x) All Stormwater Management Plans are to be signed and sealed by a Professional Engineer licensed in British Columbia.

7.02 SUMMARY OF STORMWATER AND ENVIRONMENTAL PROTECTION DESIGN AREA

.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 infrastructure must meet the following criteria: ***(REVISED MAY 2020)***

(a) A minor system conveyance capacity up to the 1:5 year return period to minimize inconvenience of frequent surface runoff. ***(REVISED MAY 2020)***

(b) A major system conveyance capacity up to the 1:100 year return period to provide safe conveyance of flows to minimize damage to life and property. ***(REVISED MAY 2020)***

(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. ***(REVISED MAY 2020)***

(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.

7.03 STORMWATER RUNOFF

.1 Scope:

This section describes the rationale, methodology and parameters for determining the hydrologic variables such as stormwater runoff volume and rates in the design of drainage flow conveyance and storage facilities. ***(REVISED MAY 2020)***

.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 contributing catchment areas which have been established by the City of Nanaimo. ***(REVISED MAY 2020)***

.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. The updated IDF curve takes climate change into account, Standard Drawing No. SW-25. ***(REVISED MAY 2020)***

(b) Rainfall Gauges:

The City of Nanaimo has several rainfall gauges with historical rainfall data. This rainfall data is available for reference if desired and can be provided by City staff; however, it is up to the individual engineer to verify the quality of the data and use the data for hydrological calculation. ***(REVISED MAY 2020)***

.4 Time of Concentration:

(a) 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.

(b) Formula:

$$Q = CIA \times 2.78$$

Where:

Q=storm runoff flow in litres/second
C=the coefficient to runoff
I=the rainfall intensity in mm per hour
A=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:

TYPE OF DEVELOPMENT	COEFFICIENT OF RUNOFF
Industrial	0.80 to 1.00
Commercial Business Areas, Multi-Family	0.65 to 0.90
Single Family Residential and Low Density Multi-Family	0.50 to 0.80
Rural Areas, Parks, Golf Courses	0.25 to 0.55

(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 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.

.7 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, river or wetland system, but discharge directly via pipes, ditches, or overland flow paths into the ocean, storm water management facilities may not be required for runoff volume controls. 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 major systems. ***(REVISED MAY 2020)***

(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, runoff volume 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. ***(REVISED MAY 2020)***

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) <u>6 month, 24 hour Storm Retained or Infiltrated Onsite:</u>

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 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 31 mm of rainfall depth.

(iii) Care should be taken to ensure that watercourse base flows are not adversely affected by stormwater runoff volume and rate controls, or other hydrologic changes. ***(REVISED MAY 2020)***

(c) 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.

(d) The above requirements for development, to ensure runoff emulates the existing natural conditions, are necessary for watershed health protections. 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: ***(REVISED MAY 2020)***

(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.

.8 <u>Water Quality Treatment Event:</u>

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.

7.04 MINOR SYSTEM

.1 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.

.2 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.

.3 Trunk Storm Sewers:

Storm sewers 600 mm in diameter or larger, or servicing an urban drainage basin in excess of 20 hectares, will be considered trunk sewers.

7.05 MAJOR SYSTEM

.1 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 design runoff including piping, 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 a 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 1.5 m/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 or 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 0.3 m above the major flow hydraulic grade line. No building shall have the bottom of its foundation less than 0.3 m 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 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 3.0 m 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 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.

7.06 PIPE DESIGN DETAILS

.1 Grades and Velocity of Stormwater in Pipes and Service Connections:

(a) The minimum design velocity for pipes shall be 1.0 m/s.
(b) Where the pipe discharge velocity of the design flow exceeds 1.5 m/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 3.0 m/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 250 mm. In residential areas, 200 mm 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 100 mm diameter, except service connections servicing lawn basins shall be a minimum 150 mm diameter.

(d) Commercial and Industrial service connections shall be a minimum 150 mm 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 1.5 m of cover in road right-of-way.
(ii) Storm sewers shall have 1.0 m of cover in untraveled areas.
(iii) Service connections shall have 0.75 m 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 on sewers require approval from the City Engineer. ***(REVISED MAY 2020)***
(b) Horizontal curves will be considered where the configuration of the property lines requires curvature for a constant offset and where the design velocity exceeds 1 m/s ***(REVISED MAY 2020)***
(c) 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.
(d) Curvature will be achieved through joint deflection only, bending of the pipe barrel will not be permitted. Joint deflections shall not exceed 50% of the manufacturer's maximum recommended joint deflection. Radius of curvature shall be uniform throughout the curves. ***(REVISED MAY 2020)***
(e) Only one vertical and/or 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 3.0 m 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 300 mm.

.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 2.0 m 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 a 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 30 m. Storm sewer services longer than 30 m shall require approval by the City Engineer. All inspection assemblies required for service connections in excess of 30 m 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 250 mm 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, ever 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 120 m unless otherwise approved by the City Engineer. For pipes larger than 600 mm in diameter, manhole spacing may be increased to 180 m.

(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 250 mm 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 375 mm or less where the difference in elevation between incoming and outgoing sewers exceed 600 mm. Drops less than 600 mm in elevation shall be accommodated by manhole benching. Precast manhole barrels shall be sized according to normal inside pipe diameter and depth as detailed below:

Minimum		
Pipe Size (Normal)	Depth of Manhole (Top of Cover to Inv.)	Barrel Size (Inside Dia.)
150 – 375 mm	0 – 5.9 m	1050 mm
150 – 375 mm	6.0 – 9.0 m	1200 mm
150 – 600 mm	9.0 m or greater	1500 mm
400 – 600 mm	0.0 – 8.9 m	1200 mm
675 – 750 mm	All Depths	1350 mm
900 – 1050 mm	All Depths	1500 mm
Minimum barrel sizes shall be increased for manholes within multiple large pipes.		

(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 or at least 25 mm, 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 (>600 mm 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 <u>Catch Basins:</u>

(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 450 m^2 of pavement drainage where grades do not exceed 5%. On grades over 5% the maximum area collected shall be reduced to 300 m^2.

(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 stump.

(d) <u>Catch Basin Leads:</u>

(i) Single basin leads shall have a minimum diameter of 200 mm.
(ii) Double basin leads shall have a minimum diameter of 250 mm.
(iii) Lawn basin leads shall have a minimum diameter of 150 mm.
(iv) Leads over 30 m shall have a minimum diameter of 250 mm.
(v) Double basin leads shall be wyed together. Basin shall not be directly connected.
(vi) The desired grade for a catch basin leads is 2%. Where it is impractical to obtain 2%, a catch basin lead with a 1% grade is acceptable.

.13 <u>Surcharge:</u>

(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 150 mm PVC perforated pipe will be placed at the bottom of the trench.

7.07 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 450 mm 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 300 mm diameter regardless of hydraulic capacity.

7.08 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 1.9 m 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 450 mm.
(e) The minimum grade of a ditch shall be 0.5%.
(f) The maximum velocity in an unlined ditch shall be 1.5 m/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.

7.09 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 150 mm, and a minimum width of 1.5 m.
(d) The minimum grade of a swale shall be 1.0%.
(e) Swales shall not be used where the velocity exceeds 1.5 m/s or on an 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: 1.5 m/s
(ii) Suitably lined channel: 3 m/s

(b) If the mean velocity exceeds that permissible for the particular kind of soil or greater than 1.5 m/s, the channel shall be suitably lined to protect it from erosion.
(c) The maximum depth of flow shall not exceed 300 mm with a freeboard of 150 mm.
(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 a part of all inlet structures to storm sewer pipes. Trash racks may be required on culverts as 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 450 mm in diameter or 3.0 m 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 2.0 m, 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 1.5 m/s shall incorporate a method to dissipate the energy so that the erosion will not occur in the receiving channel. ***(REVISED MAY 2020)***

(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 sit 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 in the active storage portion of the pond is usually released after the storm has ended, while a permanent pool is maintained during dry periods. These may form a recreational or aesthetic facility centered on a permanent pool of water. ***(REVISED MAY 2020)***

(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 grade for a wet detention pond shall be 7H:1V from the normal water level to a depth of 0.4 m; 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. ***(REVISED MAY 2020)***
(d) Storage facilities shall be designed to accommodate the design storage volume with a freeboard of 300 mm under the 100 year storm conditions. ***(REVISED MAY 2020)***
(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 8.0 m buffer zone shall be provided along the top of wet ponds, dry ponds, and constructed wetlands with a minimum building set-back of 15 m from the top of the storage facility.
(i) An access at least 3.0 m 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 1 m/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 increases 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 but to include aspects that can mimic the natural hydrologic process, protect the overall watershed health, and improve 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. ***(REVISED MAY 2020)***

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 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 ocean, rainwater best management practices may not be required for runoff volume control, but for water quality enhancement only. ***(REVISED MAY 2020)***

.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 and provides water quality treatment. ***(REVISED MAY 2020)***

(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 300 mm.

(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) Previous Paving:

Previous 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 a 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 required 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 rates 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 a small lot size, limited oversight once developed, and potential for multiple owners and other aspects related residential subdivisions, the application of best management practices for Single Family and Duplex developments is limited to absorbent landscaping and disconnected roof leaders or neighbourhood 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. Previous driveways and patios are strongly encouraged.

(b) Multi-Family Residential, Commercial, Industrial, and Institutional:

The use of rainwater best management practices to infiltrate to 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 stormwater management targets can be met. ***(REVISED MAY 2020)***

(d) Areas which are underlain by shallow coal mines 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 stormwater management targets can be met. ***(REVISED MAY 2020)***

.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:

Sand	210 mm/hr
Loamy Sand	61 mm/hr
Loam	13 mm/hr
Silt Loam	6.8 mm/hr
Sandy Clay Loam	2.3 mm/hr
Sandy Clay	1.5 mm/hr
Silty Clay	0.9 mm/hr
Clay	0.6 mm/hr

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 600 mm 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 600 mm 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:

(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 100 m^2 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 or 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 31 mm 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 in 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], the IDF curve was updated to account for Climate Change, Standard Drawing No. SW-25. Refer to Section 7.03.3.(a). ***(REVISED MAY 2020)***

[1] APEGBC, Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC, 2012, Section 3.53, Pg. 23 and Section H.3.1., pg. 123.
[2] http://www.pacificclimate.org/analysis-tools/plans2adapt Potential Impacts for Nanaimo in the 2080's.

.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 1.0 m by the end of the century shall be used as a minimum.[3]

[3] APEGBC, Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC, 2012, Section H5, Pg. 127.

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 4.0 - Excavation, Trenching and Backfill for related specifications. ***(REVISED MAY 2020)***

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 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 1.2 m shall be loaded no more than the amount computed for a 1.2 m 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 gaskets 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 675 mm 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 – 375 mm dia to ASTM D3034 and CSA B182.2
450mm – 675 mm 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 100 mm 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 100 mm diameter shall be as specified for PVC (smooth profile) mainline pipe.

.6 High Density Polyethylene (HDPE) Pipe (Smooth Profile):

(a) Pipe shall conform to AWWA C906. All pipes to be certified by Canadian Standards Association – CSA B137.1. ***(REVISED MAY 2020)***

(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.

(d) Fabricated HDPE mitred fittings shall conform to AWWA C906 and certified by Canadian Standards Association – CSA B137.1. Mounded HDPE fittings to ASTM D3261 suitable for pressure rating specified and fusion to main pipe. Pipe deflection 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. ***(REVISED MAY 2020)***

7.22 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 40 mm and 0% passing 10mm screens.

.2 Piping shall be a minimum 150 mm diameter DR28 PVC perforated pipe. A minimum of 50 perforations 5 mm 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:

Tensile Strength (ASTM 1682)	=	250N	(minimum)
Bursting Strength (ASTM D-751)	=	865kPa	(minimum)
Permeability	=	$2x10^{-2}$	cm/s

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 C478. ***(REVISED MAY 2020)***

.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 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 Drawing 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.

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.

7.26 CONCRETE

.1 Concrete for cast in place shall conform to Section 11.0 - Cast In Place Concrete Works. ***(REVISED MAY 2020)***

7.27 PRECAST CONCRETE GRADE RINGS

.1 Precast concrete grade rings conforming to ASTM C478 shall be used.

.2 For roads with steep grades, sloped concrete grade rings are to be used in conjunction with an adjustable manhole frame assembly. *(REVISED MAY 2020)*

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.

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 basins barrels shall be 600 mm or 750 mm 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 used the same type of joints, gaskets, and fittings.

.3 Leads shall be 200 mm in diameter (minimum) for single basins and 250 mm in diameter (minimum) for double basins, and shall be connected to sewers with manufactured wyes or tees. Leads over 30 m in length shall be 250 mm in diameter.

7.31B CATCH BASIN CASTINGS

.1 Catch basin frame and grating shall be in accordance with Standard Drawings:

(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

7.32 INLET AND OUTLET STRUCTURES

.1 Concrete inlet and outlet structures shall be precast unless approved by the City Engineer.

.2 Cast in place concrete shall conform to Section 11.0 - Cast In Place Concrete Works. ***(REVISED MAY 2020)***

.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 20 mm diameter hot dipped galvanized bar.

7.33 ENERGY DISSIPATOR OUTLET STRUCTURES

.1 Energy dissipators shall be constructed of concrete and be designed to reduce runoff velocities to less than 1.5 m/s and dispose runoff evenly.

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 50 mm wire mesh, 9 gauge, hot dip galvanized, or plastic coated.

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 CSA B1800.

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 All cast in place concrete shall conform to Section 11.0 - Cast In Place Concrete Works. ***(REVISED MAY 2020)***

.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:

Class of Riprap (kg.)	Nominal Thickness of Riprap (mm)	Rock Gradation (Percentage Larger than given rock mass, kg.)			Approximate Average Dimension of Rock (mm)
		85%	50%	15%	
10	350	1.0	10	30	200
25	450	2.5	25	75	300
50	550	5.0	50	150	350
100	700	10	100	300	450
250	1000	25	250	750	600
500	1200	50	500	1500	800
1000	1500	100	1000	3000	1000
2000	2000	200	2000	6000	1200
4000	2500	400	400	12000	1500

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 1.0 m 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.

7.38 SERVICE BOXES

.1 Service boxes for single storm sewer services shall be 300 mm x 500 mm 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 425 mm x 750 mm concrete boxes complete with steel traffic cover marked "Storm" and concrete extension sections as required.

7.40 TRENCH EXCAVATION, BEDDING AND BACKFILL

.1 Refer to Section 4.0 - Excavation, Trenching and Backfill for installation requirements. ***(REVISED MAY 2020)***

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	=	±	50 mm
Grade	=	±	10 mm

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 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 in Section 4.0 - Excavation, Trenching and Backfill. ***(REVISED MAY 2020)***

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.

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 joint deflection as specified in Section 7.06.6 and only where approved by the Engineer. ***(REVISED MAY 2020)***

7.45 DEFLECTION

.1 The amount of pipe deflection at joints and couplings shall be the limit as specified in Section 7.06.6. ***(REVISED MAY 2020)***

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. For connections to existing service connections refer to Standard Drawing No. SW-27 – Concrete Encasement for Connections to Existing Storm Services. ***(REVISED MAY 2020)***

.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 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 corning 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 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 and 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

.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 4.0 - Excavation, Trenching and Backfill. ***(REVISED MAY 2020)***

.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 4.0 - Excavation, Trenching and Backfill. ***(REVISED MAY 2020)***

.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 150 mm 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 a 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 channeling shall be constructed as shown on Standard Drawings or as shown on the construction drawings. Channeling shall be constructed to have a minimum 0.3 m straight section before the change in direction within the manhole.

.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.

.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.

.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.

7.50 -NOT USED-

7.51 PRECAST MANHOLE SECTIONS

.1 Precast manhole barrel sections shall be placed plumb.

.2 Joints between the top riser and the cover slab shell 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.

.2 Precast manhole bases shall be placed on 150 mm thick base if 38 mm drain rock.

.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.

7.53 CONCRETE

.1 Cast in place concrete shall conform to Section 11.0 - Cast In Place Concrete Works. ***(REVISED MAY 2020)***

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 50 mm thick and to a maximum of 100mm thick. The concrete grade rings shall be laid in common bond with racked mortar joints and shall be mortared inside and outside of the manhole.

(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 1.5 m x 1.5 m, 50 mm 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 6 mm 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 25 mm to 26 mm diameter precast or drilled holes in a manhole section.

.4 Refer to Section 7.25E for manhole steps specifications.

7.56 DROP MANHOLE STRUCTURES

.1 Manhole drop structures shall be constructed as shown on Standard Drawing No. SW-14 - Storm Drop Manhole.

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 channelled to the stub entrance.

7.58 TEMPORARY CLEANOUTS

.1 Temporary cleanouts shall be constructed as shown on the Standard Drawings.

7.59 -NOT USED-

7.60 PRECAST CATCH BASIN BARRELS AND LEADS

.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 may be allowed to avoid pipe conflicts or insufficient bury. Mitre bends shall not exceed 45˚ and there shall be a minimum 1.0 m 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 20 mm 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 400 mm 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.

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 2.0 m, the service shall be extended into the property the same distance as the depth of the service, up to a maximum distance of 4.0 m. 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 the 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 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 0.75 m over the service connection pipe at property line.
(e) In rock, the trench is to be extended three 3.0 m 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 38 mm x 89 mm 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 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.
(j) Inspection assemblies shall be installed as shown on the standard drawings.
(k) The service box shall be installed plumb with the lid 25 mm above finished grade in unpaved areas and 0 - 6 mm 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.

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 The pipes shall be cleaned upon completion of the sewer pipe installation and one month prior to the end of the maintenance period to the satisfaction of the Engineer and the Inspector. Cleaning shall be completed by power flushing with water to remove all foreign matter. ***(REVISED MAY 2020)***

.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 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 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 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 the debris at approved dump sire 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 hours 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 The contractor shall arrange for a video inspection upon completion of the sewer pipe installation and within one month prior to the end of the maintenance period to the satisfaction of the Engineer and the Inspector. ***(REVISED MAY 2020)***

.3 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 catch basin leads. Where a new sewer pipe crosses an existing sewer pipe, the contractor shall also arrange for a video inspection of the existing sewer pipe at the location of the crossing. ***(REVISED MAY 2020)***

(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 (9.0 m). 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 a fan.
(c) Camera lens to remain free of grease or other deleterious matter to ensure optimal clarity.
(d) Plan and tilt view each service connection (junction) such that the camera looks down the centerline 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 or 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 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) 0.1 m/s for pipeline of diameter less than 200 mm
  (ii) 0.15 m/s for diameters 200 mm and larger but not exceeding 310 mm: and
  (iii) 0.20 m/s for diameters exceeding 310 mm

.4 The inspection shall include the preparation of:

(a) an HDSD 32 GB Class 10 regular card. 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. ***(REVISED MAY 2020)***

(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.

.5 The Engineer shall review the 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. ***(REVISED MAY 2020)***

.6 The pipe condition report and certification shall become the property of the City of Nanaimo. ***(REVISED MAY 2020)***

.7 Variations in line of 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. Re-inspection of the pipe may be required by the Engineer at the Contractor’s expense.

.8 During the test, manhole construction and invert elevations shall be checked and any variations from the established grade, drawing, or specifications, shall be rectified.

.9 Video inspection and pipe condition coding shall be undertaken only by personnel with current Canadian certification by a City approved agency.

(REVISED MAY 2020)

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.

.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 300 mm overlap after the drain rock is placed.

.3 Place a 150 mm 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 150 mm of finished surface and surround with filter fabric.

.5 Place remaining 150 mm of drain rock or, if specified, top soil to finish grade.

.6 Install all manholes as per Section 7.0 - Stormwater Management.

7.68 INLET AND OUTLET STRUCTURES

.1 Inlet and outlet structures shall be installed in accordance with Standard Drawings.

.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.

.3 Structure shall be placed on a minimum of 100 mm (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 Cast in place concrete shall conform to Section 11.0 - Cast In Place Concrete Works. ***(REVISED MAY 2020)***

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 to 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

DEFECT CODE NO.	TYPE OF DEFECTS	POINT SCORES
1	Open Joints	1 to 2
2	Displaced Joints	1 to 2
3	Cracks	10 to 40
4	Fracture	40 to 80
5	Broken	80
6	Hole	80 to 165
7	Collapsed	165
8	Spalling	5 to 120
9	Wear	5 to 120
10	Deformation	20 to 165

Every video inspected sewer will be assigned a composite grade based on the sum of its defect point scores as per the following table: ***(REVISED MAY 2020)***

WRc - SEWER RATING COMPOSITE GRADE ***(REVISED MAY 2020)***

COMPOSITE GRADE ***(REVISED MAY 2020)***	PEAK SCORE RANGE (SUM OF THE SCORES FROM THE ABOVE TABLE)	TYPICAL DEFECT DESCRIPTION
1 (least defective)	1 to 9	No observable structural defects
	10 to 39	Circumferential crack. Moderate joint defects, i.e. open joint (medium) or joint displaced (medium), spalling slight and wear slight.
3	40 to 79	Fracture with deformation <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.
4	80 to 164	Broken, deformation up to 10% and broken fracture with deformation 5 - 10%. Multiple fractures. Serious loss of level. Spalling large. Wear large.
5 (most defective)	165+	Already collapsed. Deformation >10% and broken. Extensive areas of fabric missing. Fracture with deformation >10%.

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).

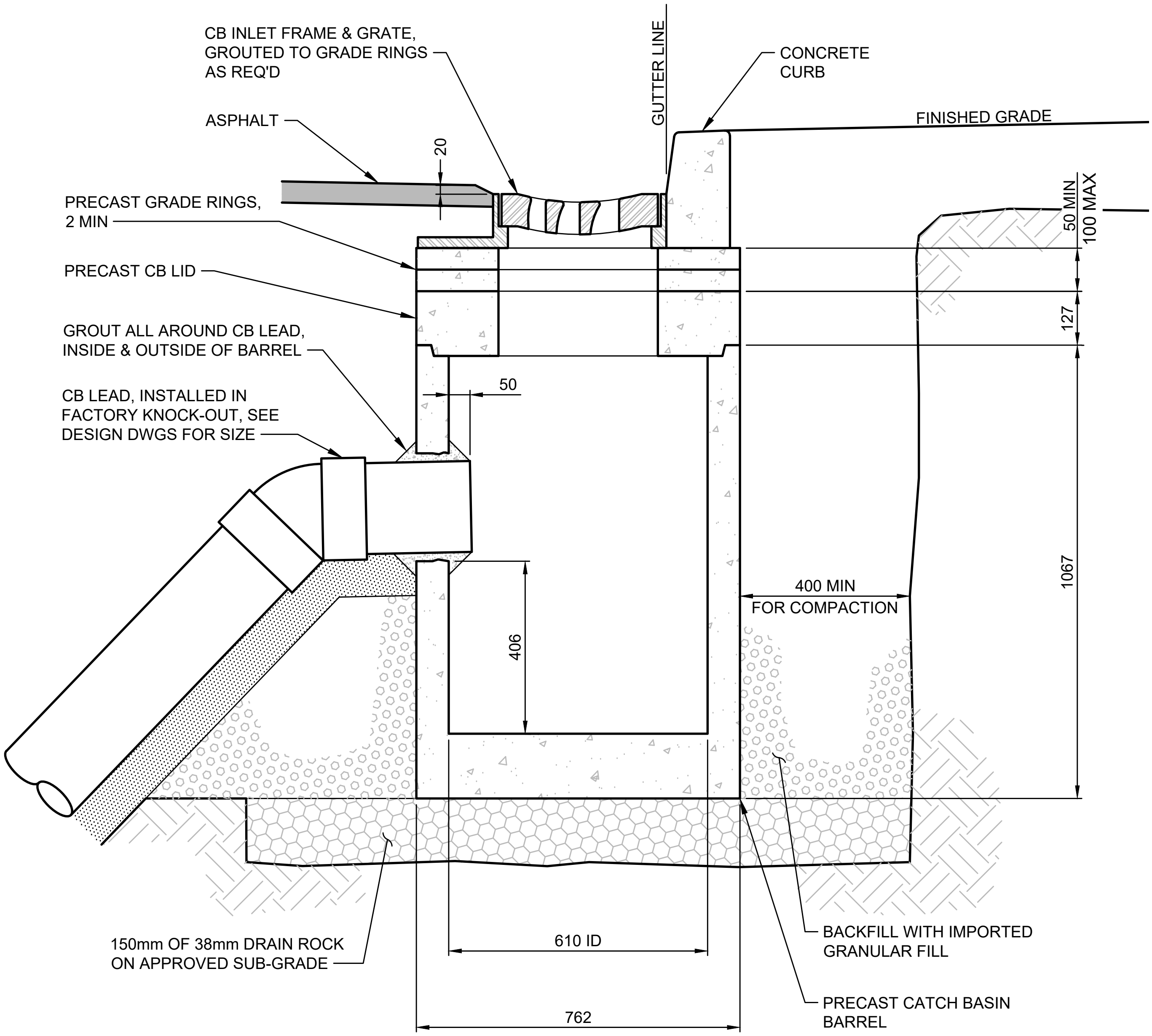
.5 Computer database file to contain identical survey report information as the printed report exclusive of photographs. Index numbers and distance of survey information shall numerically increase. For an individual survey, whether the information is sorted by index or distance, the result will be in the same order.

.6 All pipe video inspections 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.

MANOLE RATING SYSTEM

INTERNAL CONDITION GRADE	TYPICAL DEFECT DESCRIPTION
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.



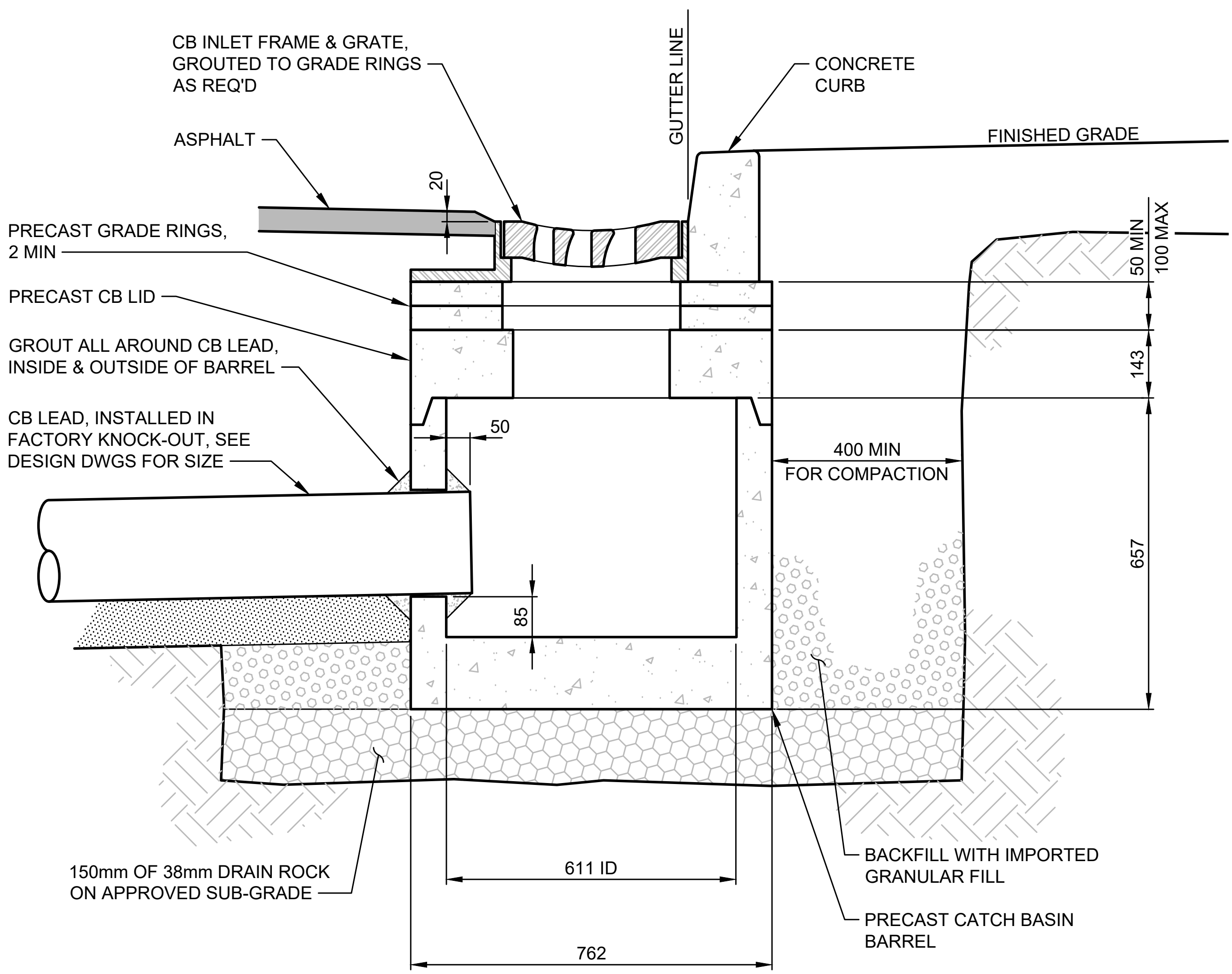
NOTES:

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.

CITY OF NANAIMO
THE HARBOUR CITY

STANDARD CATCH BASIN

Scale:	1:15
Created:	JAN 2016
Rev Date:	NOV 2016
Dwg No:	SW-1



NOTES:

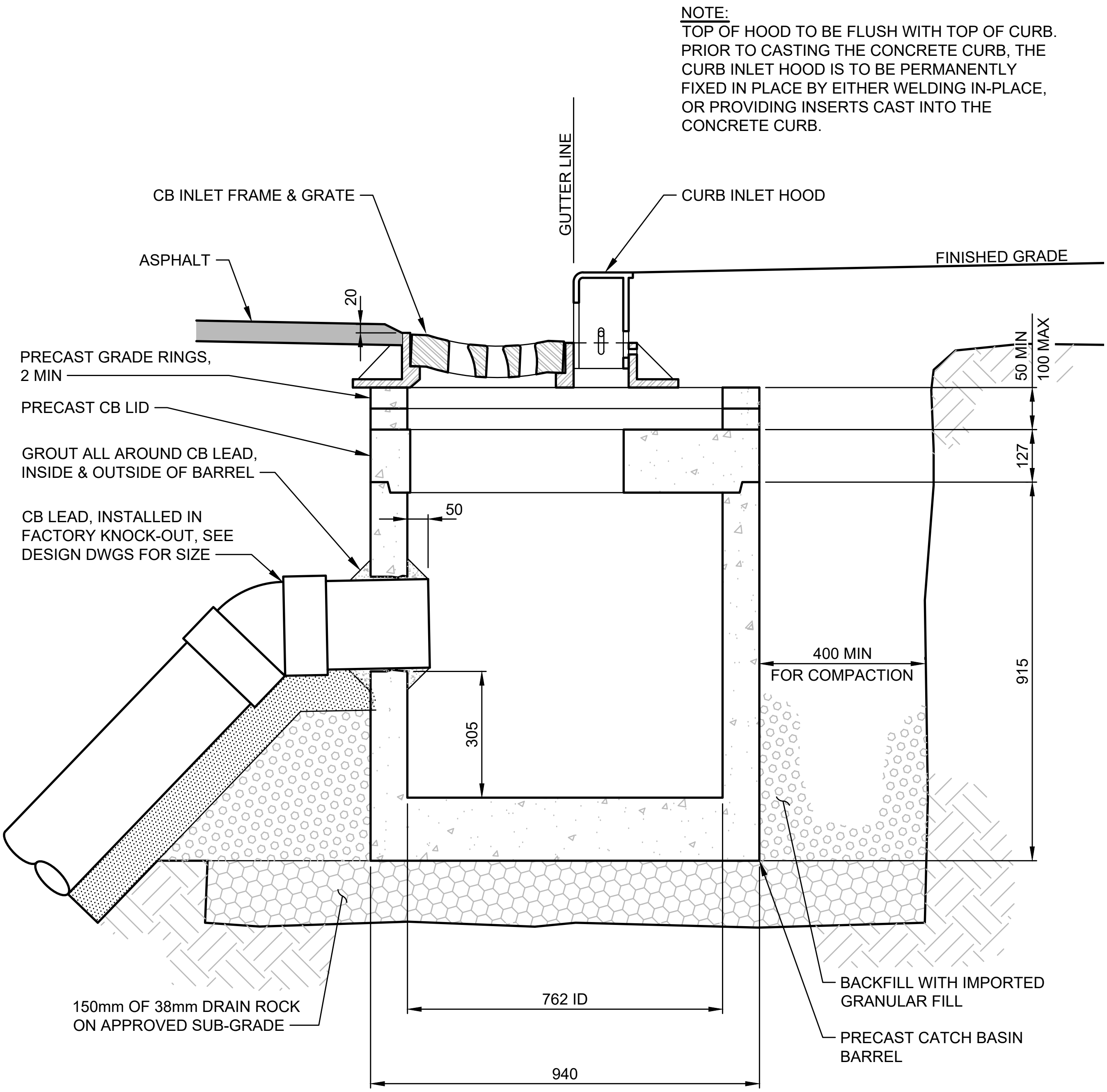
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. FOR FRAME & GRATE DETAILS, SEE STD DWG SW-6.
3. ALL JOINTS TO BE PRE-WETTED BEFORE MORTAR IS PLACED.
4. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
6. CATCH BASIN LID TO MEET CS-600 LOADING.

2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

SHALLOW CATCH BASIN

Scale:	1:15
Created:	JAN 2016
Rev Date:	NOV 2016
Dwg No:	SW-2



NOTES:

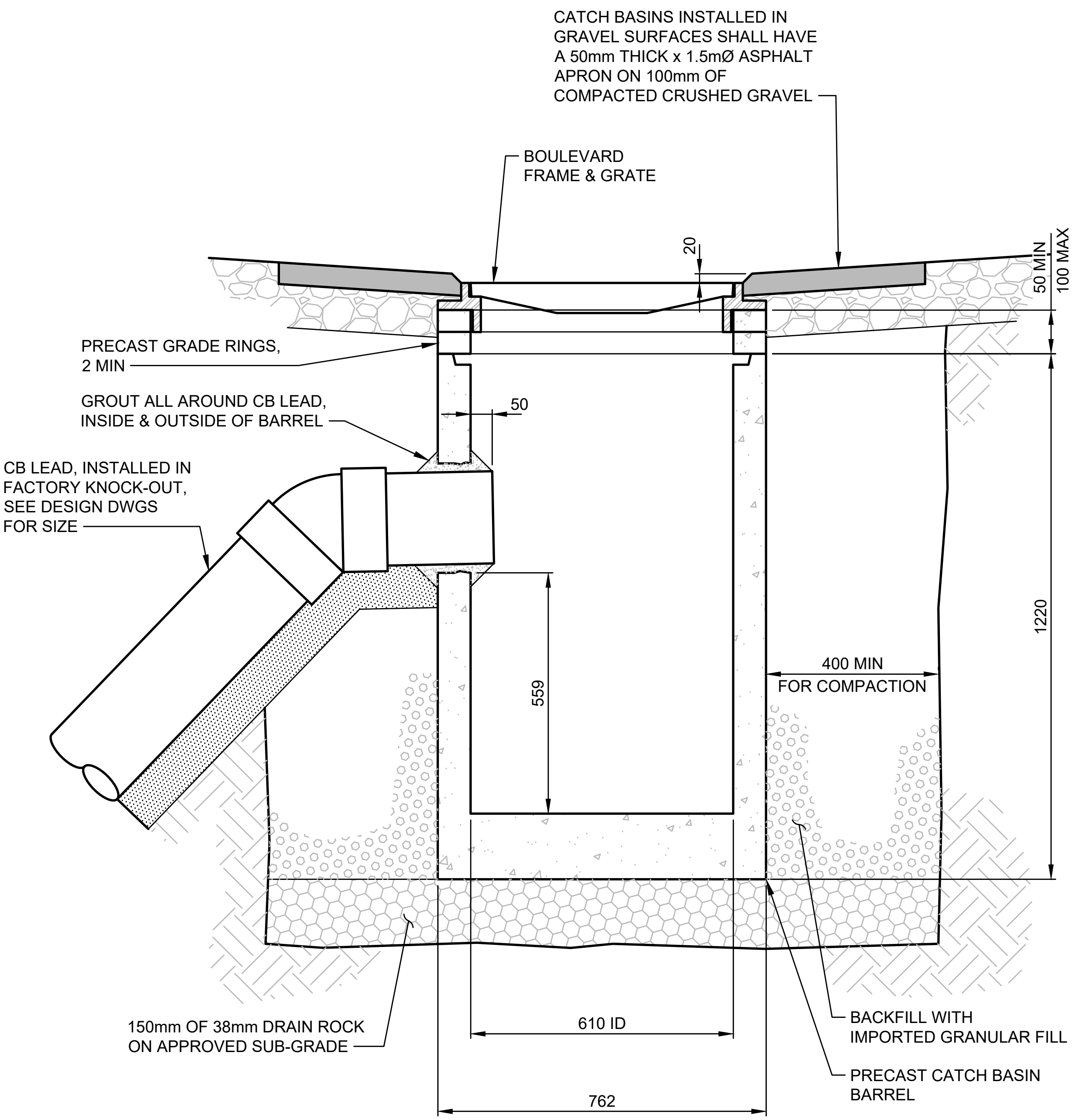
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. FOR FRAME & HOOD DETAILS, SEE STD DWG SW-7.
3. ALL JOINTS TO BE PRE-WETTED BEFORE MORTAR IS PLACED.
4. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
6. CATCH BASIN LID TO MEET CS-600 LOADING.

CITY OF NANAIMO
THE HARBOUR CITY

2.28.2020

CURB INLET CATCH BASIN

Scale:	1:15
Created:	JAN 2016
Rev Date:	NOV 2016
Dwg No:	SW-3



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.

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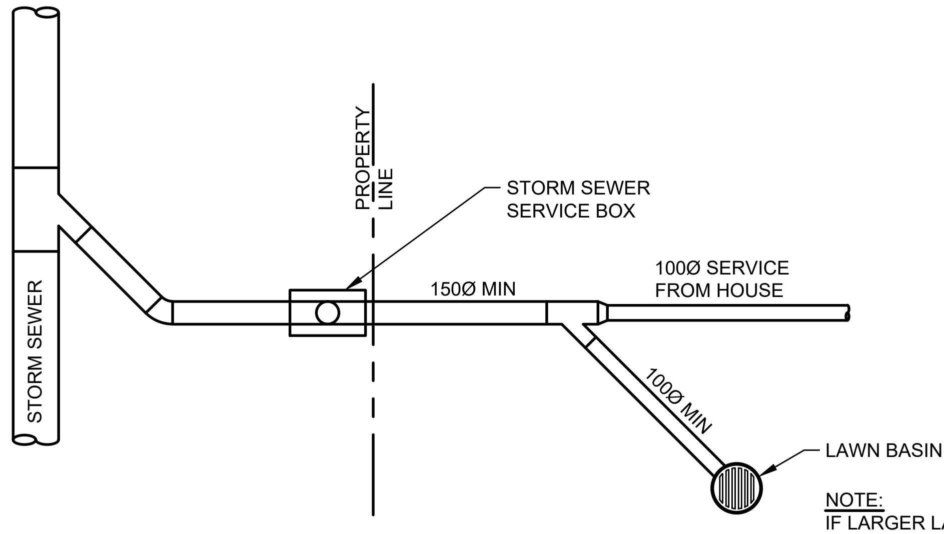
CITY OF NANAIMO
THE HARBOUR CITY

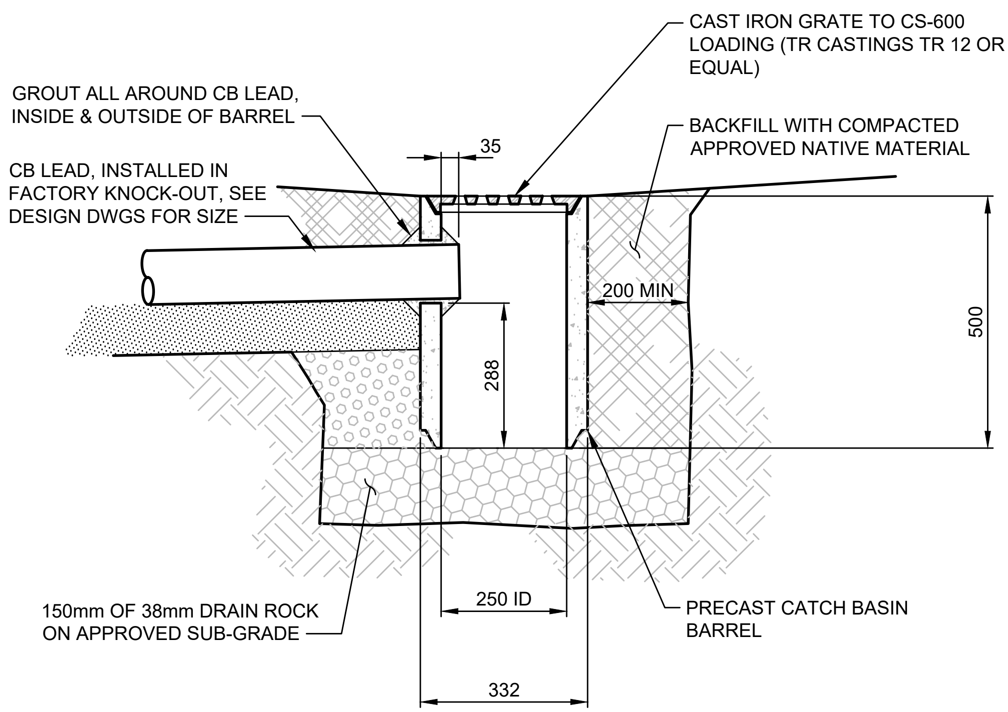
BOULEVARD CATCH BASIN

Scale:	1:15
Created:	JAN 2016
Rev Date:	NOV 2016
Dwg No:	SW-4



NOTE:
IF LARGER LAWN BASIN (SW-4) IS REQ'D, THE CB LEAD TO BE 150Ø PVC TO SERVICE BOX.

PLAN
NTS



ELEVATION
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. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
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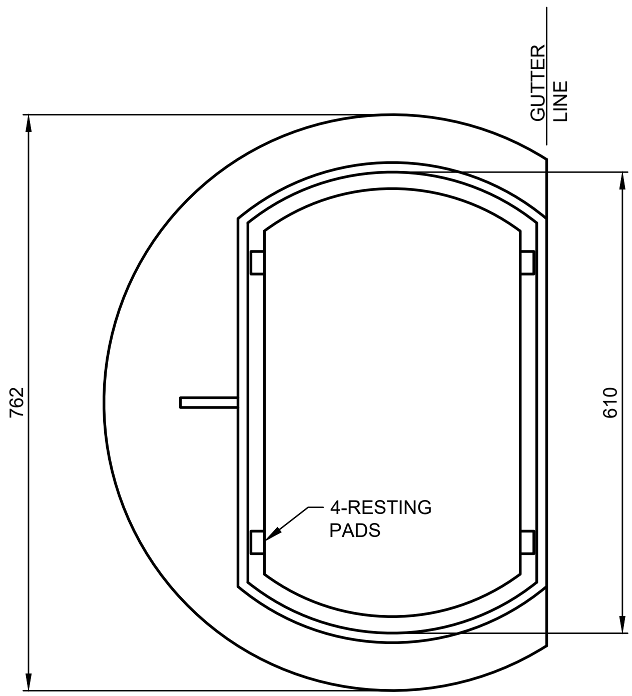
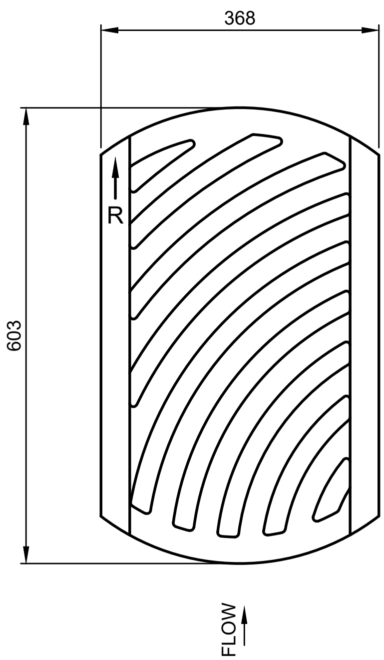
CITY OF NANAIMO
THE HARBOUR CITY

SMALL LAWN BASIN ON PRIVATE PROPERTY

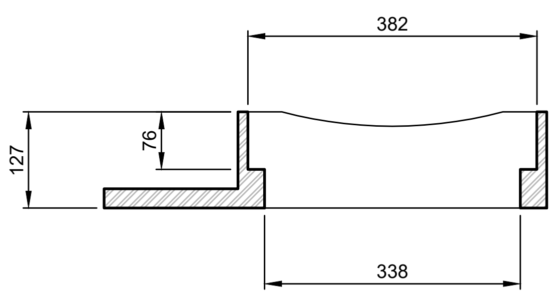
Scale:	1:15
Created:	JAN 2016
Rev Date:	NOV 2016
Dwg No:	SW-5



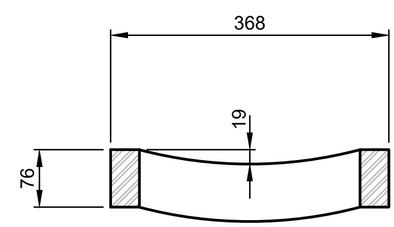
FRAME PLAN



GRATE PLAN



FRAME SECTION



GRATE SECTION

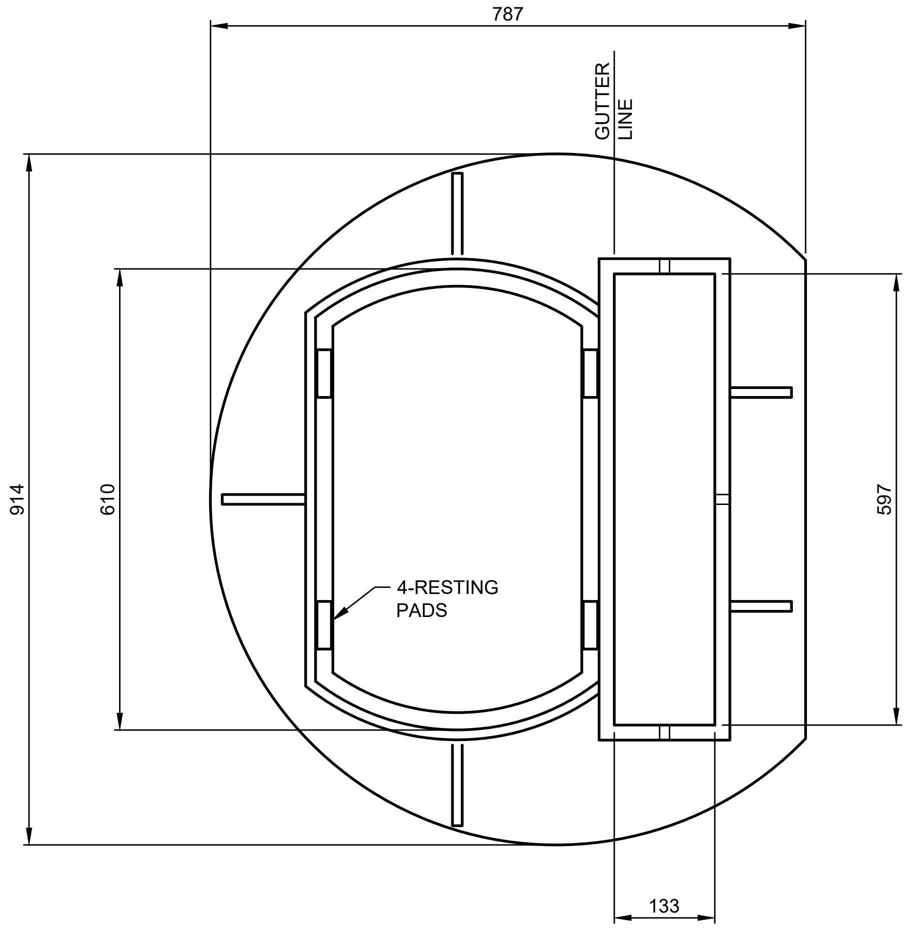
NOTES:

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.

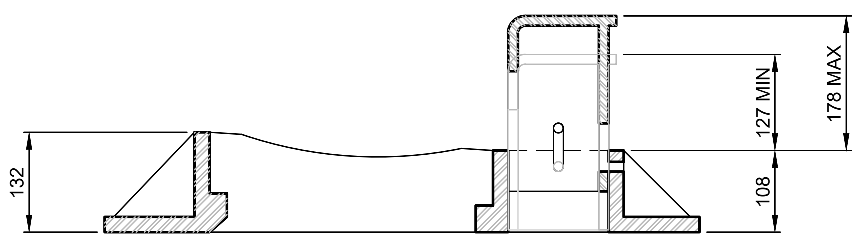
CITY OF NANAIMO
THE HARBOUR CITY

CATCH BASIN FRAME AND GRATE

Scale:	1:10
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	SW-6



FRAME PLAN



SECTION

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.

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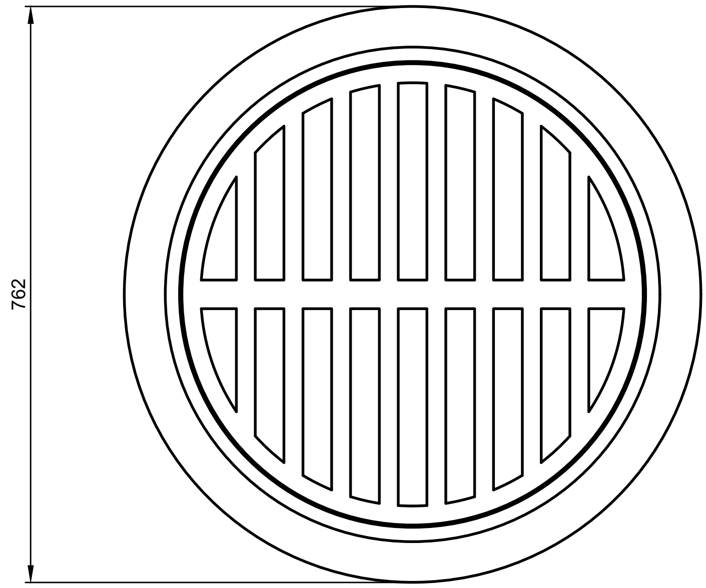
2.28.2020

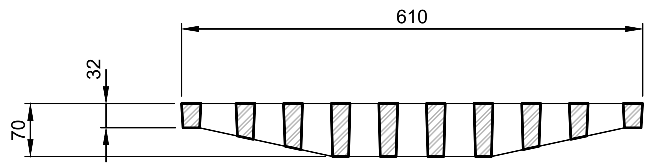
CITY OF NANAIMO
THE HARBOUR CITY

ADJUSTABLE CATCH BASIN
FRAME AND HOOD

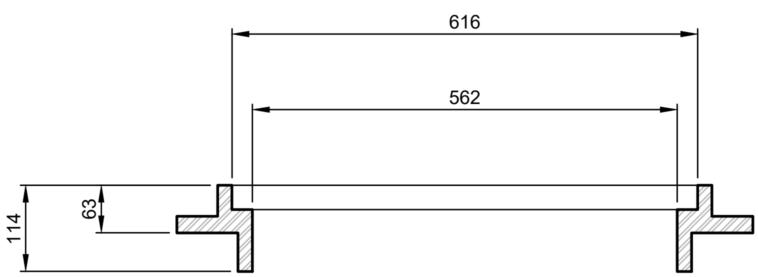
Scale:	1:10
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	SW-7



FRAME AND GRATE PLAN



GRATE SECTION



FRAME SECTION

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.

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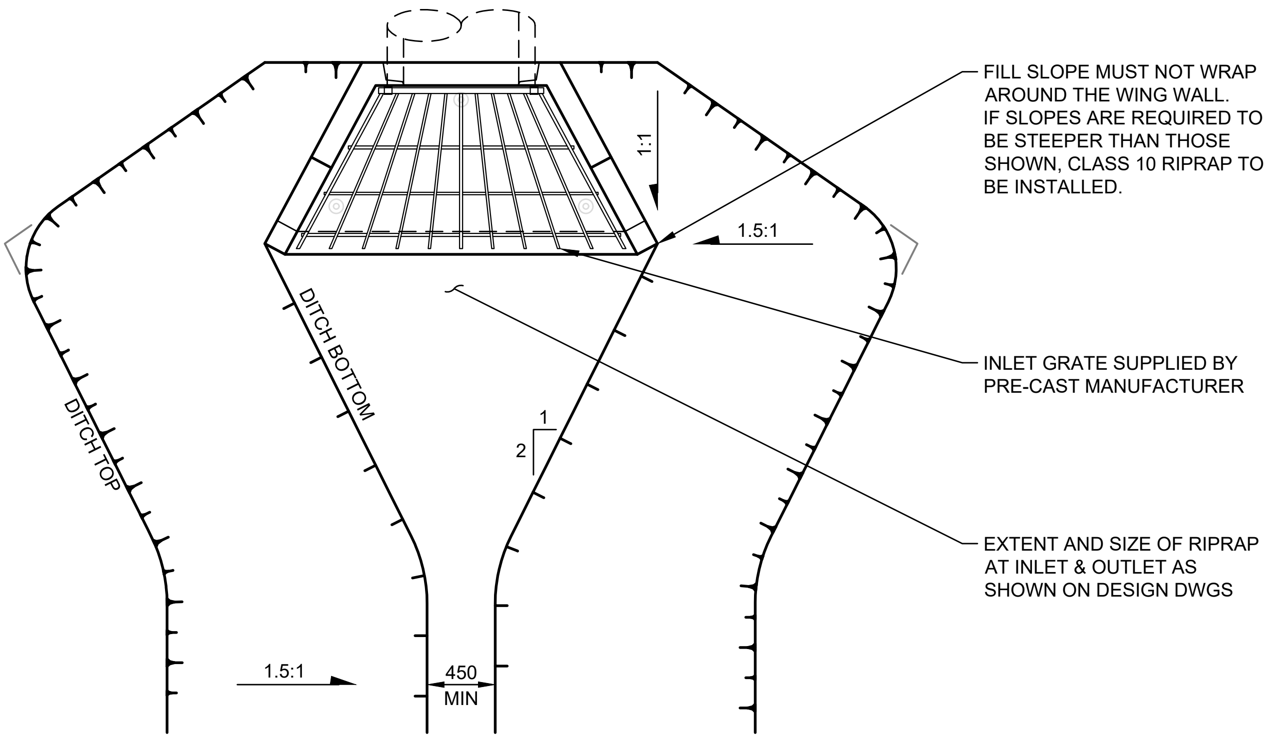
2.28.2020

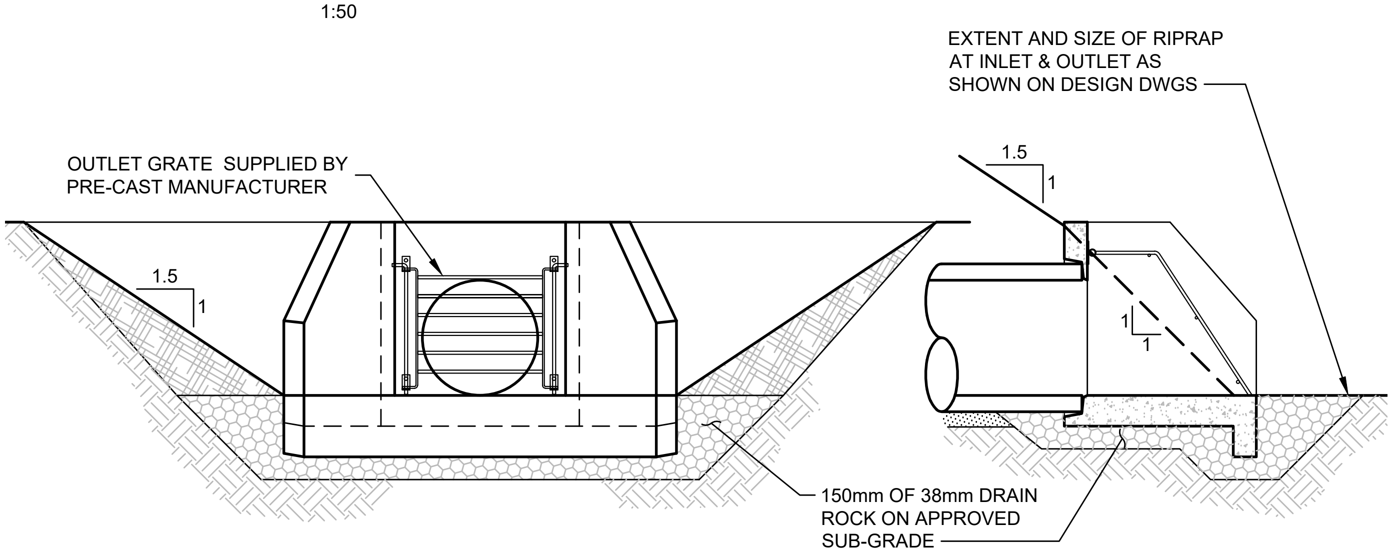
CITY OF NANAIMO
THE HARBOUR CITY

BOULEVARD CATCH BASIN
FRAME AND GRATE

Scale:	1:10
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	SW-8



PLAN (INLET SHOWN)
1:50



ELEVATION (OUTLET SHOWN)
1:50

SECTION
1:50

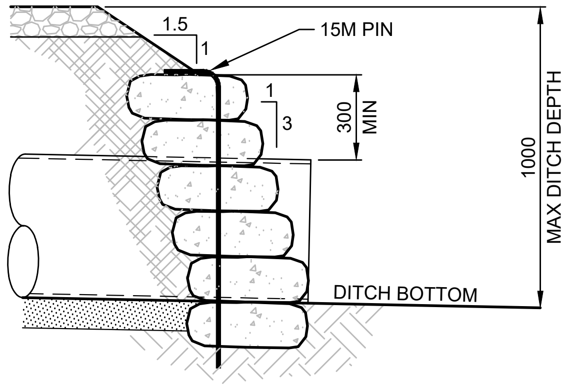
NOTES:

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.

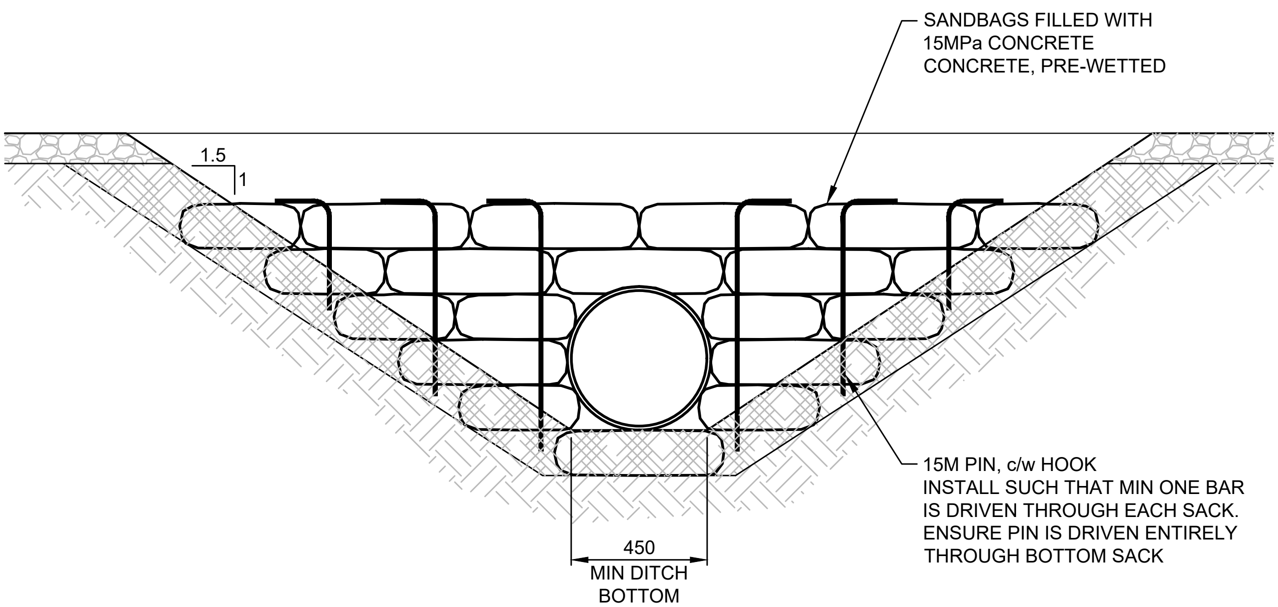
CITY OF NANAIMO
THE HARBOUR CITY

PRECAST CONCRETE HEADWALL

Scale:	1:50
Created:	FEB 2016
Rev Date:	NOV 2016
Dwg No:	SW-10



SECTION
1:25



ELEVATION
1:25

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.

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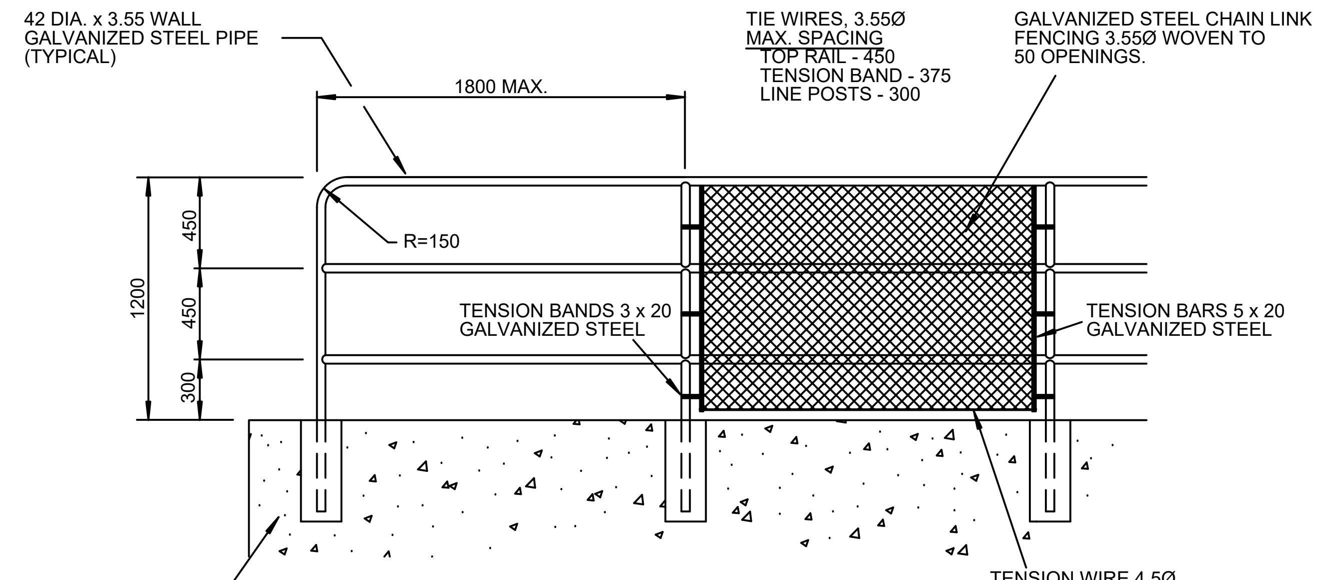
2.28.2020

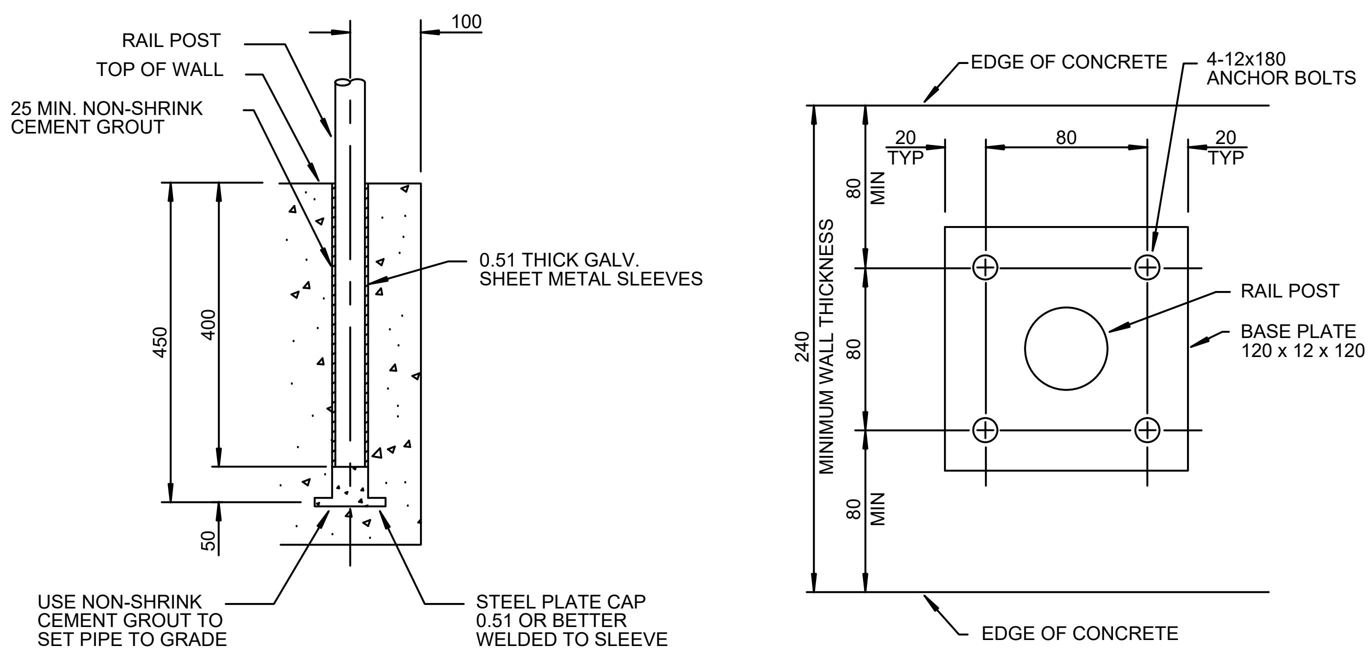
CITY OF NANAIMO
THE HARBOUR CITY

SANDBAG HEADWALL FOR
CULVERT INLETS AND OUTLETS

Scale:	1:25
Created:	FEB 2016
Rev Date:	NOV 2016
Dwg No:	SW-11



GENERAL ARRANGEMENT



EMBEDDED MOUNTING

ATTACHED MOUNTING

CONNECTION DETAILS

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.

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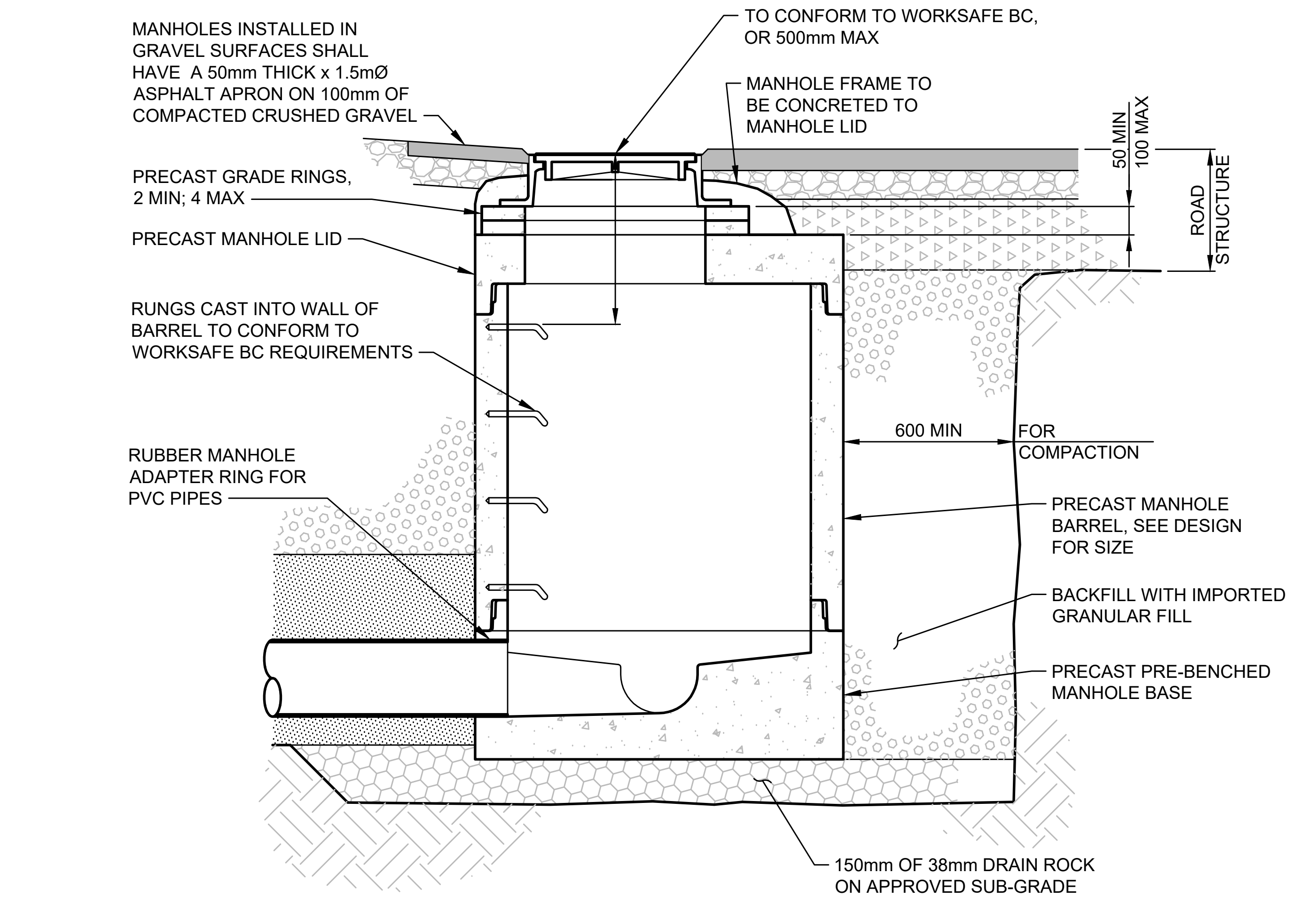
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

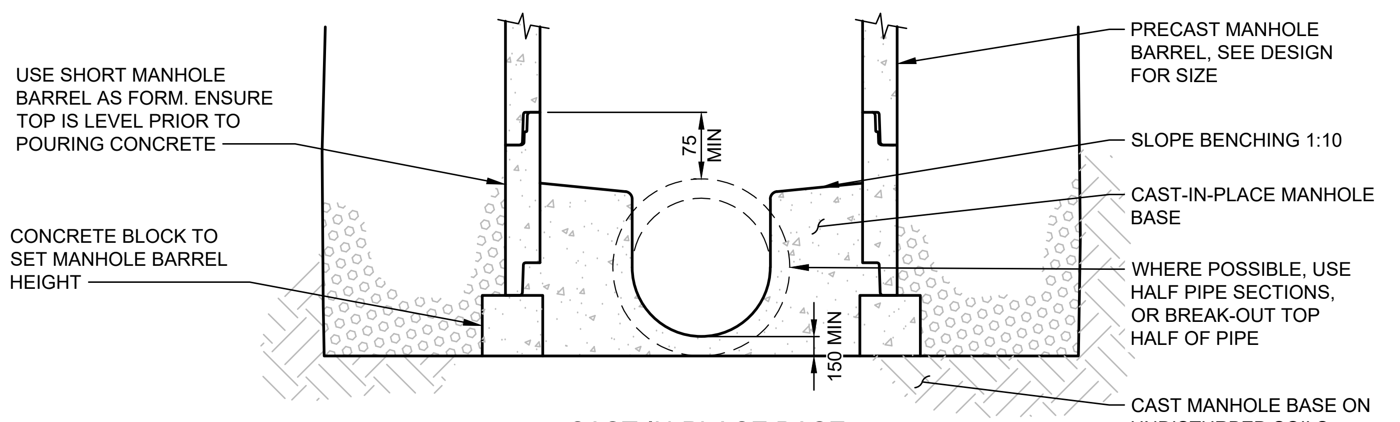
GUARD RAIL

Scale:	NTS
Created:	NOV 1997
Rev Date:	NOV 2016
Dwg No:	SW-12



TYPICAL SECTION

1:25



CAST-IN-PLACE BASE

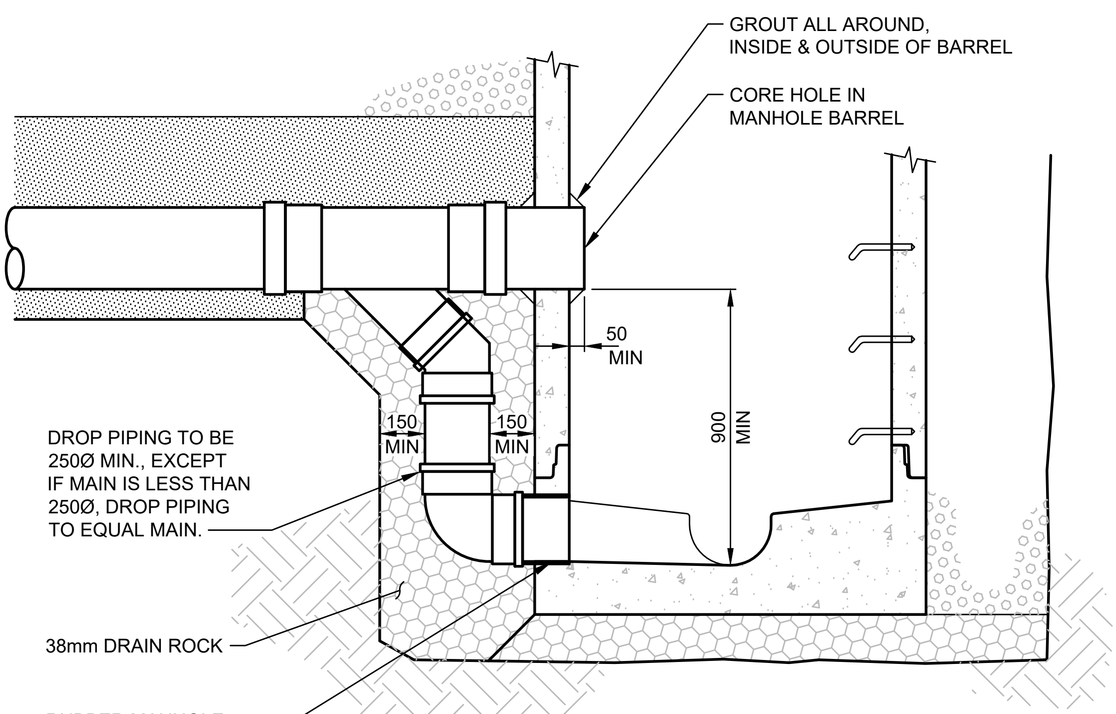
NOTES:

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 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.
6. LOW PROFILE FRAMES NOT PERMITTED IN ROADS UNLESS APPROVED BY CITY ENGINEER.
7. CASTING TO BE SET FLUSH WITH TRAVELLED SURFACE SUCH THAT THERE ARE NO IRREGULARITIES GREATER THAN 6mm WHEN CHECKED WITH A 3m STRAIGHT EDGE IN ANY DIRECTION.

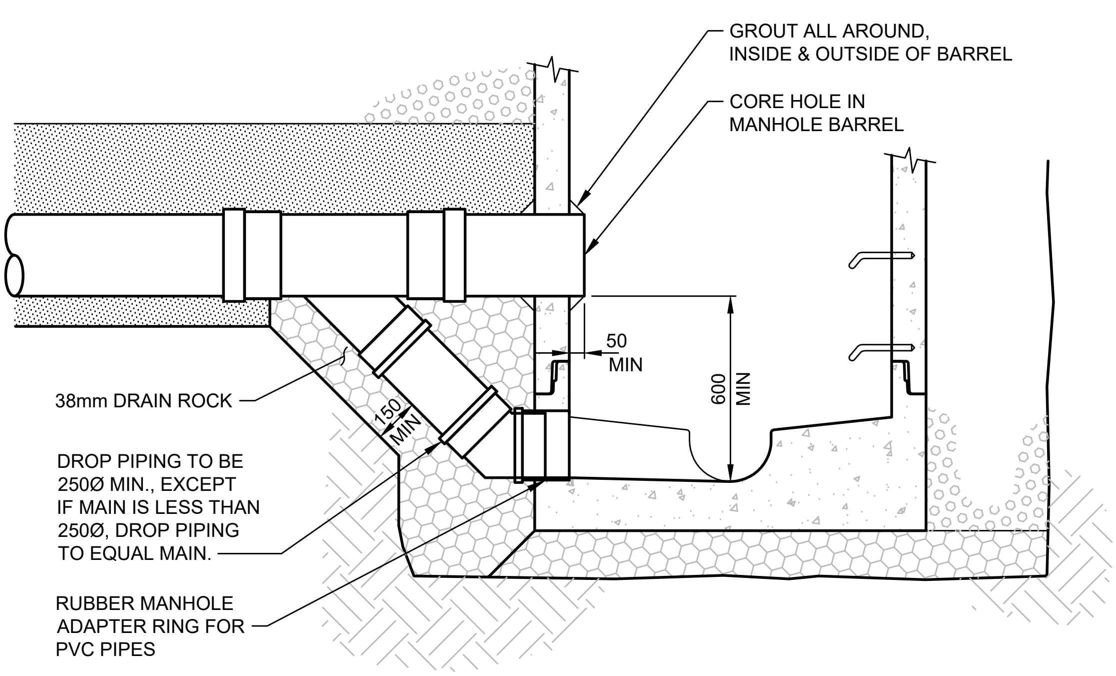
CITY OF NANAIMO
THE HARBOUR CITY

STORM MANHOLE

Scale:	1:25
Created:	FEB 2016
Rev Date:	MAY 2020
Dwg No:	SW-13



DROP MANHOLE TYPE 1
1:25



DROP MANHOLE TYPE 2
1:25

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.

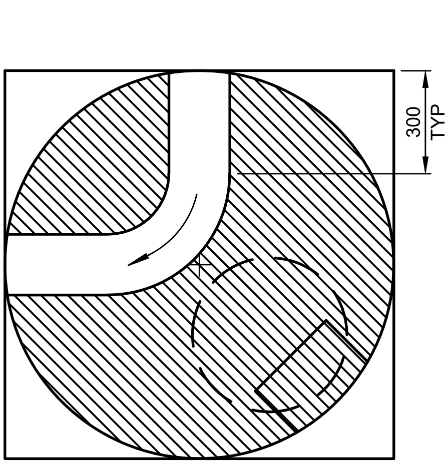
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 7 DWGS\SW-14

2.28.2020

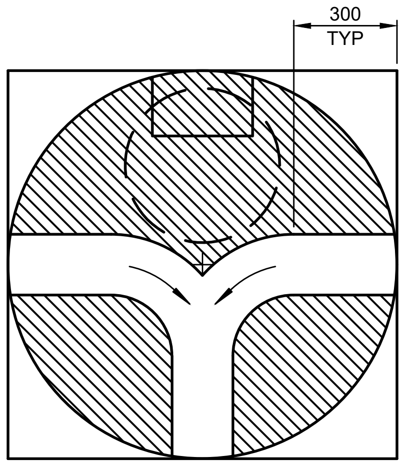
CITY OF NANAIMO
THE HARBOUR CITY

STORM DROP MANHOLE

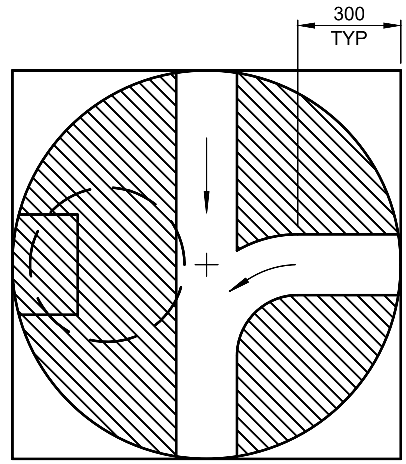
Scale:	1:25
Created:	FEB 2016
Rev Date:	MAY 2020
Dwg No:	SW-14



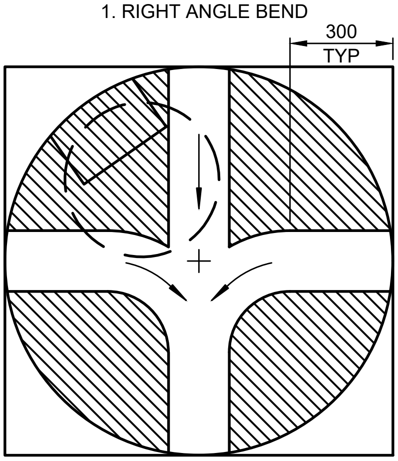
1. RIGHT ANGLE BEND



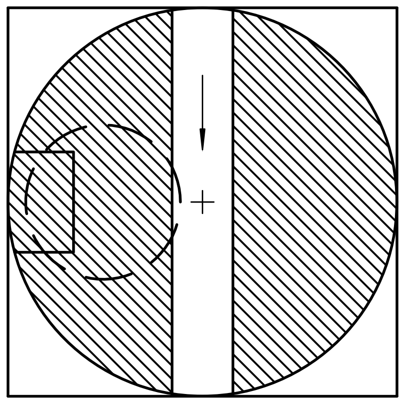
2. TEE CONNECTION



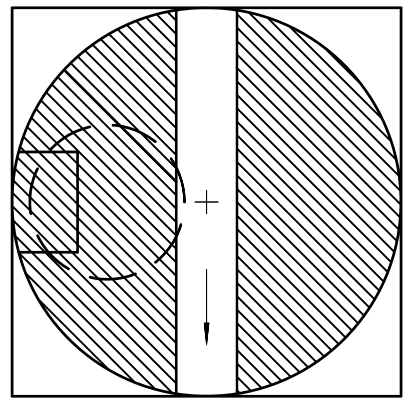
3. THREE WAY JUNCTION



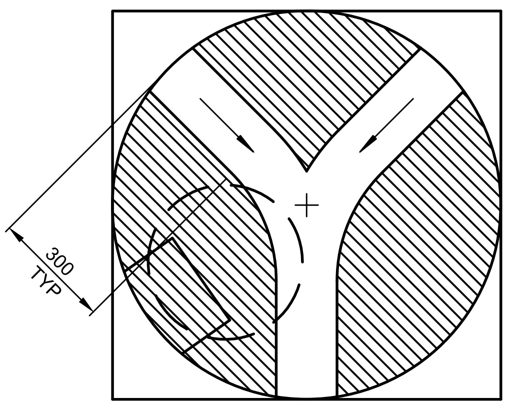
4. FOUR WAY JUNCTION



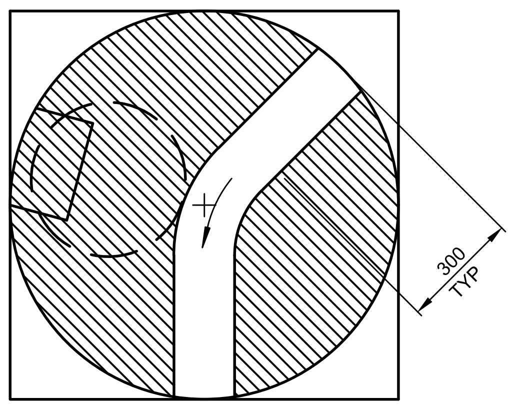
5. STRAIGHT THROUGH



6. DEAD END



7. WYE CONNECTION



8. 45° BEND

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.

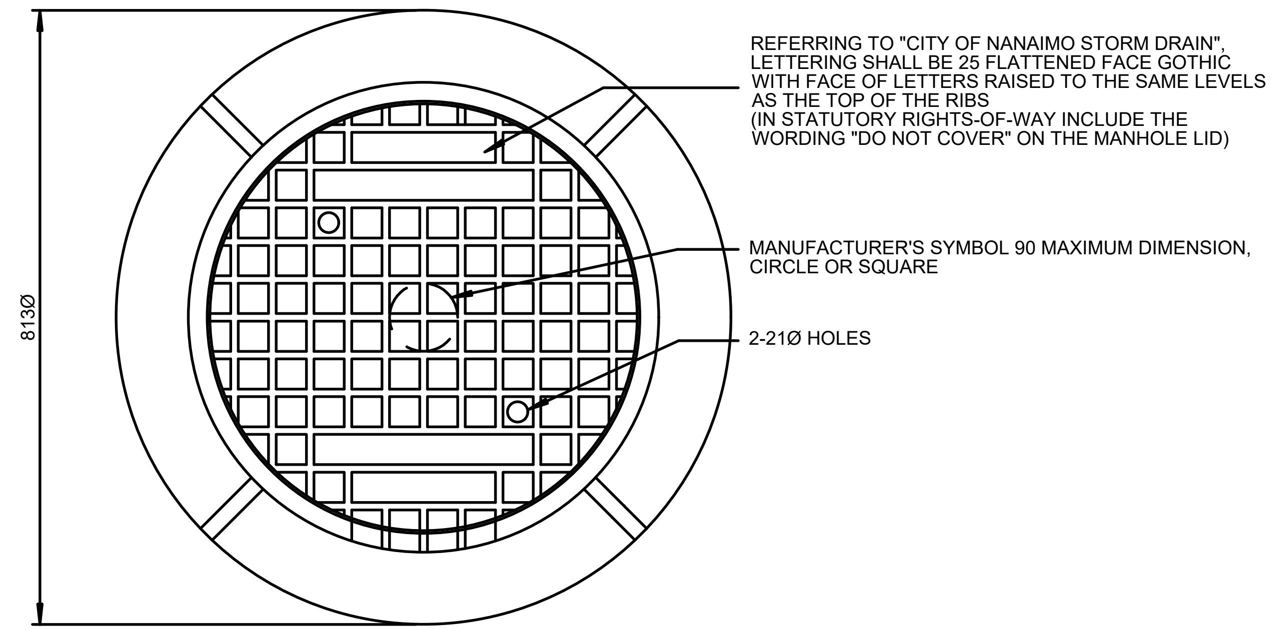
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 7 DWGS\SW-15

2.28.2020

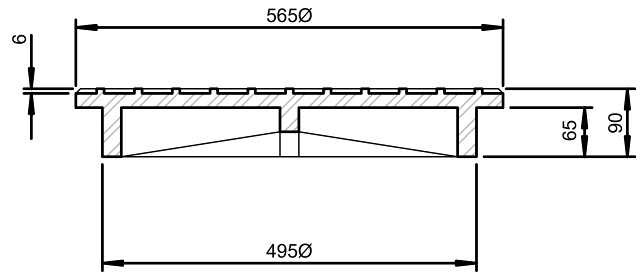
CITY OF NANAIMO
THE HARBOUR CITY

STORM MANHOLE BENCHING

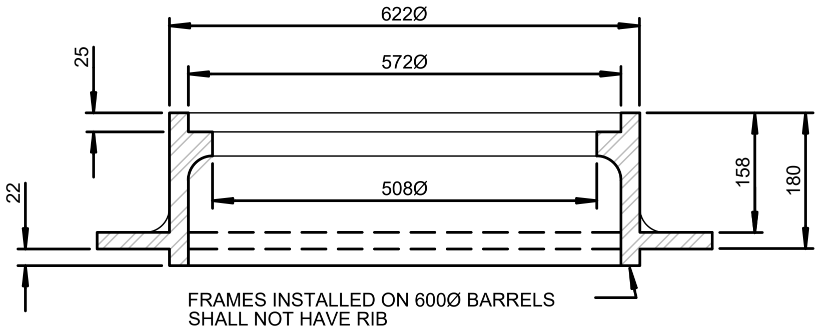
Scale:	NTS
Created:	MAY 2012
Rev Date:	NOV 2016
Dwg No:	SW-15



PLAN



COVER



FRAME

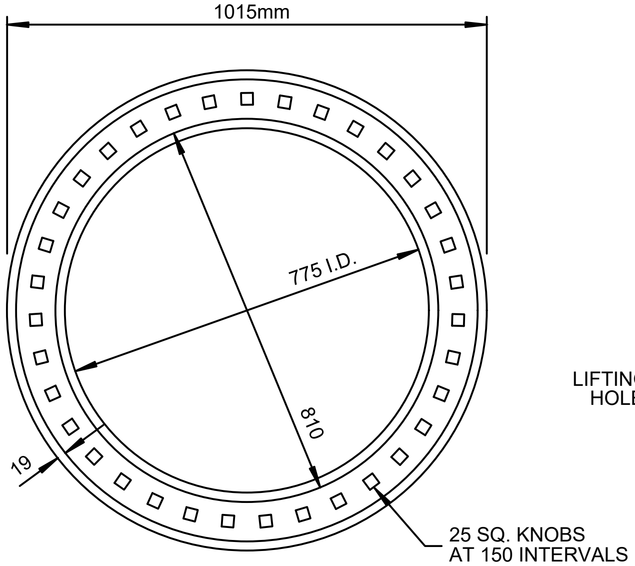
NOTES:

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 NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
6. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.

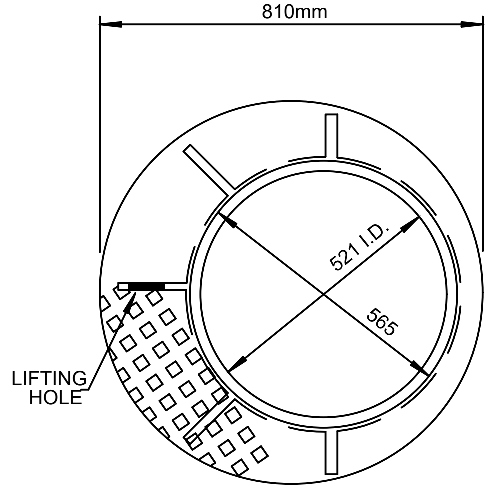
CITY OF NANAIMO
THE HARBOUR CITY

STORM MANHOLE
FRAME AND COVER

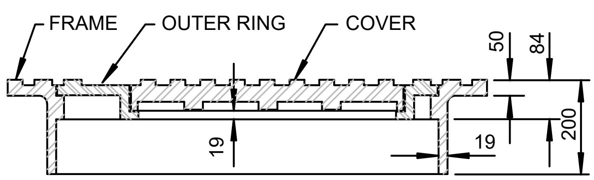
Scale:	NTS
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	SW-16



PLAN OF FRAME



PLAN OF OUTER RING



SECTION OF FRAME, RING AND COVER

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.

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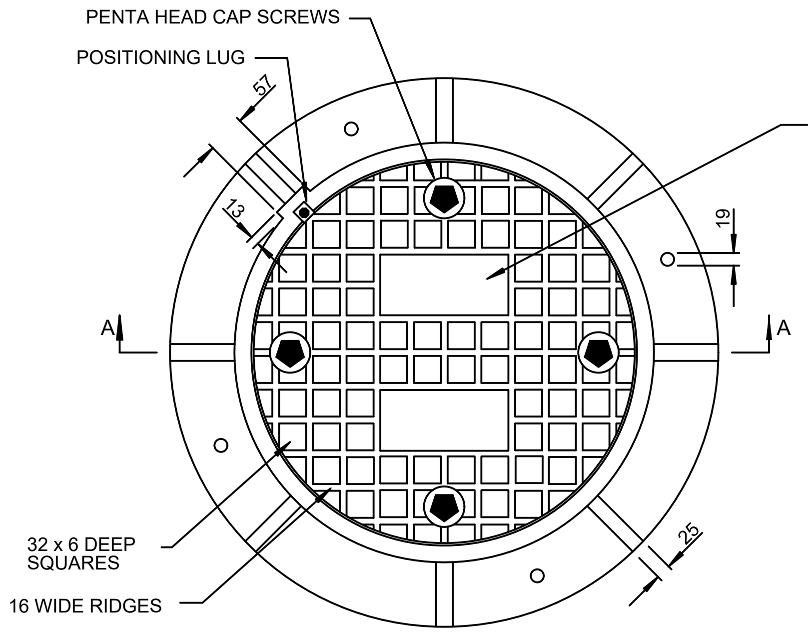
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

UTILITY CHAMBER STORM MANHOLE
FRAME, RING AND COVER

Scale:	NTS
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	SW-17

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.

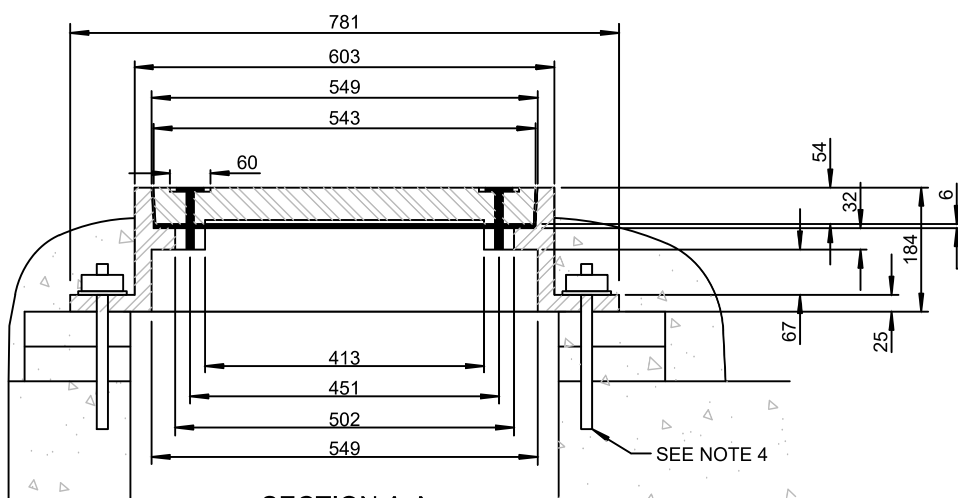


REFERRING TO "CITY OF NANAIMO STORM DRAIN", LETTERING SHALL BE 25 FLATTENED FACE GOTHIC WITH FACE OF LETTERS RAISED TO THE SAME LEVELS AS THE TOP OF THE RIBS (IN STATUTORY RIGHTS-OF-WAY INCLUDE THE WORDING "DO NOT COVER" ON THE MANHOLE LID)

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.

PLAN



DIA. OF COVER ------ 543
THICKNESS OF COVER -- 54
DIA. OF FRAME ------ 781
DEPTH OF FRAME -----184

SECTION A-A

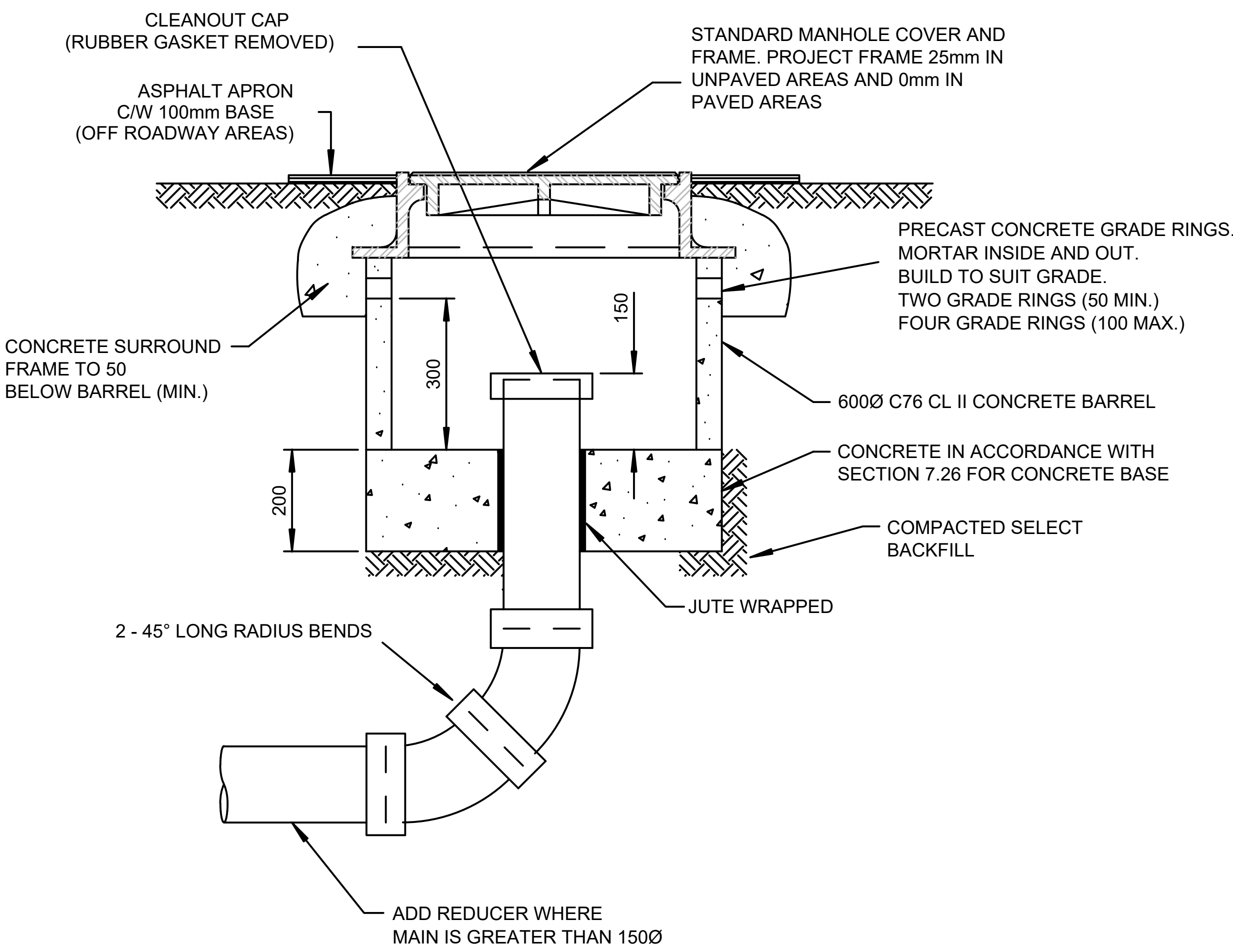
NOTES:

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 19Ø 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.

CITY OF NANAIMO
THE HARBOUR CITY

WATERTIGHT STORM MANHOLE FRAME AND COVER

Scale:	NTS
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	SW-18



NOTES:

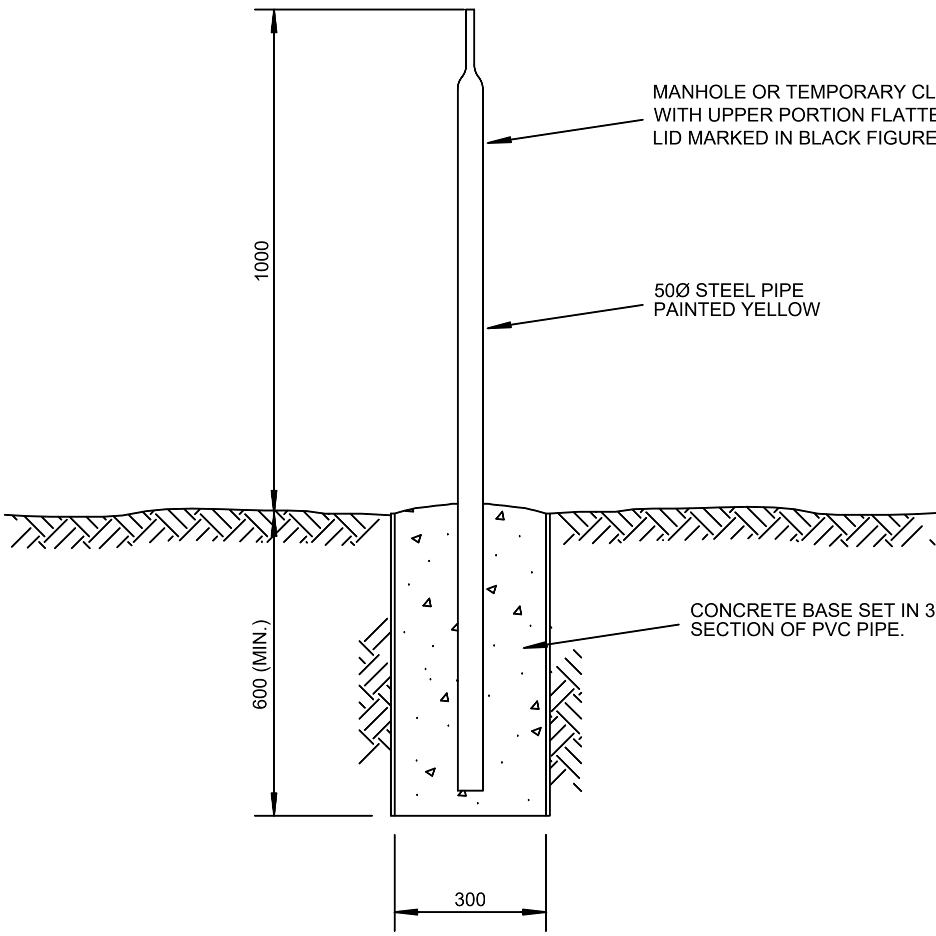
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. TEMPORARY CLEANOUT STRUCTURES MAY ONLY BE USED AT THE DISCRETION OF THE CITY ENGINEER WHERE THERE IS DEVELOPMENT PHASING.
3. USE WHERE NO SERVICE EXTENSION IS REQUIRED.
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.

CITY OF NANAIMO
THE HARBOUR CITY

TEMPORARY STORM
CLEANOUT STRUCTURE

Scale:	1:15
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	SW-19

2.28.2020



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.

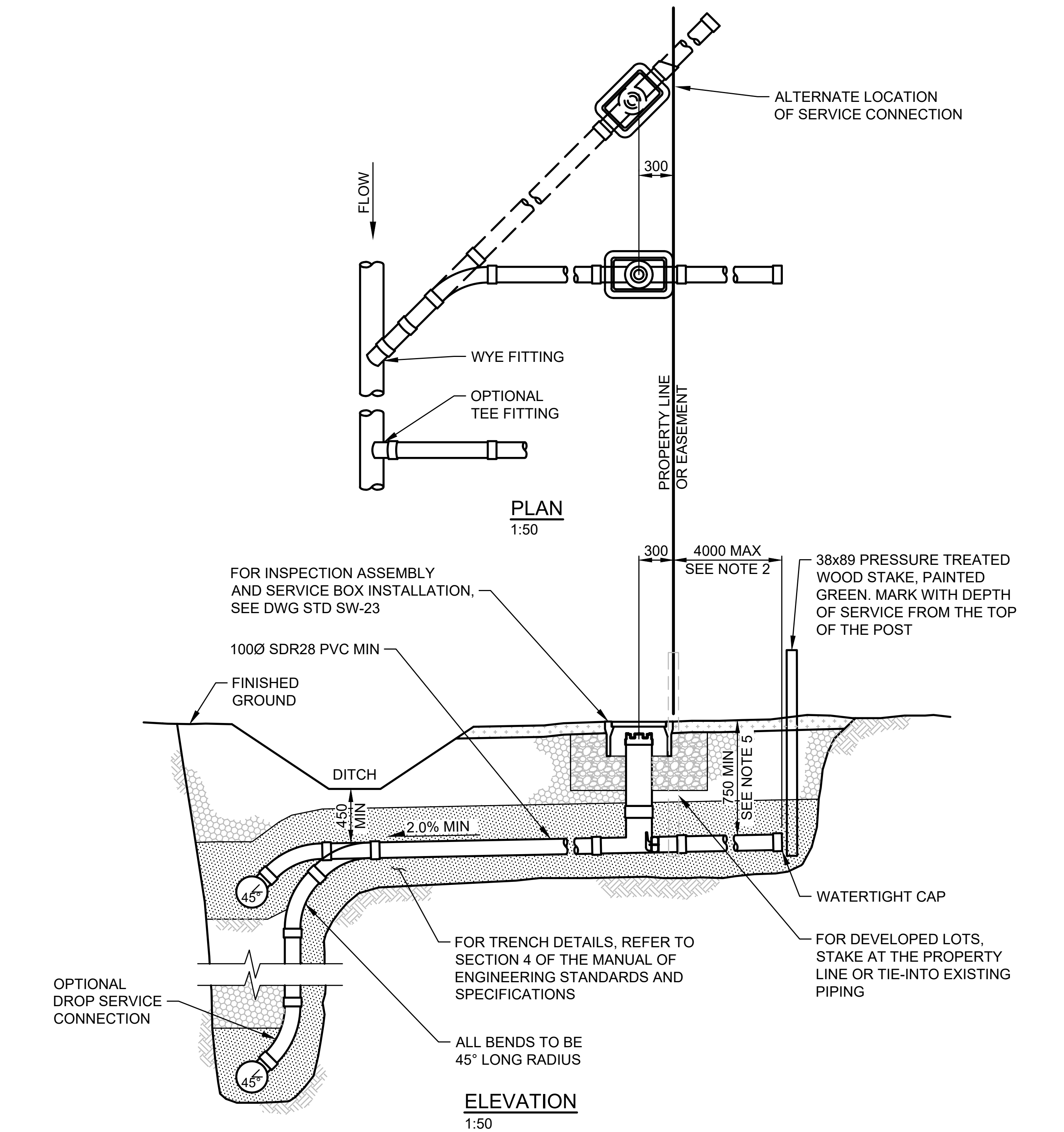
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 7 DWGS\SW-20

2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

STORM MANHOLE AND TEMPORARY CLEANOUT MARKER

Scale:	1:15
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	SW-20



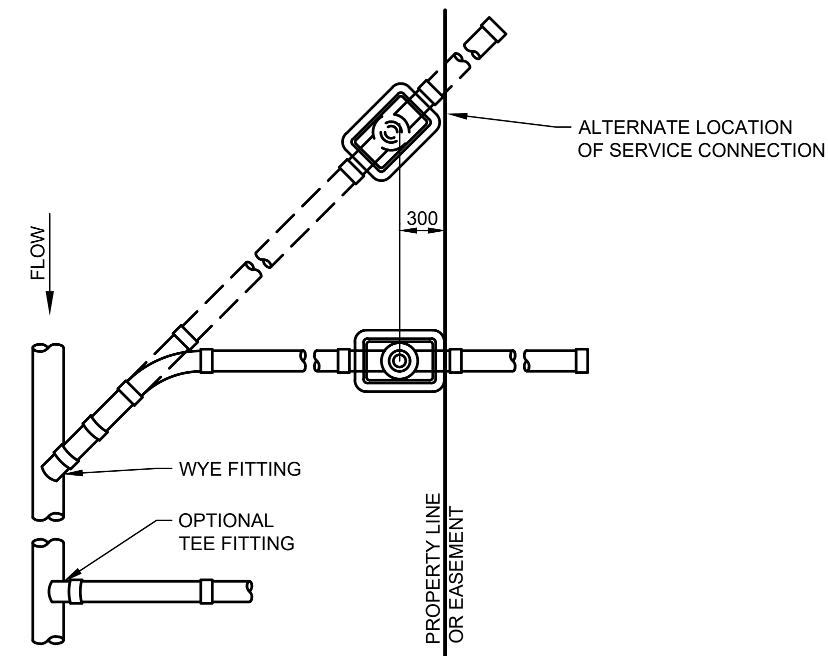
NOTES:

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.

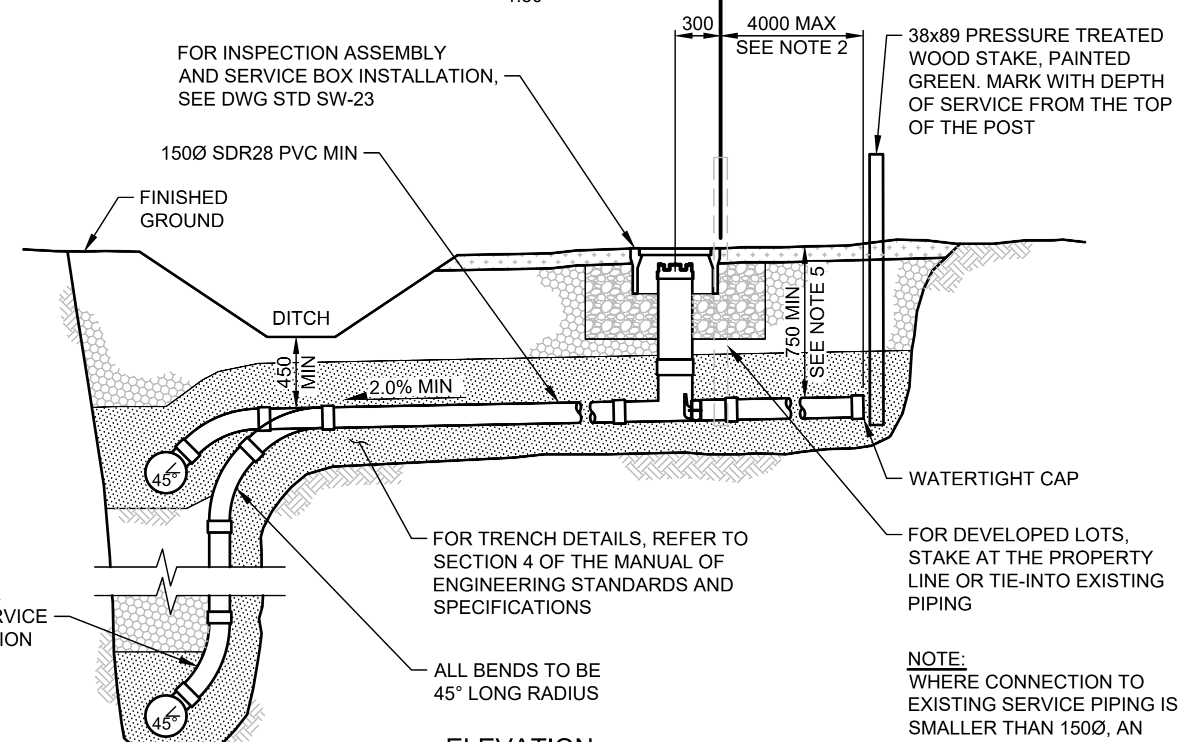
CITY OF NANAIMO
THE HARBOUR CITY

GENERAL STORM SERVICE CONNECTION DETAIL
RISER AND NON-RISER TYPES

Scale:	1:50
Created:	MAR 2016
Rev Date:	MAY 2020
Dwg No:	SW-21



PLAN
1:50



NOTE:
WHERE CONNECTION TO EXISTING SERVICE PIPING IS SMALLER THAN 150Ø, AN ECCENTRIC REDUCER SHALL BE INSTALLED.

ELEVATION
1:50

NOTES:

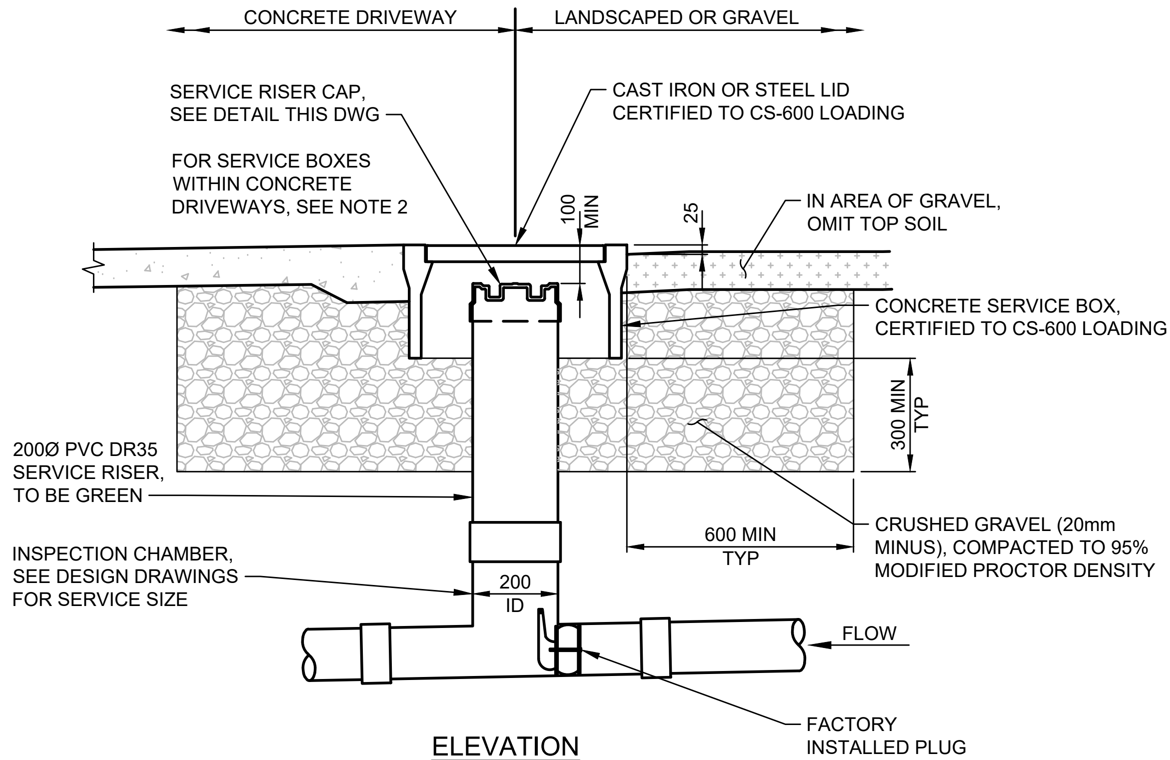
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. WHERE DEPTH OF SERVICE AT PROPERTY LINE IS GREATER THAN 2.0m, EXTEND THE SERVICE PAST THE PROPERTY LINE EQUAL TO ITS DEPTH, TO A MAXIMUM OF 4.0m.
3. WHERE SERVICE 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.

2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

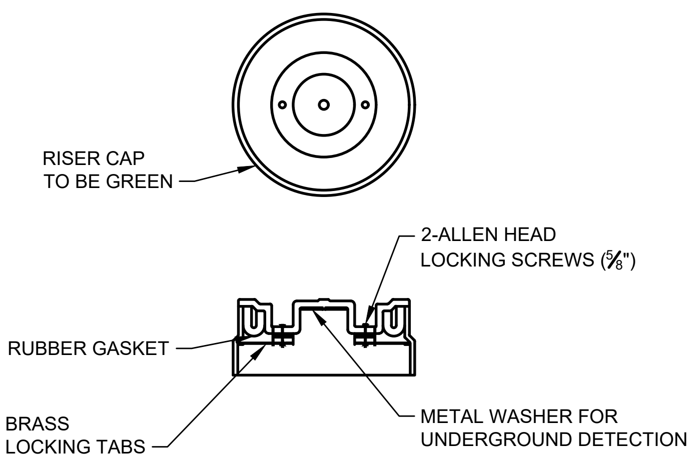
COMMERCIAL AREA STORM SERVICE CONNECTION DETAIL RISER AND NON-RISER TYPES

Scale:	1:50
Created:	MAR 2015
Rev Date:	MAY 2020
Dwg No:	SW-22



ELEVATION

1:20



RISER CAP DETAIL

NTS

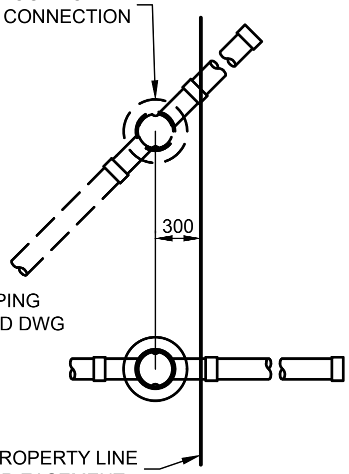
NOTES:

1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING 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.

CITY OF NANAIMO
THE HARBOUR CITY

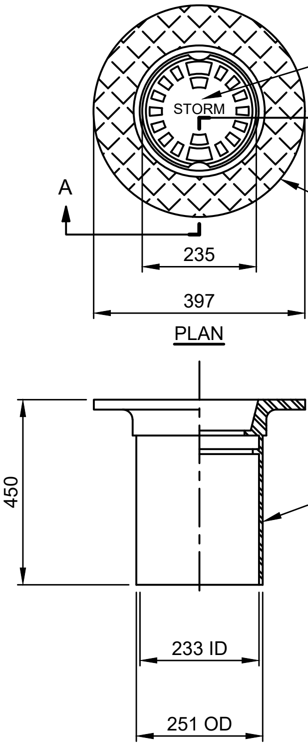
STORM SERVICE BOX AND
INSPECTION ASSEMBLY INSTALLATION

Scale:	1:20
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	SW-23



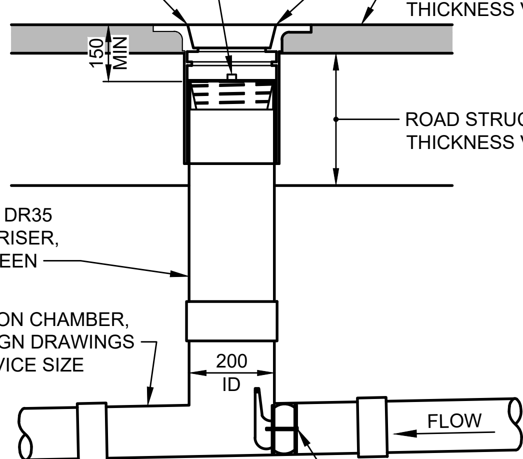
PLAN - VALVE BOX LOCATIONS

NTS



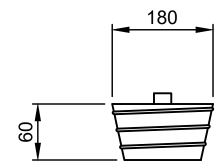
MR STYLE VALVE BOX

1:15

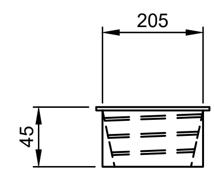


INSPECTION ASSEMBLY ELEVATION

1:20



RIGID PLASTIC PLUG



RUBBER SEALING COLLAR

MECHANICAL SCREW PLUGS

NTS

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.

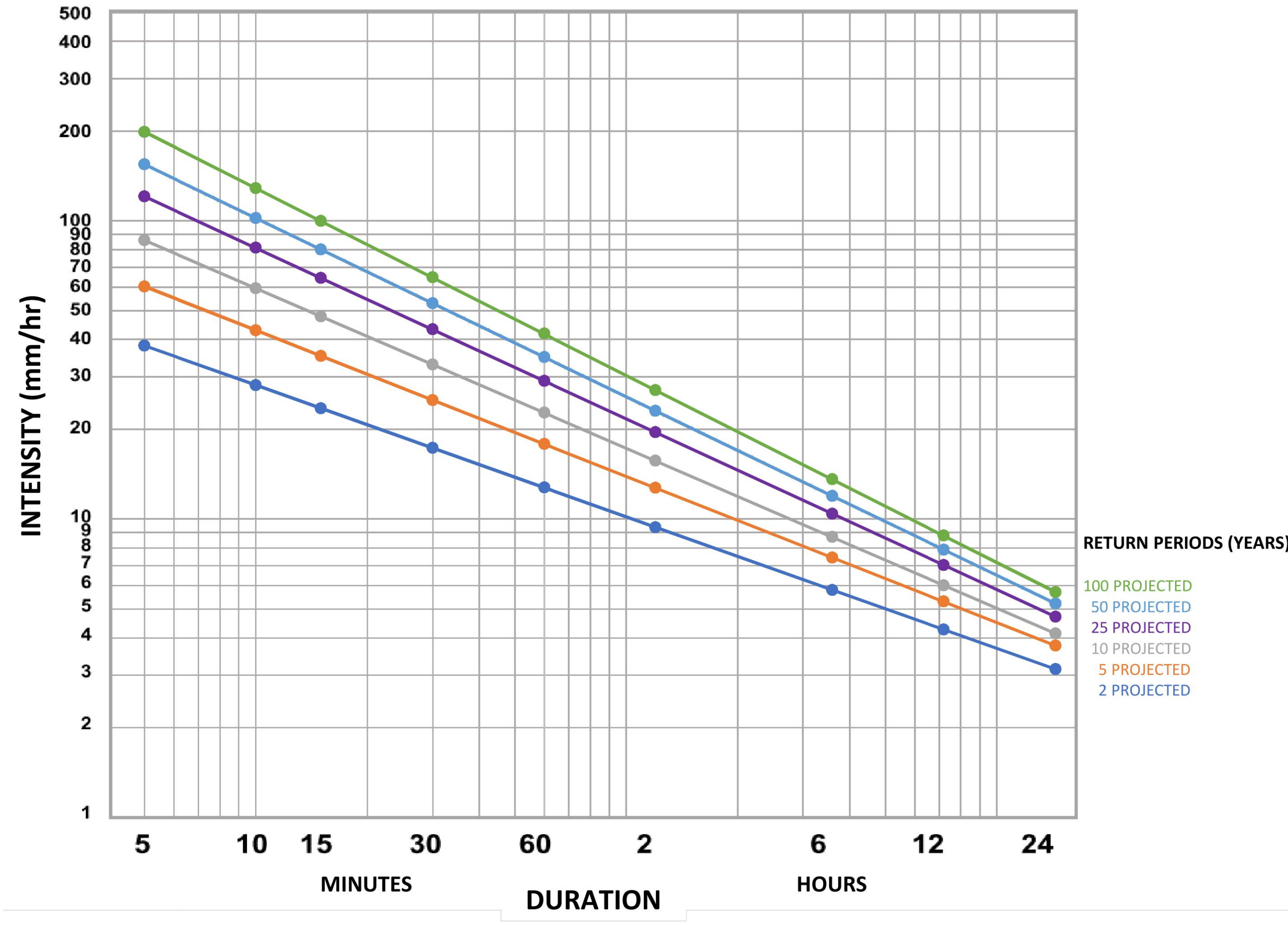
CITY OF NANAIMO
THE HARBOUR CITY

STORM SERVICE BOX AND INSPECTION ASSEMBLY
INSTALLATION IN PAVED LANES AND ROADWAYS

Scale:	AS NOTED
Created:	MAR 2016
Rev Date:	NOV 2016
Dwg No:	SW-24

SHORT DURATION RAINFALL INTENSITY-DURATION FREQUENCY DATA FOR NANAIMO

(BASED ON RECORDING RAIN GAUGE DATA FOR THE PERIOD 1980 - 2018 FROM CITY OF NANAIMO PUBLIC WORKS YARD AND ADJUSTED FOR CLIMATE CHANGE)



CURVE BEST-FIT PARAMETERS:

RETURN PERIOD (YR)	2	5	10	25	50	100
A	12.8	17.9	22.7	29.1	34.9	41.8
B	-0.441	-0.490	-0.536	-0.573	-0.599	-0.628

CURVES BASED ON FORMULA: $I = AxT^{B}$

where T = Time of Concentration (hr)
where I = Intensity (mm/hr)

NOTE:
Convert Time of Concentration to HOURS in above formula.

RAINFALL INTENSITIES, I (mm/hr):

	RETURN PERIOD (YR)					
T	2	5	10	25	50	100
5 min	38.2	60.3	86.2	120.7	154.7	199.0
10 min	28.1	42.9	59.4	81.2	102.2	128.8
15 min	23.5	35.2	47.8	64.3	80.1	99.9
30 min	17.3	25.1	33.0	43.3	52.9	64.6
1 h	12.8	17.9	22.7	29.1	34.9	41.8
2 h	9.4	12.7	15.7	19.6	23.1	27.1
6 h	5.8	7.4	8.7	10.4	11.9	13.6
12 h	4.3	5.3	6.0	7.0	7.9	8.8
24 h	3.1	3.8	4.1	4.7	5.2	5.7

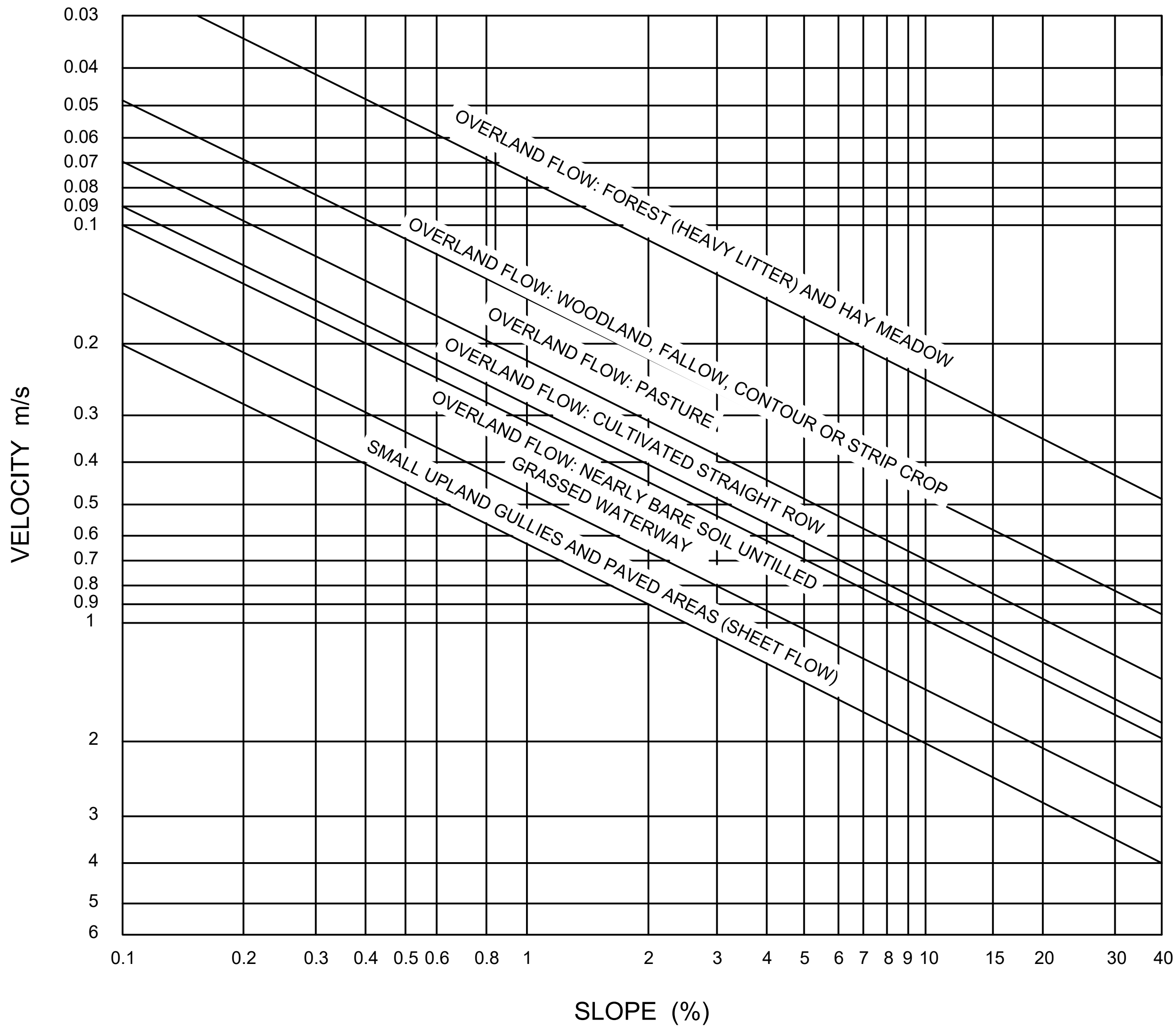
NOTES:

1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.

CITY OF NANAIMO
THE HARBOUR CITY

RAINFALL CURVES

Scale:	NTS
Created:	MAR 2016
Rev Date:	MAY 2020
Dwg No:	SW-25



UPLAND METHOD FOR ESTIMATING TIME OF CONCENTRATION

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 10km^2.
3. THIS TABLE DOES NOT MAKE ALLOWANCES FOR VARIATIONS IN SOIL TYPES AND MAY UNDERESTIMATE TIMES FOR PERMEABLE BASINS.

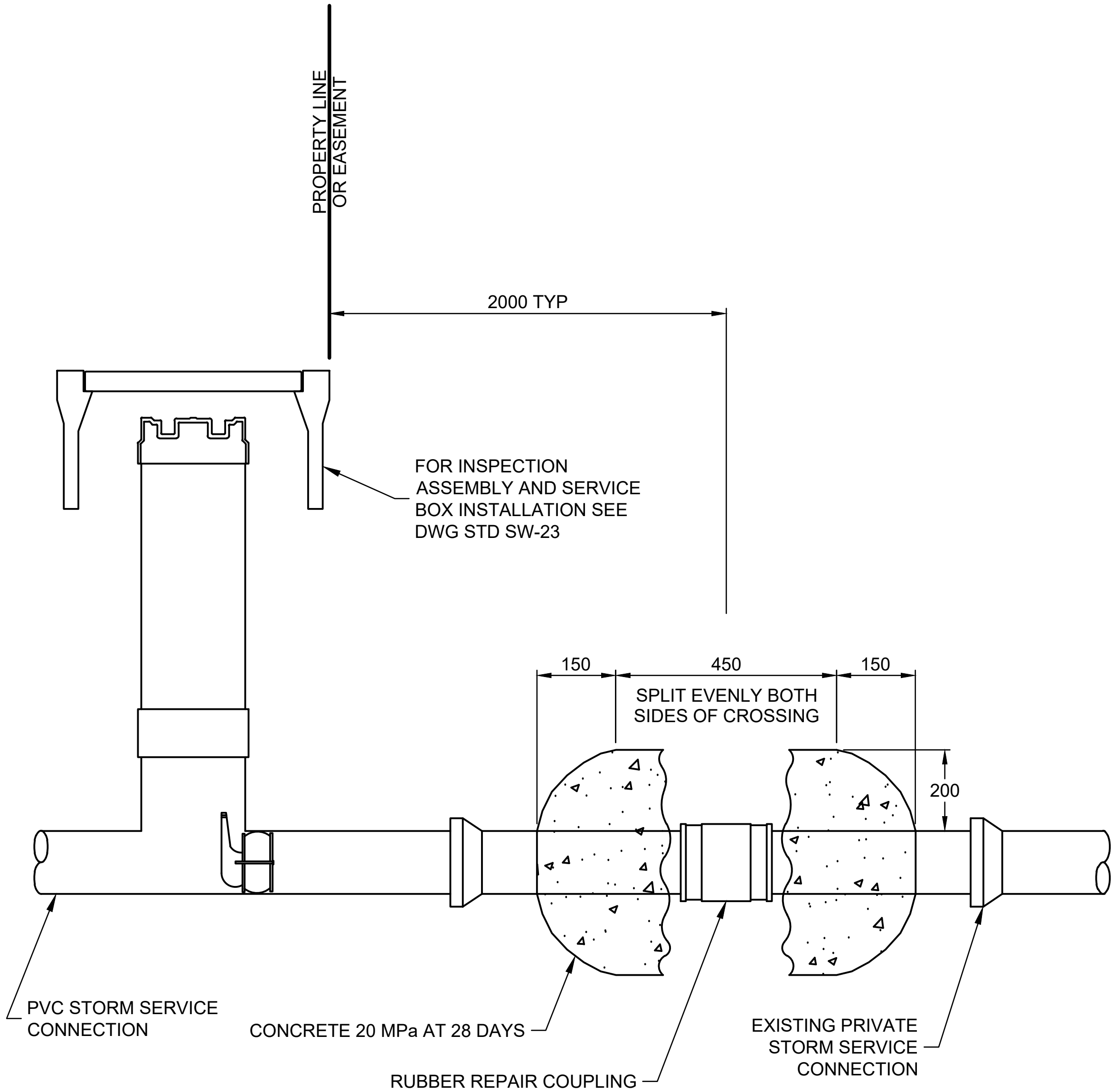
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 7 DWGS\SW-26

2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

TIME OF CONCENTRATION TABLE

Scale:	NTS
Created:	NOV 2009
Rev Date:	NOV 2016
Dwg No:	SW-26



ELEVATION

NOTES:

1. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
3. SPIGOTS IF PRESENT SHALL BE REMOVED BEFORE COUPLING IS INSTALLED.

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8.10.2020

CITY OF NANAIMO
THE HARBOUR CITY

CONCRETE ENCASEMENT FOR
CONNECTIONS TO EXISTING
STORM SERVICE CONNECTIONS

Scale:	NTS
Created:	AUG 2020
Rev Date:	MAY 2020
Dwg No:	SW-27

SECTION 8 – TRANSPORTATION
CONTENTS
(REVISED MAY 2020)

SECTION 8 – TRANSPORTATION
CONTENTS
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SECTION 8 – TRANSPORTATION
CONTENTS
(REVISED MAY 2020)

SECTION 8 – TRANSPORTATION
DESIGN CRITERIA
(REVISED MAY 2020)

8.01 INTRODUCTION

.1 Scope:

The City of Nanaimo has adopted a Complete Streets framework in an effort to create a more Complete Community and Complete Network. This design philosophy prioritizes universal design and the need for streets to be designed for all users, regardless of mode, age, or ability. This includes, but is not limited to, pedestrians, cyclists, transit, commercial vehicles and motorists.

All transportation infrastructure shall be designed in accordance to the following design criteria. The construction shall be in accordance to the outlined specifications and installation requirements captured throughout all sections of the Manual of Engineering Standards and Specifications.

.2 Objectives:

The objectives of this section are to:

(a) Improve safety and comfort for all modes.
(b) Provide accessibility for people of all ages and abilities through Universal Design.
(c) Accommodate larger vehicles and turning radii where needed, to account for truck routes, transit routes and emergency vehicles.
(d) Improve travel time reliability on the street network for all modes, with emphasis on transit and goods movements.
(e) Incorporate smart infrastructure opportunities to support emerging transportation technologies.
(f) Encourage attractive streetscapes that respond to surrounding land uses, providing opportunities for place-making, social interaction, and art.
(g) Improve local ecology through stormwater management and vegetation.

.3 City Initiatives:

This manual should be used in accordance with the most recent version of other City guidelines, policies, and bylaws including, but not limited to, those listed below:

(a) Official Community Plan
(b) Nanaimo Transportation Master Plan
(c) Nanaimo's Complete Streets Guidelines

.4 Government Resources:

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) Ministry of Transportation and Infrastructure (MoTI):

(i) BC Supplement to Transportation Association of Canada (TAC)
(ii) British Columbia Community Road Safety Toolkit
(iii) Active Transportation Design Guide

(b) BC Transit:

(i) Transit Future Plan
(ii) Bus Stop Infrastructure Design Summary
(iii) Infrastructure Design Guidelines

.5 Industry Resources:

In addition, this manual should be used in accordance with other applicable guidelines and documents, including but not necessarily limited to, the most recent versions of the following:

(a) Transportation Association of Canada (TAC):

(i) Geometric Design Guide for Canadian Roads
(ii) Manual of Uniform Transportation and Traffic Control Devices (MUTCD)
(iii) Pedestrian Crossing Control Manual
(iv) Bikeway Traffic Control Guidelines for Canada
(v) Canadian Guide to Traffic Calming

(b) Institute of Transportation Engineers (ITE) Transportation Planning Handbook.

(c) National Association of City Transportation Officials (NATCO):

(i) Urban Street Design Guide
(ii) Urban Bikeway Design Guide
(iii) Transit Street Design Guide

.6 Design Deviation:

City of Nanaimo mobility networks have been constructed over many years using design criteria and practices that were in place at the time. The current criteria and best practices are to be used when designing all new infrastructure. When retrofitting existing corridors, limitations will create challenges with design and compromises may be necessary. Existing pedestrian and cycling facilities 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 Engineer will be responsible to ensure the design is appropriate, founded on solid engineering principles and practices, and approved by the City Engineer.

.7 Development and Deviation Requirements:

(a) Responsibilities:

It is the Engineer's responsibility to ensure that all applicable guidelines, standards, bylaws and other regulations and policies are strictly followed.

(b) Reporting:

(i) The City may require various studies to be submitted to the City Engineer for approval. These could include, but are not limited to a:

1. Transportation Impact Assessment
2. Parking Study
3. Transportation Demand Management Plan
4. Road Safety Audit

(ii) If design standards cannot be met due to the existing conditions, it shall be documented and a design deviation memo shall be submitted to the City Engineer for approval.

8.02 DEFINITIONS

.1 For the purpose of this specification, the following definitions apply, unless otherwise noted:

(a) Curb refers to concrete curbs with or without integral gutters.
(b) Curb Ramp refers to the transitional grade between two surfaces (typically a sidewalk and a street crosswalk).
(c) Tactile Walking Surface Indicator (TWSI), also referred to as detectable warning surfaces or tactile attention indicators, are standardized walking surfaces that convey information to people with vision loss through texture.

(i) Attention TWSIs – sometimes called warning TWSIs, call attention to key hazards such as vehicle-pedestrian conflict zones, the start of a staircase, or the edge of a platform.
(ii) Guidance TWSIs – also known as wayfinding TWSIs, provide information about the direction of travel through open spaces. They are designed to guide a person on a designated path of travel.

(d) Sidewalk refers to concrete sidewalks located within a road right-of-way accommodating pedestrians.
(e) Walkway refers to asphalt or concrete sidewalks located outside a road right-of-way accommodating pedestrians.

(f) Multi-use path refers to an asphalt, concrete, or gravel pathway accommodating pedestrians, cyclists, and other wheeled modes.
(g) Bike path refers to asphalt pathways located within a road right-of-way accommodating cyclists and other wheeled modes.
(h) Elephants' Feet markings refer to a series of white painted squares that delineate a crosswalk where cycling is permitted and dismounting is not required.
(i) Design Vehicle refers to the least maneuverable vehicle that routinely uses a street or a facility to prevent the overdesign of a street.
(j) Control Vehicle refers to the least maneuverable vehicle that is ever planned to use a street, but potentially at very low speeds or with multi-point turns.
(k) Woonerf refers to a shared street with various modes utilizing the same space in a traffic calmed environment.

8.03 STREET TYPES AND CLASSIFICATIONS

.1 Mobility Streets:

The Mobility classification includes specifically selected nodes or corridors where higher density development is present or expected to occur. These streets focus on increased public space and accommodation for all modes, with an emphasis on sustainable transportation.

(a) Mobility Local:

(i) Mobility Local Streets can be considered as a destination. People will come here to visit commercial destinations, and will arrive on foot from higher density mixed use development nearby, or via bicycle, transit or car from further afield. The street design will encourage lower speeds where bicycles can safely mix with traffic. Wide sidewalks will provide opportunities for seating and activity to spill out on the sidewalk turning the street into a vibrant public space. Like the urban local roads, entry and exit from such streets should be across continuous and raised crosswalks that slow vehicles down entering or leaving these Mobility Local Streets. Where on-street parking is provided, it should be in a style that blurs the line between roadway and sidewalk, making the street more pedestrian friendly and encouraging slower speeds. Street trees are recommended at frequent spacing between parked vehicles. Shared use designs such as the Woonerf concept may be applicable here.

(b) Mobility Collector:

(i) The Mobility Collector provides a connection for all modes between Mobility Local Streets and Mobility Arterial Streets. This classification is multi-functional providing land access, on-street parking where it supports adjacent land uses, and typically accommodates higher volumes of traffic than a Local Street. Commercial activity is still expected to be a priority on these streets and sidewalks are wide to accommodate spillover uses from adjacent properties and add vibrant life to the street. Parking is provided in parking pockets which then provide space for landscaping or furniture or bicycle parking. Street trees are provided between the bike path and sidewalk, helping to separate bicycles from pedestrians on these activity streets.

(c) Mobility Arterial:

(i) Mobility Arterial streets carry traffic for all modes between the principle areas of traffic generation. Pedestrian activity on the street is expected to be lower relative to vehicular traffic. Mobility arterial streets shall be designed to minimize direct access to development with access provided by adjoining streets of lower classifications. Parking is prohibited on these streets. Their location within mobility hubs will generally mean that while these carry higher volumes, vehicle speeds should be lower than more suburban environments and less separation is required between opposing directions of traffic. Median islands are generally not present on these streets. Bicycles are accommodated on bike paths between the sidewalk and boulevard. Intersections have protected facilities.

.2 Urban Streets:

The Urban classification includes all areas outside of mobility hubs or industrial areas. It forms the majority of the City's streets and is typically associated with lower density development, single family homes, or smaller scale commercial areas.

These streets try to balance the needs of all modes, providing less pedestrian accommodation than streets classified in the Mobility category, while providing increased traffic capacity.

(a) Urban Local:

(i) Urban Local Streets primarily carry traffic with an origin and/or destination along its length. It is not intended to carry large volumes of traffic or through traffic other than to immediately adjoining streets. They are intended to be lower volume, slower streets where it is safe for cyclists to share the road with motor vehicle traffic. In some cases, they may be supplemented by measures to create neighbourhood bikeways. Road widths are relatively narrow to encourage slower vehicle speeds, on-street parking is provided in pocket parking adjacent to residential driveways where practical, and where it can be integrated with boulevards and street trees. Pedestrians take priority on such streets and, as such, intersection designs favour pedestrian priority through raised and continuous sidewalks at the intersections with Collector Streets. This aims to calm traffic as it enters the neighbourhood and reinforce a change in priorities.

(b) Urban Collector:

(i) The Urban Collector Streets provide a connection for all modes between Urban Local Streets and Urban Arterial Streets. This classification is multi-functional, providing land access, some on-street parking where it supports adjacent land uses, and typically accommodates higher volumes of traffic than a Local Street. Narrow lane widths that still support bus and truck movements are recommended to manage vehicle speeds. Curb extensions at frequent intervals along the street add further friction, particularly where parking is underutilized and provide space for street trees. Bike paths between the sidewalk and parking/boulevard provide safety for cyclists. Intersections with other Collector Streets or Arterial Streets shall provide protected intersection designs for cyclists. Where on-street parking is provided, there must be a suitable door zone buffer between vehicles and the bike path. Intersection corners may require the use of compound curves to accommodate the appropriate design vehicle.

(c) Urban Arterial:

(i) Urban Arterial streets carry traffic for all modes between the principle areas of traffic generation. They are intended to carry large volumes of all types of traffic. Urban arterial streets shall be designed to minimize direct access to development with access provided by adjoining streets of lower classifications. Parking is prohibited on these streets. These streets may often feature multiple travel lanes, and, as such, the design vehicle and the control vehicle may differ. Like Collector Streets, cyclists are accommodated on bike paths between wide boulevards and sidewalks, and intersection shall be designed as protected intersections.

.3 Industrial Streets:

The Industrial classification includes specifically selected streets that serve industrial development. These streets focus on the accommodation of larger vehicles; however, employees and customers still have to get to work in these locations and this can be done by sustainable modes, if designed appropriately. It is not anticipated that there would be industrial arterial roads, rather Industrial Collector Streets would connect to Urban Arterial Streets or Provincial Highways.

(a) Industrial Local:

(i) Industrial Local streets will provide direct access to industrial businesses. They will typically be used by employees, customers, and delivery vehicles. The street design features wider travel lanes and parking lanes more suited to larger vehicles. Multi-use paths are separated from vehicles by a boulevard helping separate pedestrians and cyclists from large vehicles.

(b) Industrial Collector:

(i) The Industrial Collector provides a connection for all modes between Urban Arterial Streets and Industrial Local Streets. This classification is multi-functional providing land access, on-street parking, and typically accommodates higher volumes of traffic than a Local Street. Bike paths are provided to provide employees with sustainable transportation choices. It is important that these be separated from the parking lane by a door zone. Sidewalks are provided adjacent to the bike path, separated by a small buffer.

.4 Half Road Dedication and Construction:

(a) Half road construction shall be limited to situations where future development of surrounding properties will result in dedication and construction of the full road.

(b) All design parameters shall match those specified as per the City's Road Classification Network and Cross Sectional Standard Drawings.

(c) The road width requirements will be to construct the lesser of 1 m beyond the opposing back of curb, or 4.6 m past the centerline, unless otherwise determined by the City Engineer.

(d) Parking is not supported where ultimate weekday traffic volumes are anticipated to exceed 300 veh/day.

(e) Half road construction for lanes is not supported in new development.

(f) Drainage must be contained and conveyed to the storm system within the pavement surface. Open channel drainage may be considered along the interim road edge with additional dedication for a drainage swale.

(g) For half roads with no exit, a temporary turnaround must be designed and constructed, as per Standard Drawing No. R-TT.

(h) Parking must be restricted through signage where not accommodated.

.5 Cul-de-Sac:

(a) Use of cul-de-sacs shall be limited to situations where in the opinion of the City Engineer, there is no possibility of future road connection, such as abutting an environmentally sensitive area or topographic barrier. Abutting land with potential for further subdivision under the current zoning, will not be considered an impediment to future connections.

(b) Cul-de-sacs shall be limited to 90 m in length and shall be constructed to the applicable local road standard.

(c) Cul-de-sacs shall terminate with a 6 m wide road dedication suitable for use as a future pedestrian and cycling connection. Final development and construction of the connection will be the responsibility of the City.

.6 Temporary Turn-a-Rounds:

(a) Temporary asphalt turn-a-rounds shall be required for all temporary dead end streets and designed as per Standard Drawing No. R-TT.

(b) Extent of works is to be determined on a site specific basis and approved by the City Engineer.

.7 Other:

Streets that do not conform to the above classifications, such as rural streets and laneways, shall be designed in collaboration with the City Engineer and in accordance to the cross-sections provided within the Standard Drawings.

8.04 GEOMETRICS

.1 Horizontal and vertical alignments including horizontal curvature, stopping sight distances, vertical curvature, and intersection geometry shall be based on the TAC Geometric Design Guide for Canadian Roads.

.2 Dimensions:

(a) Dimensions are to be designed according to the requirements outlined in the Standard Drawings, unless otherwise approved by the City Engineer.
(b) Lane widths include gutter measurements, unless otherwise specified.
(c) Large variations in lane widths are to be avoided. Where extra width exists, priority is to be given to active transportation, boulevards, or medians.
(d) Where urban local roads are constructed in a reduced road right-of-way, in no case shall the pavement width be less than 6.6 m.

(e) Right-of-way widths:

Road Class	Minimum R/W Width (m)	STD. DWG. No.
Mobility Arterial	30.0	MA-XS1
Mobility Collector	28.4	MC-XS1, MC-XS2
Mobility Local	20.0	ML-XS1
Urban Arterial	34.5	UA-XS1
Urban Collector	25.0 – 26.7	UC-XS1, UC-XS2
Urban Local	20.0	UL-XS1
Industrial Collector	25.0	IC-XS1
Industrial Local	22.0	IL-XS1
Rural Local	20.0	RL-XS1
Lane	8.0	L-XS1
Half Road	<14.0	HR-XS1

(f) In constrained corridors, with approval from the City Engineer, a statutory right-of-way may be utilized to achieve the required width needed to achieve the cross-sectional elements.

.3 Alignment and Curvature:

(a) Minimum radius of curb returns at street intersections shall be 6.0 m for mobility and urban streets, and 8.0 m for industrial streets.
(b) Corner radii will be the minimum appropriate to accommodate the design and control vehicles approved by the City Engineer.
(c) Smaller corner radii can be implemented on roads where there are multiple turn lanes.
(d) Compound curves may be needed to accommodate turn movements into narrower receiving lanes.
(e) Intersections that require large turn radii for larger design vehicles, shall utilize mountable truck aprons to reduce the asphalt surface.
(f) Radius of curbs forming nodes at intersections or mid-block shall be a minimum 3.0 m concave or 5.0 m convex radius.

.4 Grades:

(a) Longitudinal:

All longitudinal grades shall meet the following criteria, unless approved by the City Engineer:

Classification	Minimum	Maximum
Gutter	0.5%	
Curb Return	1.0%	12%
Pedestrian Facilities	0.5%	12%
Residential driveway		20%
Lane	0.5%	12%
Local Road		10%*
Collector/Arterial		8%**
Intersection		5%

***The City Engineer may grant a relaxation up to 12% for sections of road less than 100 m in length that have met all other geometric criteria and have identified a location for sanitation and recycling receptacles elsewhere. Further consideration for road grades will be considered for comprehensive land developments with challenging topography.**

****Under exceptional circumstances, the City Engineer may relax the maximum.**

(b) Vertical Curves at Intersections (K Values)

Providing the minor intersecting street is marked as a STOP, the following K values must be used for the minor street, unless otherwise approved by the City Engineer:

Classification	Crest	Sag
Local	4	4*
Collector	6	6

***The minimum may be reduced to 2 where the speed limit is 30 kmh or less**

(c) Crown and Crossfall:

(i) All streets shall normally be a crown section. Crossfalls shall require prior approval from the City Engineer.
(ii) Pocket parking that utilizes a reverse crossfall must not exceed 4%.
(iii) Pedestrian and cycling crossfalls:

Minimum	1.0%
Recommended	2.0%
Maximum	4.0%*

****Pedestrian and cycling crossfall grades in excess of 4.0% shall only be permitted for short sections at driveway or lane crossings, subject to approval by the City Engineer.***

(d) Earthwork:

All earthwork shall meet the following cut/fill requirements:

Classification	Desirable	Maximum
Gravel	4H:1V	2H:1V
Earthwork	4H:1V	2H:1V
Rock		1H:4V

8.05 INTERSECTIONS

.1 Protected Intersection:

(a) Every intersection is site specific and detailed geometry will be approved by the City Engineer. The layout of a protected intersection shall use Standard Drawing No. R-PI as guidance.
(b) Bike paths will be offset sufficiently from the curb at the pedestrian crossing location to allow suitable space for a pedestrian sidewalk ramp between the curb and bike path; 2.5 m is preferable.
(c) Corner protection islands with raised barrier curb will be provided unless otherwise approved by the City Engineer and only in constrained retrofit situations may exceptions be permitted.
(d) Space will be provided between the pedestrian sidewalk ramp and the bike path ramp to accommodate placement of a signal pole.
(e) Crosswalk markings and elephant's feet markings on the roadway will be suitably offset from the intersection to permit the inclusion of the corner protection island in the design.
(f) Narrow pedestrian crossing markings (0.3 m width, 0.3 m gap) will be provided on the bike path to indicate to cyclists that pedestrians have priority.
(g) A stop bar for cyclists will be provided where cyclists approach the roadway.
(h) Where the bike path transition from or to the roadway, flat or valley curb will be used to smooth the transition.
(i) A Road Safety Audit is a mandatory requirement for any protected intersection designs.

.2 Roundabouts:

(a) Roundabouts shall be used as directed by the Nanaimo Transportation Master Plan and at the discretion of the City Engineer.
(b) When a roundabout is required, the extent of the works shall be determined on a site specific basis and approved by the City Engineer.
(c) The layout of a protected roundabout shall use Standard Drawing R-PRI as guidance.
(d) A Road Safety Audit is a mandatory requirement for any roundabouts designed.

.3 Raised Local Intersection:

(a) At raised intersections with local roads, the bike path and sidewalk will continue across the intersection without interruption. The intent is that vehicles cross the bicycle and pedestrian space rather than pedestrians and cyclists crossing the vehicle space. The layout of a protected intersection shall use Standard Drawing No. R-LRI as guidance.
(b) Where pedestrian sidewalk ramps are provided, they will be separated from the local ramp by a barrier curb and bollards to reduce the likelihood of vehicles turning in the pedestrian ramp.

(c) At the transition to the crosswalk, flat or valley curb will be used to provide a smooth path for people in wheelchairs or mobility devices.

(d) The ramp from the local street to the sidewalk will be 2.0 m in length, and the drainage requirements are to be approved by the City Engineer.

8.06 CURBS

.1 All roads shall require curb and gutter unless otherwise approved by the City Engineer.

.2 All curbs shall be non-mountable concrete barrier curbs, unless detailed in a Standard Drawing or otherwise approved by the City Engineer.

.3 Pocket parking delineation curb to be optional where there is no grade break between the abutting lane and the pocket parking. Rollover or valley curb to be used as a grade break for drainage purposes as per the Standard Drawings.

.4 Where intersecting streets have both mountable roll-over and non-mountable barrier curbs, non-mountable barrier curbs shall be required for the curb returns and along the tangent to the first driveway or lane crossing.

.5 Curbs within raised local road intersections, lane crossings, or industrial driveways require an additional concrete footing or reinforcing steel as shown on Standard Drawing No. CS-1.

.6 Asphalt curbs only to be used to provide a transition from new concrete curbs to existing roadworks, if required.

8.07 MEDIANS AND ISLANDS

.1 Medians:

(a) Designs should first consider raised and planted medians.

(b) Centre medians for divided roads shall be designed as per Standard Drawing No. CS-7.

.2 Traffic Islands:

(a) Traffic Islands require approval from the City Engineer.

(b) Traffic Islands shall aim to provide at-grade crossings.

8.08 BUFFERS

(a) Buffers are lateral spaces of varying colour and texture to separate one mode from another.

(b) Buffer widths shall be in accordance with the cross-sections found in the Standard Drawings.

(c) Alternative treatments, such as painted gore areas, different material types, curbs, landscaping or other physical features may be used if approved by the City Engineer.

8.09 FLEX ZONES

.1 The Flex zone is a fixed width within the cross-section that remains flexible in nature, so that various competing requirements can be achieved.

(a) Landscaping and street trees.
(b) Transit stops and bus shelters.
(c) Bike and vehicle pocket parking.
(d) Furniture & planters.
(e) Utility boxes, cabinets, and hydrants.
(f) Power poles and streetlights.
(g) Stormwater management.
(h) Waste receptacle placement.

.2 Cross-sectional elements between the curb and the property line may be reorganized to meet the needs of the corridor with approval from the City Engineer.

.3 In constrained corridors, with approval from the City Engineer, a statutory right-of-way may be utilized to achieve the required width needed to achieve the cross-sectional elements.

8.10 PEDESTRIAN FACILITIES

.1 Sidewalks and Walkways:

(a) Sidewalks and walkways shall be generous, unobstructed, and accessible. They shall be designed to the requirements outlined in this section and TAC's Geometric Design Guide for Canadian Roads, unless otherwise approved by the City Engineer.

(b) Sidewalks and walkways adjacent to trees shall have structural soil composite or soil cells to achieve the soil volume required for trees in accordance with Section 14.0 - Landscape.

.2 Tactile Walking Surface indicators (TWSI):

(a) Attention TWSIs are to be arranged in a square grid pattern, parallel to the main direction of travel.
(b) Attention TWSIs to measure a minimum 0.61 m wide and 1.5 m long. They are to measure across the entire width of a hazard, as per the Standard Drawings.
(c) Attention TWSIs should be used along tactile guidance paths to identify turns and other decision-making points.

(d) Guidance TWSIs should consist of a pattern of parallel, fat-topped, elongated bars that extend in the direction of travel.

.3 Crosswalks:

(a) Crosswalk locations shall be determined in accordance with the most current version of the TAC Pedestrian Crossing Control Guide or as required by the City Engineer.
(b) If sidewalks cross local streets, laneways, or high-volume accesses, designs should first consider raised and continuous sidewalks, as per Standard Drawing No. R-RLI.
(c) Mid-block crosswalks on collector and arterials must be approved by the City Engineer. Where possible, medians shall be utilized to accommodate a two-stage protected at-grade crossing.

.4 Curb Ramps:

(a) Ramps shall be designed to the requirements outlined in this section and the Standard Drawings.
(b) Ramps should land users safely in the crosswalk and in the desired direction of travel, lining up with the ramp across the street.

(i) Score lines will be provided on the curb ramp directing visually impaired users to the appropriate opposing curb ramp.
(ii) Safety yellow TWSIs will be placed across the sidewalk or curb ramp where pedestrians will cross the conflict area with vehicles on arterial, collector, or local streets.
(iii) Lower contrast TWSIs, such as attention domes or stamped concrete domes will be provided where the pedestrian will cross the conflict area with cyclists or with vehicles at laneways and driveways.

(c) Ramp orientations are dependent on sidewalk variations, as per Standard Drawing No. CS-12.
(d) Catch basins are not permitted within ramp let-downs and should be located up stream of the crosswalk.
(e) Constrained curb ramp details are only to be used where obstructions or geometry prevent the preferred design from being utilized.

.5 Termination and Transitions:

(a) Sidewalks shall be terminated in a manner that is safe for pedestrians as follows:

(i) At the beginning of the curb return if construction of the intersection is not required.
(ii) At the end of the curb return if construction of the intersection is required.
(iii) At the end of the development phase or property line.
(iv) At other specified locations as required by the City Engineer.

(b) Extend and terminate sidewalks as required to allow wheelchair access to pedestrian pushbuttons.
(c) Transition sidewalk refers to all portions of concrete or asphalt placed as “fill-in” sidewalk between existing curbs and sidewalk, sidewalks and inset building walls, sidewalks, and paved parking area.
(d) Transition sidewalk or walkway shall be constructed at all locations designated by the Engineer and shall be edged and finished in a manner compatible with the adjacent sidewalk or walkway and shall be to the satisfaction of the Engineer.

8.11 BICYCLE FACILITIES

.1 Bike paths and cycle tracks shall be designed in accordance with the road classification of the adjacent street, unless otherwise approved by the City Engineer.

.2 Crossings:

(a) Crossing locations shall be determined in accordance with the most current version of the TAC Geometric Design Guide for Canadian Roads or as required by the City Engineer.
(b) If a cycling facility on a collector street crossing a local street, raised and continuous bike paths and cycle tracks should first be considered.
(c) If a fully separated intersection crossing is not achievable, coloured bike boxes or a shared crossing with elephant’s feet should be considered.

8.12 MULTI-USE FACILITIES

.1 Walkway and multi-use path pavement widths shall be a minimum of 3.0 m. A minimum unobstructed width of 4.0 m is required where vertical obstructions exist.

.2 Walkway right-of-ways width shall be a minimum of 6.0 m unless otherwise approved by the City Engineer.

.3 To prevent vehicles from entering a multi-use facility, splitter islands, bollards, or barrier posts may be utilized.

8.13 TRANSIT FACILITIES

.1 Bus stops and bus pullout locations will be determined by the City Engineer and the Regional District of Nanaimo Transit. .

.2 Transit stops and pullout configurations will adhere to the most current standards in BC Transit's Bus Stop Infrastructure Design Summary and Infrastructure Design Guidelines.

.3 Reinforced bus slabs shall be designed as per Standard Drawing No. CS-23.

8.14 MOTOR VEHICLE FACILITIES

.1 Lane and pavement widths shall be designed to the requirements outlined in this section, the Standard Drawings, and TAC's Geometric Design Guide, unless otherwise approved by the City Engineer.

.2 Parking:

(a) On streets within mobility hubs or other high density areas, on-street parking shall be provided within parking pockets between curb extensions.

.3 Driveways and Laneways:

(a) Driveways and laneways shall be designed in accordance with Standard Drawing No.'s CS-24, CS-25 and CS-26.
(b) A boulevard should be provided between the roadway and sidewalk, pathway, or bike path to provide separation of users and to provide suitable space for a driveway or laneway crossing letdown.
(c) The sidewalk, multi-use path, or bike path are to remain at a level grade past the driveway or laneway.
(d) Driveway and laneways shall be located in accordance with the City of Nanaimo's Crossing Control Bylaw.

(i) Maximum driveway width for single family residential lot shall be 6.0 m.
(ii) Maximum driveway width for all other zoned lots shall be 9.0 m, unless otherwise approved by the City Engineer.

8.15 BOLLARDS

.1 To prevent vehicles from entering a pedestrian, cycling, or multi-use facility, the design may require bollards, splitter islands, or barrier posts.
.2 Decorative bollards are the preferred treatment if required curbside.
.3 Splitter Islands are the preferred treatment at the entrances of walkways and paths, and shall be designed in accordance with Standard Drawing No. CS-20.
.4 Barrier posts shall be designed in accordance with Standard Drawing No. CS-30 and should be placed no closer than 1.5 m apart, and must be installed in odd numbers (one, three or five) so that the centre post is positioned on the centerline of the pathway.

8.16 HANDRAILS AND STAIRWAYS

.1 Handrails:

(a) Sidewalks or walkways adjacent to retaining walls or other vertical drops exceeding a slope of 1.5H:IV or height of 0.6 m shall require a handrail. Alternatively, a chain link fence may be installed, if approved by the City Engineer.
(b) Other unsafe areas, as determined by the City Engineer, may also require the installation of a handrail or chain link fence.

.2 Stairways:

(a) Where walkway grades exceed 12%, stairways shall be installed to suit adjacent topography.
(b) Walkways requiring stairways shall have a minimum of three stairs, and landings at all entrances to the walkway.
(c) Landings at a 2% grade are required at the top and bottom of all stairways. Stairways shall have a maximum of 12 risers between landings.
(d) At stairs and landings, attention TWSIs should commence one tread depth back from the leading edge of the nosing at the top step and extend across the width of the stairs. The attention TWSI alerts a person with vision loss that there is a set of stairs ahead and to seek the support of a handrail for safe navigation.
(e) Concrete stairways shall be designed in accordance with Standard Drawing No.'s CS-32 and CS-33.
(f) Wooden stairways shall be designed in accordance with Standard Drawing No.'s CS-34 and CS-35.

8.17 FENCES

.1 Fences shall be designed in accordance with Standard Drawing No.'s CS-36 and CS-37, unless otherwise approved by the City Engineer.

8.18 PAVEMENT MARKINGS

.1 The design and construction of all roads shall include the design and application of pavement, hazard, and delineation markings in accordance with the most current standards contained in the MUTCD.

.2 When particular design criteria is not specified in the MUTCD, the Manual of Standard Traffic Signs and Pavement Markings distributed by the Ministry of Transportation and Infrastructure may be considered.

.3 Green conflict paint applications to be evaluated by the City Engineer, but are to be used:

(a) Where bicycle facilities cross major driveways and laneways, intersections with permissive left and right turn motor vehicle conflicts, or where there is poor compliance with turn restrictions.

(b) Where bicycle lanes approach an intersection away from the curb, either due to a bicycle only turn lane or where a dedicated right turn is located to the right of a bicycle lane.

(c) In bike boxes and two-stage turn boxes.

8.19 TRAFFIC SIGNAGE

.1 The design and construction of all roads shall include the design and installation of traffic signs (regulatory and warning) and traffic signals, in accordance with the most current standards contained in the MUTCD.

.2 Round stock sign poles are the preferred pole type.

.3 Perforated steel sign poles shall be installed in soil and not set in concrete.

.4 Street name signs shall be provided at all intersections. Where possible, the street name sign shall be located above a traffic sign at one corner of the intersection.

.5 Address signage must be visible from the street. Where a common driveway accesses multiple properties or where homes are not visible from the street, address signs may be located within road right-of-way.

SECTION 8 – TRANSPORTATION SPECIFICATIONS
(REVISED MAY 2020)

8.20 SCOPE

.1 All transportation infrastructure shall be constructed in accordance to the outlined specification requirements captured throughout all sections of the Manual of Engineering Standards and Specifications.

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

8.21 INTERSECTIONS

.1 Intersections that require truck aprons shall be constructed with concrete that is pigmented brick red and stamped using a brick pattern.

8.22 TACTILE WARNING SURFACE INDICATORS (TWSI)

.1 Attention TWSIs

(a) Cast-in-place or recessed installations are the preferred installation method. Surface application are only considered if cast-in-place cannot be achieved.
(b) Surface retrofit applications are to be installed with beveled edges to decrease the likelihood of tripping and attached firmly to prevent edges from lifting.
(c) Preferred colour for attention TSWIs to be used on platforms, staircases, and curb ramps where pedestrians will cross paths with vehicles, is safety yellow.
(d) Stamped or metal attention domes may be used alternatively where pedestrians will be crossing paths with cyclists, as per the Standard Drawings.
(e) Circular truncated domes installed on a walking surface should have the following measurements:

(i) The height of the domes should be four to five millimetres.

(ii) The diametre of the top of the domes should be between 12 and 25 mm.

(iii) The diametre of the lower base of the domes or cones should be 10 mm (+/- 1 mm) more than the diametre of the top.

.2 Guidance TWSIs

(a) To clearly differentiate warning information from guidance information, safety yellow should not be used for guidance TWSIs.
(b) Guidance Bars installed on a walking surface should have the following measurements:

(i) The height of the bars should be four to five millimetres.
(ii) The top of the elongated bars should have a width between 17 and 30 mm.
(iii) The width of the base of the bars should be 10mm (+/- 1 mm) wider than the top.
(iv) The top length of the bars should be at least 270 mm.

(v) If drainage is a concern, a space of 10 – 30 mm should be provided at the ends of the bars.

8.23 MEDIANS AND ISLANDS

.1 Medians and islands are to have concrete infill with a brushed finish, stamped finish, or landscaping as directed by the City Engineer.

8.24 BUFFERS

.1 Buffers and curb-side landings are to utilize colour and/or texture to demarkate the separation of modes. This can be achieved through stamped concrete, coloured concrete, or concrete pavers.

8.25 PAVEMENT MARKINGS

.1 All road markings shall be thermoplastic with a minimum thickness of 3 mm.

8.26 TRAFFIC SIGNAGE

.1 Posts and Bases:

(a) Street name and traffic sign posts and anchors shall be roll formed from strip steel (structural quality) in accordance with ASTM A653, Grade 33.

.2 Fasteners:

(a) Non-corrosive metal fasteners shall be used for attaching all signs to their supports to avoid discolouration.

.3 Street Name Signs:

(a) Street name signs shall be double sided and constructed of 3 mm x 200 mm flat sign grade aluminum with rounded corners.
(b) Signs shall consist of diamond grade reflective sheeting with transparent blue Electro Cut vinyl. Letters shall be 150 mm Helvetian Med font and shall be upper and lower case.
(c) The abbreviations, St., Dr., Pl, Rd., etc., are to be the same height as the street name.

.4 Traffic Signs:

(a) Traffic sign shapes, colours, dimensions, symbols and wording shall be in accordance with the standards detailed in the most current Motor Vehicle Act Regulations.
(b) Illumination or reflectorization of signs shall also be in accordance with the standards detailed in the most current Motor Vehicle Act.
(c) Signs shall be made on 12 gauge (3 mm) sign grade aluminum.

(d) Reflective sheeting shall be diamond grade. Signs for Parking Restrictions, Loading Zones, Bus Stops and No Stopping shall be engineering grade and no more than 300 mm wide.

INSTALLATION

(REVISED MAY 2020)

8.40 SCOPE

.1 All transportation infrastructure shall be installed in accordance to the requirements captured throughout all sections of the Manual of Engineering Standards and Specifications.

8.41 REMOVALS

.1 Removals shall be done in accordance with Section 4.0 – Excavation, Bedding and Backfill.

.2 Existing asphalt pavement, sidewalk, curb and gutter shall be cut in a straight line parallel to the line of the proposed work.

.3 Existing concrete pavement, sidewalk, curb and gutter shall be removed by cutting the concrete at the nearest joint or other location designated by the Engineer.

.4 The top surface of the remaining concrete section shall have a neat vertical face with a straight edge for a minimum of ¼ the depth of the section.

.5 All material removed shall be disposed of as waste material.

8.42 BACKFILL AND GRADING

.1 Backfill and grading shall be done in accordance with Section 4.0 Excavation, Bedding and Backfill.

.2 The gravel road base adjacent to the curb shall be filled tight to the curb, graded, compacted, and left in a neat condition.

.3 The boulevard area adjacent to the curb or sidewalk shall be cleared of construction debris and raked clear of all rock exceeding 50 mm in its largest dimension.

.4 The boulevard area shall be backfilled to within 50 mm of the top of the curb for a minimum width as shown on the drawings, such that the water does not undermine the curb installation. Backfill shall be compacted to 90% of Modified Proctor Density (ASTM D1557).

.5 Boulevards shall be graded and prepared suitable for placement of topsoil, or as otherwise directed by the Engineer.

.6 Sod, plants, and trees to be installed as per Section 14.0 – Landscape.

8.43 TACTILE WARNING SURFACE INDICATORS (TWSI)

.1 TWSIs are to be installed in accordance with the manufacturer's recommendations.

8.44 PAVEMENT MARKINGS

.1 Layout of markings shall be as per the construction drawings or as per direction from the City Engineer.

.2 Thermoplastic shall be applied in accordance with the manufacturer's recommendations.

8.45 TRAFFIC SIGNAGE

.1 Posts and Bases:

(a) Sign post bases installed within concrete, shall be installed as per Standard Drawing No. CS-40.
(b) Sign post bases installed within soil, shall be installed as per Standard Drawing No.'s CS-40 or CS-41.
(c) Anchor posts shall be provided for sign base installations where native soils are unable to hold the sign rigidly in its proper and permanent position and to prevent it from swaying in the wind, from being turned, or otherwise displaced.
(d) Sign installation shall not impede on the clear zone of a pedestrian or cycling facility. A minimum 1.2 m must be accommodated on pedestrian facilities and 1.5 m on cycling or multi-use facilities.

.2 Signs:

(a) All signs to conform to the most current standards in the MUTCD.
(b) Signs shall be installed as per the Standard Drawings.
(c) Street name and traffic signs shall be as per the construction drawings or as per direction from the City Engineer.
(d) All signs shall be mounted perpendicular to the direction of traffic, facing the direction of traffic they are intended to service, except in the case of No Parking and No Stopping signs.
(e) Reflectorized signs shall be placed at a slight angle away from approaching traffic.
(f) Unless otherwise specified, street signs shall be supplied by the City of Nanaimo at the Developer's expense.

8.46 CLEAN UP

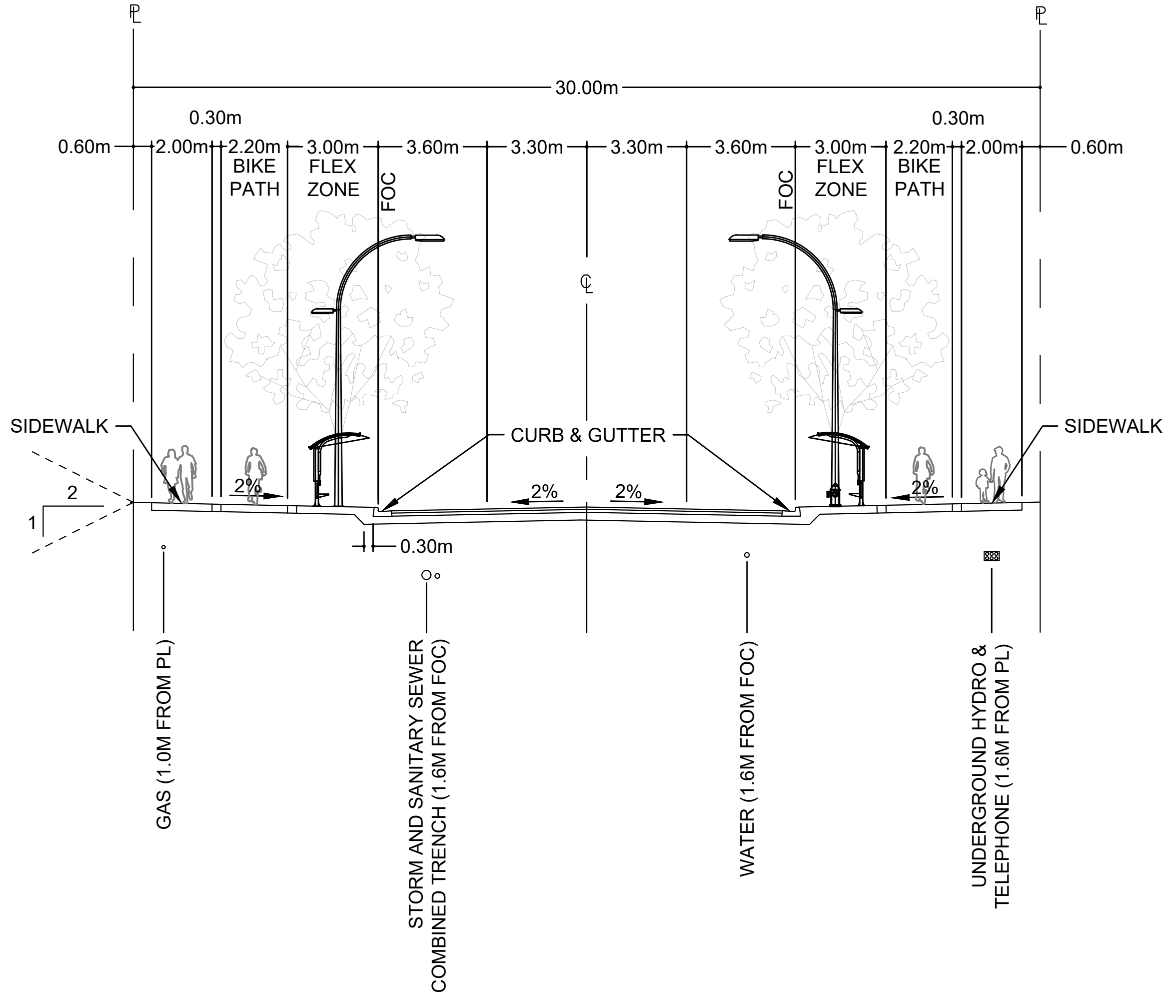
.1 The construction site shall be kept clean and safe throughout the duration of the project.

.2 Special precautions shall be made for sites that experience heavy pedestrian, cycling, and motor vehicle volumes.

.3 Fire hydrants shall be left clear for hose connections at all times.

.4 Prior to completion of construction, all existing and newly constructed drainage ditches, waterways and culverts shall be cleaned to restore their full effectiveness.

.5 All areas affected by the construction operation shall be cleaned of all loose rock, boulders, and debris.



NOTES:

1. PAVED SURFACE - 125mm ASPHALT (COMPACTED THICKNESS)
2. BASE - 200mm AS PER SECTION 9
3. SUB-BASE - 250mm AS PER SECTION 9
4. BARRIER CURB AND GUTTER TO BE USED IN ACCORDANCE WITH STANDARD DRAWING CS-1.
5. CENTER MEDIANS TO BE LANDSCAPED WHERE POSSIBLE AND IN ACCORDANCE WITH STANDARD DRAWING CS-7.
6. DEPTHS OF SURFACING AND BASE GRAVELS ARE MINIMUM AND IN SOME CASES WILL HAVE TO BE INCREASED TO MEET MAXIMUM ALLOWABLE BENKELMAN BEAM DEFLECTION.
7. FLEX ZONE TO BE UTILIZED FOR: LANDSCAPING, STREET TREES, TRANSIT STOPS, BUS SHELTERS, BIKE PARKING, FURNITURE, UTILITY BOXES/CABINETS, HYDRANTS, POWER POLES, STREETLIGHTS, STORMWATER MANAGEMENT, OR WASTE RECEPTACLES.
8. BANDING/BUFFER ON EITHER SIDE OF THE BIKE PATH SHALL BE 0.3m STAMPED CONCRETE WITH TRANSVERSE SCORE LINES AT 0.3m INTERVALS. WHERE VERTICAL SEPARATION IS PREFERRED, MOUNTABLE MONOLITHIC CURB MAY BE UTILIZED. ALTERNATIVE TREATMENTS TO BE APPROVED BY THE CITY ENGINEER.
9. ROAD HAS CONTROLLED ACCESS. ACCESS UNDER APPROVAL FROM CITY ENGINEER.
10. CROSS-SECTIONS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.
11. STREETLIGHTS ARE DIAGRAPHIC. LIGHTING LEVELS TO BE IN ACCORDANCE WITH SECTION 10.
12. LANDSCAPING TO BE IN ACCORDANCE WITH SECTION 14.

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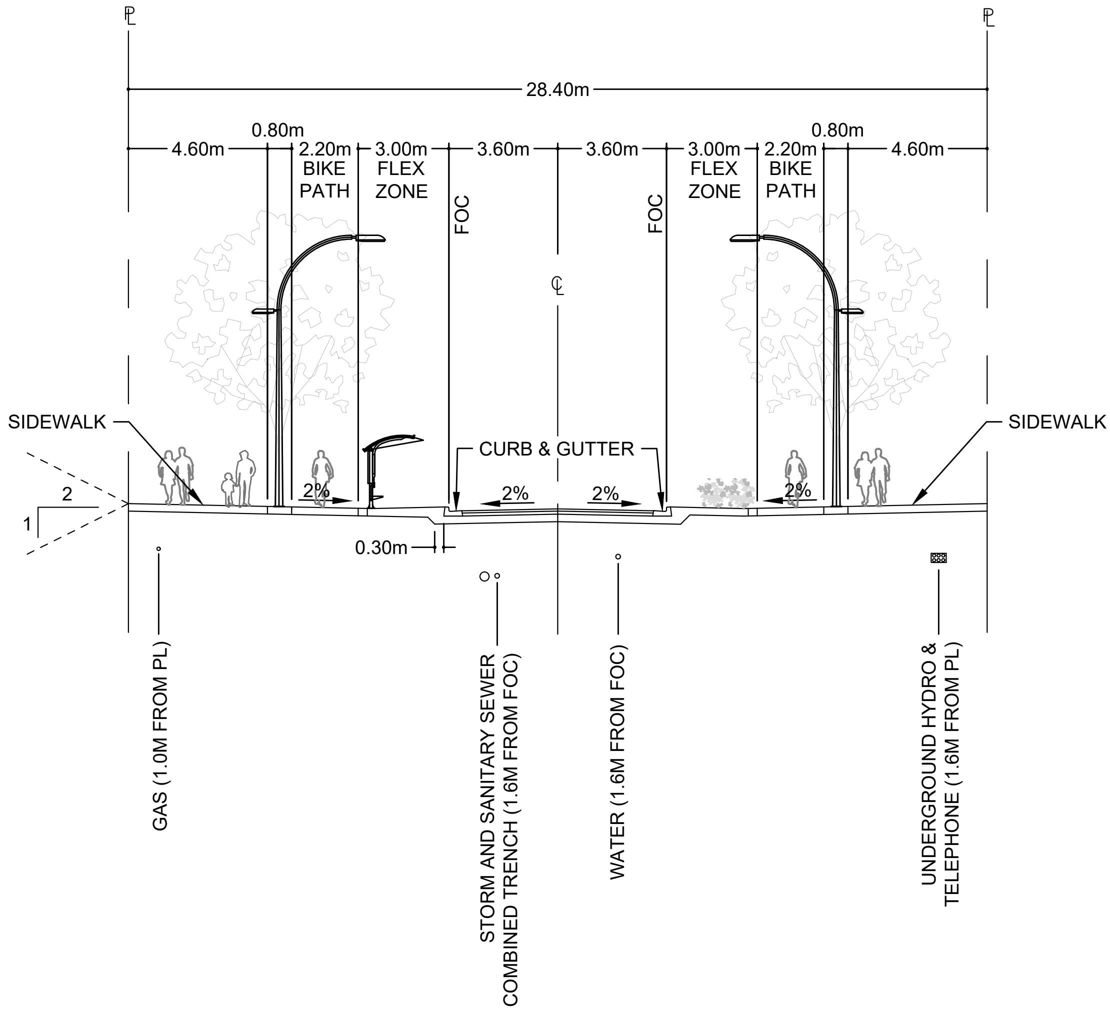
7.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
MOBILITY ARTERIAL

Scale:	NTS
Created:	AUG 2019
Rev Date:	MAY 2020
Dwg No:	MA-XS1



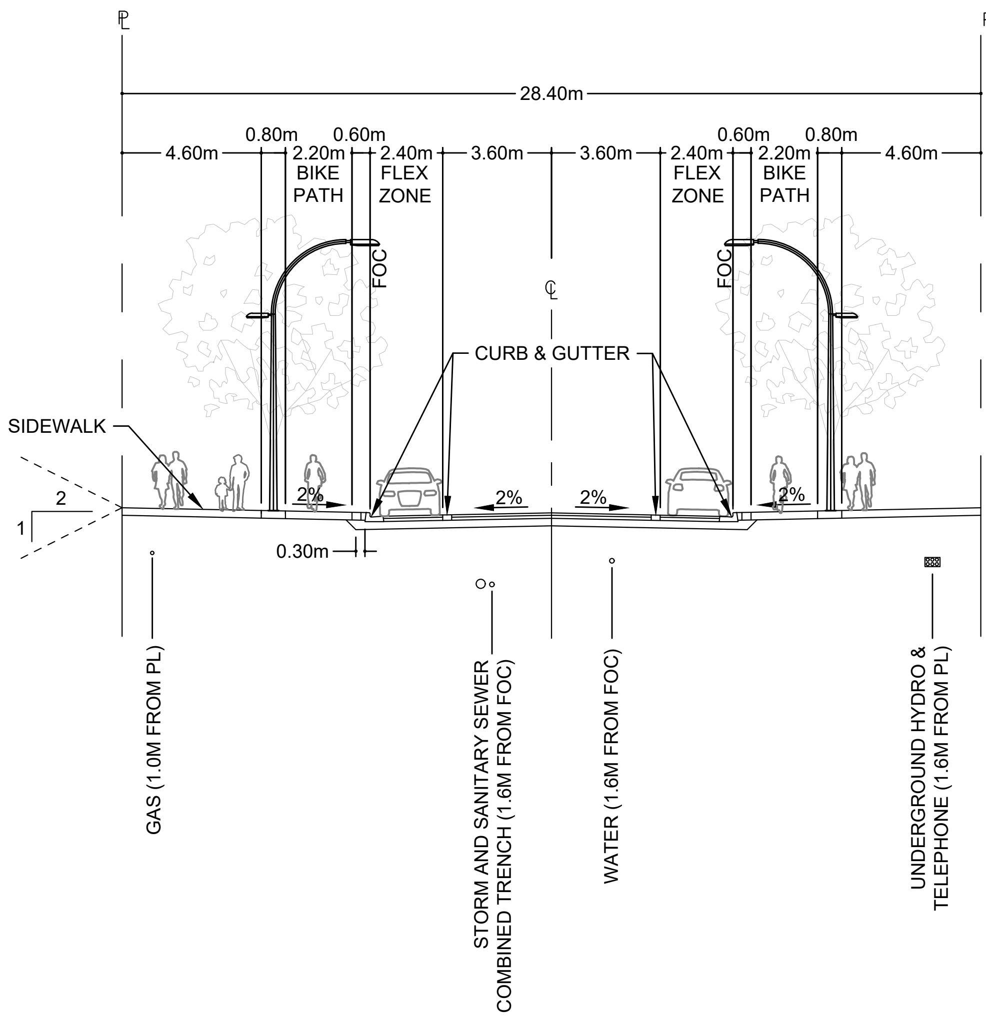
NOTES:

1. PAVED SURFACE - 100mm ASPHALT (COMPACTED THICKNESS)
2. BASE - 150mm AS PER SECTION 9
3. SUB-BASE - 250mm AS PER SECTION 9
4. BARRIER CURB AND GUTTER TO BE USED IN ACCORDANCE WITH STANDARD DRAWING CS-1.
5. CENTER MEDIANS TO BE LANDSCAPED WHERE POSSIBLE AND IN ACCORDANCE WITH STANDARD DRAWING CS-7.
6. DEPTHS OF SURFACING AND BASE GRAVELS ARE MINIMUM AND IN SOME CASES WILL HAVE TO BE INCREASED TO MEET MAXIMUM ALLOWABLE BENKELMAN BEAM DEFLECTION.
7. FLEX ZONE TO BE UTILIZED FOR: LANDSCAPING, STREET TREES, POCKET PARKING, TRANSIT STOPS, BUS SHELTERS, BIKE PARKING, FURNITURE, UTILITY BOXES/CABINETS, HYDRANTS, POWER POLES, STREETLIGHTS, STORMWATER MANAGEMENT, OR WASTE RECEPTACLES.
8. SIDEWALK TO INTEGRATE WITH BUILDING FRONTAGE.
9. BANDING/BUFFER ON EITHER SIDE OF THE BIKE PATH SHALL BE 0.3m STAMPED CONCRETE WITH TRANSVERSE SCORE LINES AT 0.3m INTERVALS. WHERE VERTICAL SEPARATION IS PREFERRED, MOUNTABLE MONOLITHIC CURB MAY BE UTILIZED. ALTERNATIVE TREATMENTS TO BE APPROVED BY THE CITY ENGINEER.
10. POCKET PARKING DOOR ZONES OR OTHER HARD SURFACES TO USE COLOURED AND/OR STAMPED CONCRETE.
11. ROAD HAS CONTROLLED ACCESS. ACCESS UNDER APPROVAL FROM CITY ENGINEER.
12. CROSS-SECTIONS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.
11. STREETLIGHTS ARE DIAGRAPHIC. LIGHTING LEVELS TO BE IN ACCORDANCE WITH SECTION 10.
12. STREET TREES TO BE DESIGNED USING SOIL VOLUMES OR SILVA CELLS AS PER SECTION 14.

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
MOBILITY COLLECTOR (BOULEVARDS)

Scale:	NTS
Created:	AUG 2019
Rev Date:	MAY 2020
Dwg No:	MC-XS1



NOTES:

1. PAVED SURFACE - 100mm ASPHALT (COMPACTED THICKNESS)
2. BASE - 150mm AS PER SECTION 9
3. SUB-BASE - 250mm AS PER SECTION 9
4. BARRIER CURB AND GUTTER TO BE USED IN ACCORDANCE WITH STANDARD DRAWING CS-1.
5. CENTER MEDIANS TO BE LANDSCAPED WHERE POSSIBLE AND IN ACCORDANCE WITH STANDARD DRAWING C-7.
6. POCKET PARKING DELINEATION CURB TO BE OPTIONAL UNLESS PARKING HAS BEEN DESIGNED WITH A REVERSE CROSSFALL. ROLLOVER OR VALLEY CURB TO BE USED AS GRADE BREAK FOR DRAINAGE PURPOSES.
7. DEPTHS OF SURFACING AND BASE GRAVELS ARE MINIMUM AND IN SOME CASES WILL HAVE TO BE INCREASED TO MEET MAXIMUM ALLOWABLE BENKELMAN BEAM DEFLECTION.
8. FLEX ZONE TO BE UTILIZED FOR: LANDSCAPING, STREET TREES, POCKET PARKING, TRANSIT STOPS, BUS SHELTERS, BIKE PARKING, FURNITURE, UTILITY BOXES/CABINETS, HYDRANTS, POWER POLES, STREETLIGHTS, STORMWATER MANAGEMENT, OR WASTE RECEPTACLES.
9. SIDEWALK TO INTEGRATE WITH BUILDING FRONTAGE.
10. BANDING/BUFFER ON EITHER SIDE OF THE BIKE PATH SHALL BE 0.3m STAMPED CONCRETE WITH TRANSVERSE SCORE LINES AT 0.3m INTERVALS. WHERE VERTICAL SEPARATION IS PREFERRED, MOUNTABLE MONOLITHIC CURB MAY BE UTILIZED, ALTERNATIVE TREATMENTS TO BE APPROVED BY THE CITY ENGINEER.
11. POCKET PARKING DOOR ZONES OR OTHER HARD SURFACES TO USE COLOURED AND/OR STAMPED CONCRETE.
12. ROAD HAS CONTROLLED ACCESS. ACCESS UNDER APPROVAL FROM CITY ENGINEER.
13. CROSS-SECTIONS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.
14. STREETLIGHTS ARE DIAGRAPHIC. LIGHTING LEVELS TO BE IN ACCORDANCE WITH SECTION 10.
15. STREET TREES TO BE DESIGNED USING SOIL VOLUMES OR SILVA CELLS AS PER SECTION 14.

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
MOBILITY COLLECTOR (PARKING)

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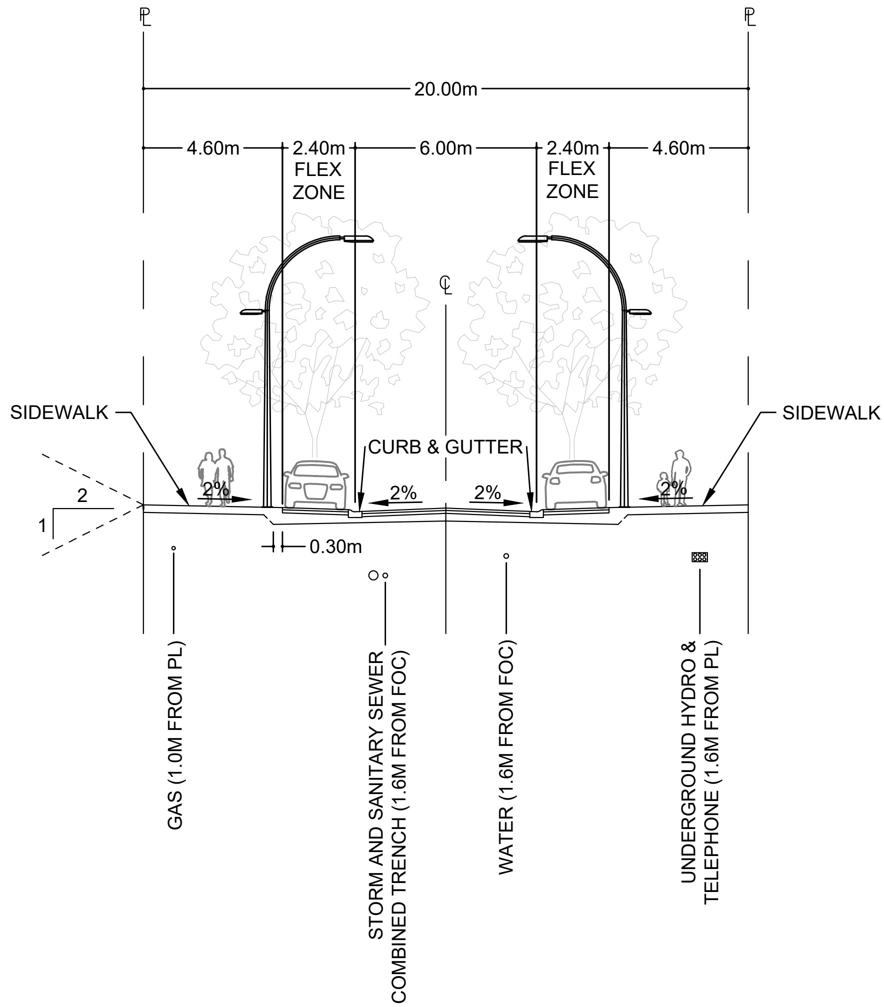
Dwg No:	MC-XS2



NOTES:

1. PAVED SURFACE - 75mm ASPHALT (COMPACTED THICKNESS)
2. BASE - 100mm AS PER SECTION 9
3. SUB-BASE - 250mm AS PER SECTION 9
4. ROLLOVER CURB AND GUTTER TO BE USED IN ACCORDANCE WITH STANDARD DRAWING CS-3.
5. POCKET PARKING DELINEATION CURB TO BE OPTIONAL UNLESS PARKING HAS BEEN DESIGNED WITH A REVERSE CROSSFALL. ROLLOVER OR VALLEY CURB TO BE USED AS GRADE BREAK FOR DRAINAGE PURPOSES.
6. DEPTHS OF SURFACING AND BASE GRAVELS ARE MINIMUM AND IN SOME CASES WILL HAVE TO BE INCREASED TO MEET MAXIMUM ALLOWABLE BENKELMAN BEAM DEFLECTION.
7. FLEX ZONE TO BE UTILIZED FOR: LANDSCAPING, STREET TREES, POCKET PARKING, TRANSIT STOPS, BUS SHELTERS, BIKE PARKING, FURNITURE, UTILITY BOXES/CABINETS, HYDRANTS, POWER POLES, STREETLIGHTS, STORMWATER MANAGEMENT, OR WASTE RECEPTACLES.
8. SIDEWALK TO INTEGRATE WITH BUILDING FRONTAGE.
9. BANDING, BUFFERS, POCKET PARKING DOOR ZONES, OR OTHER HARD SURFACES TO USE COLOURED AND/OR STAMPED CONCRETE.
10. CROSS-SECTIONS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.
11. STREETLIGHTS ARE DIAGRAPHIC. LIGHTING LEVELS TO BE IN ACCORDANCE WITH SECTION 10.
12. STREET TREES TO BE DESIGNED USING SOIL VOLUMES OR SILVA CELLS AS PER SECTION 14.

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7.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
MOBILITY LOCAL

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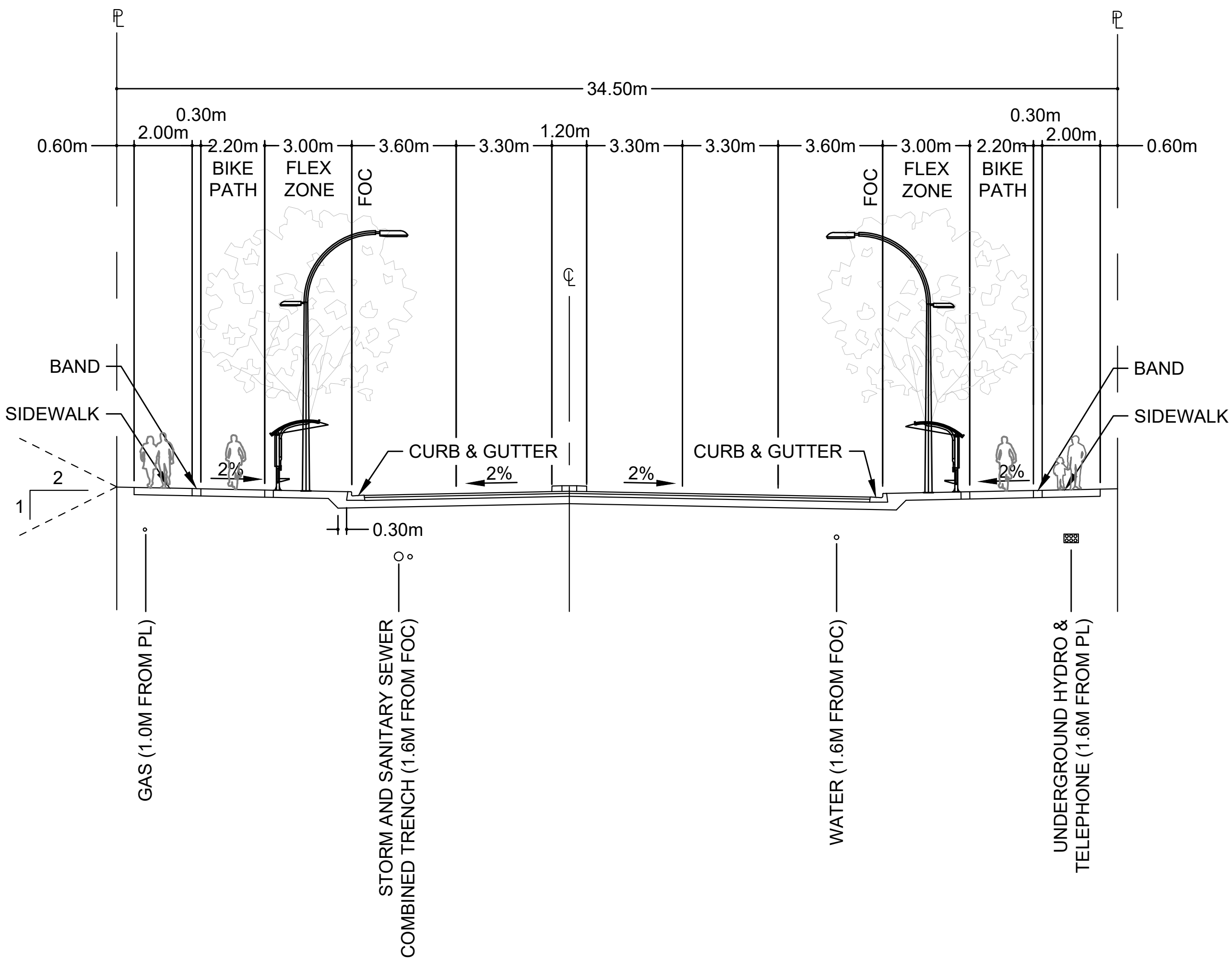
Dwg No:	ML-XS1



NOTES:

1. PAVED SURFACE - 125mm ASPHALT (COMPACTED THICKNESS)
2. BASE - 200mm AS PER SECTION 9
3. SUB-BASE - 250mm AS PER SECTION 9
4. BARRIER CURB AND GUTTER TO BE USED IN ACCORDANCE WITH STANDARD DRAWING CS-1.
5. CENTER MEDIANS TO BE LANDSCAPED WHERE POSSIBLE AND IN ACCORDANCE WITH STANDARD DRAWING CS-7.
6. DEPTHS OF SURFACING AND BASE GRAVELS ARE MINIMUM AND IN SOME CASES WILL HAVE TO BE INCREASED TO MEET MAXIMUM ALLOWABLE BENKELMAN BEAM DEFLECTION.
7. FLEX ZONE TO BE UTILIZED FOR: LANDSCAPING, STREET TREES, TRANSIT STOPS, BUS SHELTERS, BIKE PARKING, FURNITURE, UTILITY BOXES/CABINETS, HYDRANTS, POWER POLES, STREETLIGHTS, STORMWATER MANAGEMENT, OR WASTE RECEPTACLES.
8. BANDING/BUFFER ON EITHER SIDE OF THE BIKE PATH SHALL BE 0.3m STAMPED CONCRETE WITH TRANSVERSE SCORE LINES AT 0.3m INTERVALS. WHERE VERTICAL SEPARATION IS PREFERRED, MOUNTABLE MONOLITHIC CURB MAY BE UTILIZED. ALTERNATIVE TREATMENTS TO BE APPROVED BY THE CITY ENGINEER.
9. ROAD HAS CONTROLLED ACCESS. ACCESS UNDER APPROVAL FROM CITY ENGINEER.
10. CROSS-SECTIONS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.
11. STREETLIGHTS ARE DIAGRAPHIC. LIGHTING LEVELS TO BE IN ACCORDANCE WITH SECTION 10.
12. LANDSCAPING TO BE IN ACCORDANCE WITH SECTION 14.

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
URBAN ARTERIAL

Scale:	NTS
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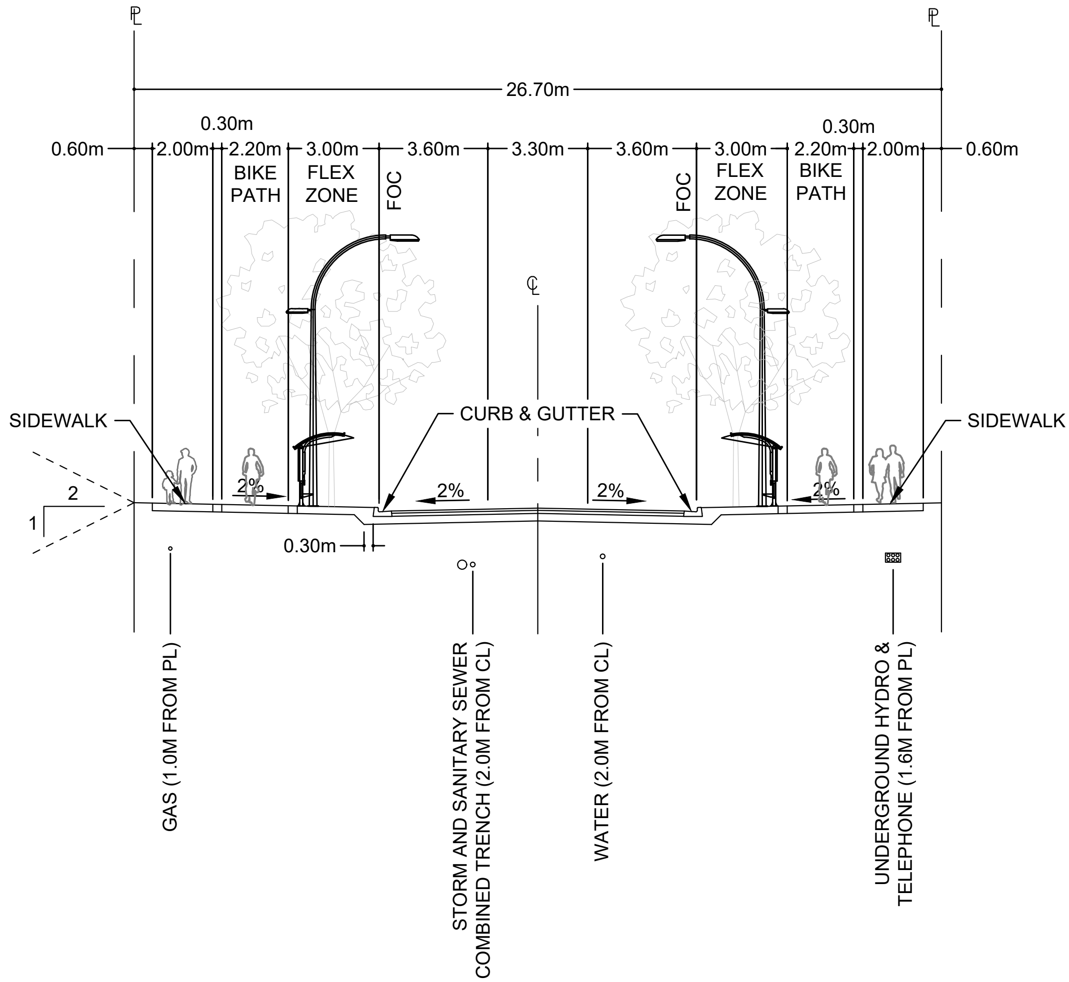
Dwg No:	UA-XS1



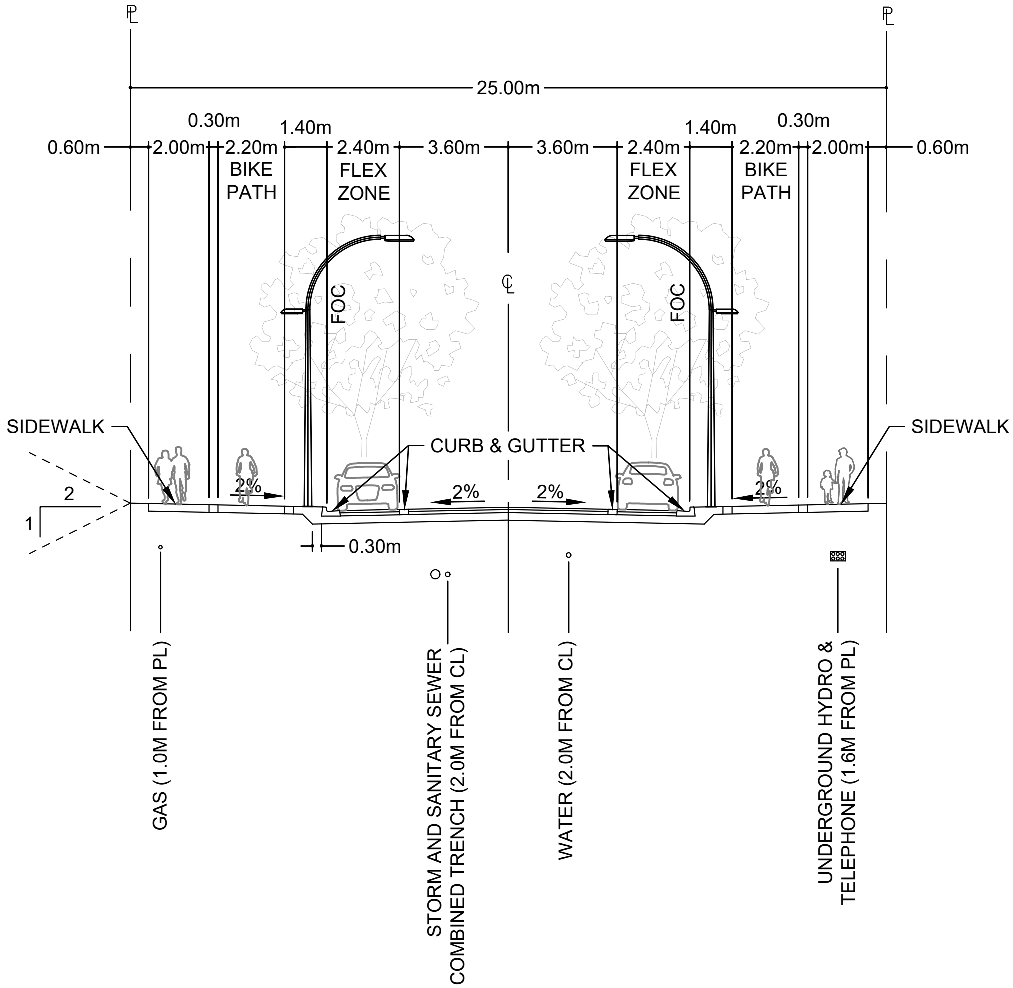
NOTES:

1. PAVED SURFACE - 100mm ASPHALT (COMPACTED THICKNESS)
2. BASE - 150mm AS PER SECTION 9
3. SUB-BASE - 250mm AS PER SECTION 9
4. BARRIER CURB AND GUTTER TO BE USED IN ACCORDANCE WITH STANDARD DRAWING CS-1.
5. CENTER MEDIANS TO BE LANDSCAPED WHERE POSSIBLE AND IN ACCORDANCE WITH STANDARD DRAWING CS-7.
6. DEPTHS OF SURFACING AND BASE GRAVELS ARE MINIMUM AND IN SOME CASES WILL HAVE TO BE INCREASED TO MEET MAXIMUM ALLOWABLE BENKELMAN BEAM DEFLECTION.
7. FLEX ZONE TO BE UTILIZED FOR: LANDSCAPING, STREET TREES, POCKET PARKING, TRANSIT STOPS, BUS SHELTERS, BIKE PARKING, FURNITURE, UTILITY BOXES/CABINETS, HYDRANTS, POWER POLES, STREETLIGHTS, STORMWATER MANAGEMENT, OR WASTE RECEPTACLES.
8. BANDING/BUFFER ON EITHER SIDE OF THE BIKE PATH SHALL BE 0.3m STAMPED CONCRETE WITH TRANSVERSE SCORE LINES AT 0.3m INTERVALS. WHERE VERTICAL SEPARATION IS PREFERRED, MOUNTABLE MONOLITHIC CURB MAY BE UTILIZED. ALTERNATIVE TREATMENTS TO BE APPROVED BY THE CITY ENGINEER.
9. POCKET PARKING DOOR ZONES, OR OTHER HARD SURFACES TO USE COLOURED AND/OR STAMPED CONCRETE.
10. ROAD HAS CONTROLLED ACCESS. ACCESS UNDER APPROVAL FROM CITY ENGINEER.
11. CROSS-SECTIONS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.
12. STREETLIGHTS ARE DIAGRAPHIC. LIGHTING LEVELS TO BE IN ACCORDANCE WITH SECTION 10.
13. LANDSCAPING TO BE IN ACCORDANCE WITH SECTION 14.

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
URBAN COLLECTOR (TURN LANE)

Scale:	NTS
Created:	AUG 2019
Rev Date:	MAY 2020
Dwg No:	UC-XS1



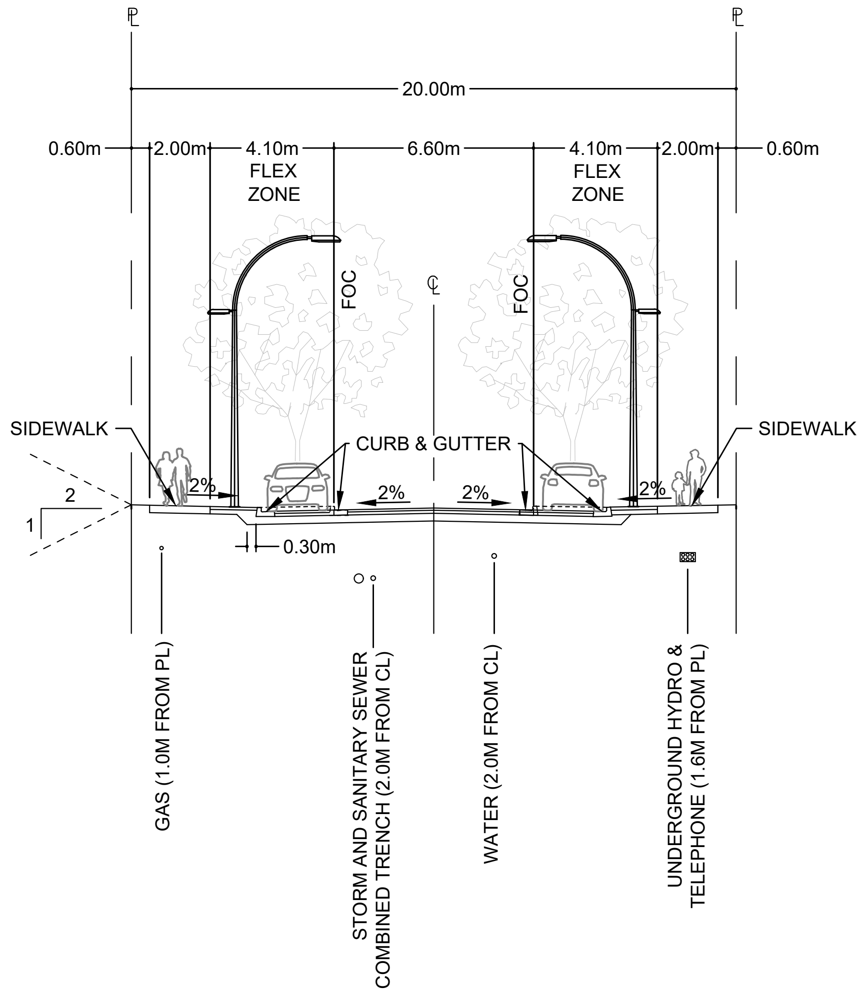
NOTES:

1. PAVED SURFACE - 100mm ASPHALT (COMPACTED THICKNESS)
2. BASE - 150mm AS PER SECTION 9
3. SUB-BASE - 250mm AS PER SECTION 9
4. BARRIER CURB AND GUTTER TO BE USED IN ACCORDANCE WITH STANDARD DRAWING CS-1.
5. POCKET PARKING DELINEATION CURB TO BE OPTIONAL UNLESS PARKING HAS BEEN DESIGNED WITH A REVERSE CROSSFALL. ROLLOVER OR VALLEY CURB TO BE USED AS GRADE BREAK FOR DRAINAGE PURPOSES.
6. DEPTHS OF SURFACING AND BASE GRAVELS ARE MINIMUM AND IN SOME CASES WILL HAVE TO BE INCREASED TO MEET MAXIMUM ALLOWABLE BENKELMAN BEAM DEFLECTION.
7. FLEX ZONE TO BE UTILIZED FOR: LANDSCAPING, STREET TREES, POCKET PARKING, TRANSIT STOPS, BUS SHELTERS, BIKE PARKING, FURNITURE, UTILITY BOXES/CABINETS, HYDRANTS, POWER POLES, STREETLIGHTS, STORMWATER MANAGEMENT, OR WASTE RECEPTACLES.
8. BANDING/BUFFER ON EITHER SIDE OF THE BIKE PATH SHALL BE 0.3m STAMPED CONCRETE WITH TRANSVERSE SCORE LINES AT 0.3m INTERVALS. WHERE VERTICAL SEPARATION IS PREFERRED, MOUNTABLE MONOLITHIC CURB MAY BE UTILIZED. ALTERNATIVE TREATMENTS TO BE APPROVED BY THE CITY ENGINEER.
9. POCKET PARKING DOOR ZONES OR OTHER HARD SURFACES TO USE COLOURED AND/OR STAMPED CONCRETE.
10. ROAD HAS CONTROLLED ACCESS. ACCESS UNDER APPROVAL FROM CITY ENGINEER.
11. CROSS-SECTIONS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.
12. STREETLIGHTS ARE DIAGRAPHIC. LIGHTING LEVELS TO BE IN ACCORDANCE WITH SECTION 10.
13. LANDSCAPING TO BE IN ACCORDANCE WITH SECTION 14.

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
URBAN COLLECTOR

Scale:	NTS
Created:	AUG 2019
Rev Date:	MAY 2020
Dwg No:	UC-XS2



NOTES:

1. PAVED SURFACE - 75mm ASPHALT (COMPACTED THICKNESS)
2. BASE - 100mm AS PER SECTION 9
3. SUB-BASE - 250mm AS PER SECTION 9
4. BARRIER CURB AND GUTTER IN ACCORDANCE WITH STANDARD DRAWING CS-1.
5. POCKET PARKING DELINEATION CURB TO BE OPTIONAL UNLESS PARKING HAS BEEN DESIGNED WITH A REVERSE CROSSFALL. ROLLOVER OR VALLEY CURB TO BE USED AS GRADE BREAK FOR DRAINAGE PURPOSES.
6. DEPTHS OF SURFACING AND BASE GRAVELS ARE MINIMUM AND IN SOME CASES WILL HAVE TO BE INCREASED TO MEET MAXIMUM ALLOWABLE BENKELMAN BEAM DEFLECTION.
7. FLEX ZONE TO BE UTILIZED FOR: LANDSCAPING, STREET TREES, POCKET PARKING, TRANSIT STOPS, BUS SHELTERS, BIKE PARKING, FURNITURE, UTILITY BOXES/CABINETS, HYDRANTS, POWER POLES, STREETLIGHTS, STORMWATER MANAGEMENT, OR WASTE RECEPTACLES.
8. BANDING, BUFFERS, POCKET PARKING DOOR ZONES, OR OTHER HARD SURFACES TO USE COLOURED AND/OR STAMPED CONCRETE.
9. CROSS-SECTIONS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.
10. STREETLIGHTS ARE DIAGRAPHIC. LIGHTING LEVELS TO BE IN ACCORDANCE WITH SECTION 10.
11. LANDSCAPING TO BE IN ACCORDANCE WITH SECTION 14.

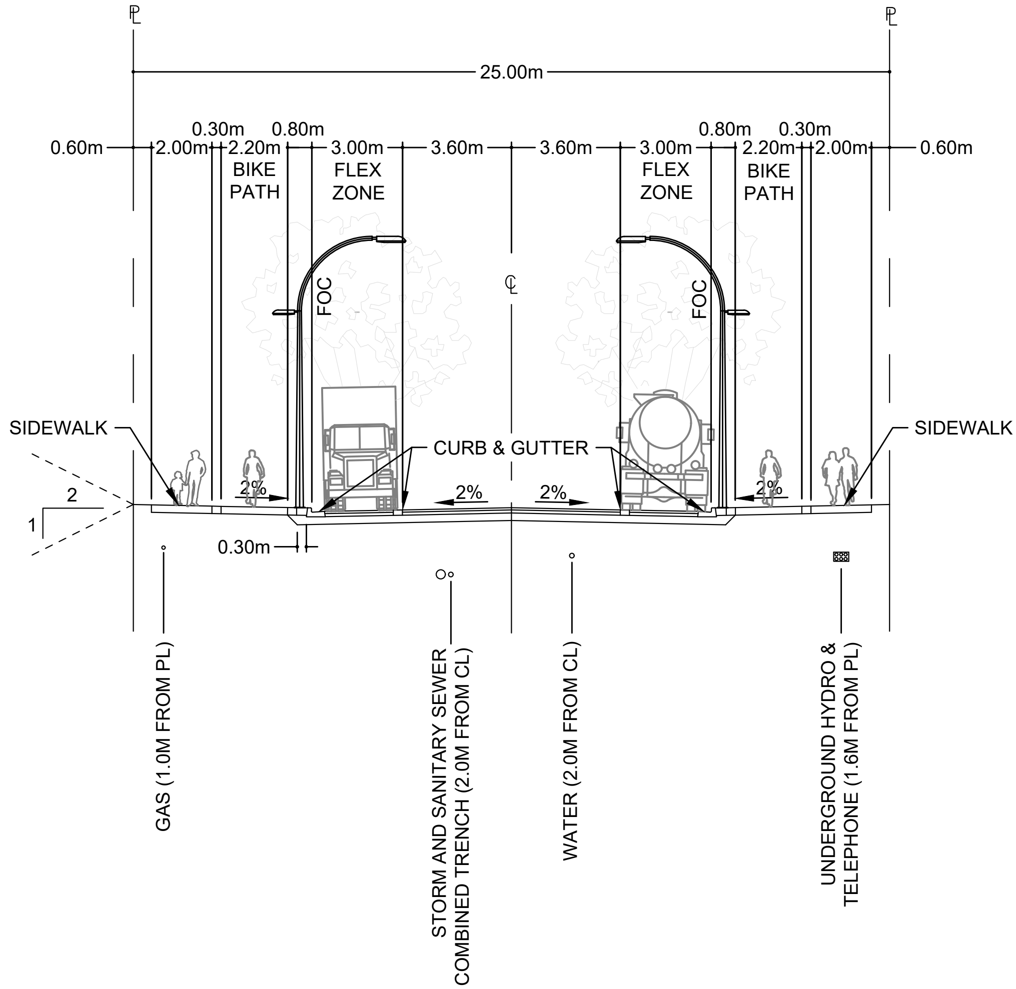
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2020-05-01 FINAL MOESS EDITION NO13 DOCUMENT\2020 DRAWING SECTIONS\SECTION 8 DWGS\UL-XS1

7.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
URBAN LOCAL

Scale:	NTS
Created:	AUG 2019
Rev Date:	MAY 2020
Dwg No:	UL-XS1



NOTES:

1. PAVED SURFACE - 100mm ASPHALT (COMPACTED THICKNESS)
2. BASE - 200mm AS PER SECTION 9
3. SUB-BASE - 250mm AS PER SECTION 9
4. BARRIER CURB AND GUTTER TO BE USED IN ACCORDANCE WITH STANDARD DRAWING CS-1.
5. POCKET PARKING DELINEATION CURB TO BE OPTIONAL UNLESS PARKING HAS BEEN DESIGNED WITH A REVERSE CROSSFALL. ROLLOVER OR VALLEY CURB TO BE USED AS GRADE BREAK FOR DRAINAGE PURPOSES.
6. DEPTHS OF SURFACING AND BASE GRAVELS ARE MINIMUM AND IN SOME CASES WILL HAVE TO BE INCREASED TO MEET MAXIMUM ALLOWABLE BENKELMAN BEAM DEFLECTION.
7. FLEX ZONE TO BE UTILIZED FOR: LANDSCAPING, STREET TREES, POCKET PARKING, TRANSIT STOPS, BUS SHELTERS, BIKE PARKING, FURNITURE, UTILITY BOXES/CABINETS, HYDRANTS, POWER POLES, STREETLIGHTS, STORMWATER MANAGEMENT, OR WASTE RECEPTACLES.
8. BANDING/BUFFER ON EITHER SIDE OF THE BIKE PATH SHALL BE 0.3m STAMPED CONCRETE WITH TRANSVERSE SCORE LINES AT 0.3m INTERVALS. WHERE VERTICAL SEPARATION IS PREFERRED, MOUNTABLE MONOLITHIC CURB MAY BE UTILIZED. ALTERNATIVE TREATMENTS TO BE APPROVED BY THE CITY ENGINEER.
9. POCKET PARKING DOOR ZONES, OR OTHER HARD SURFACES TO USE COLOURED AND/OR STAMPED CONCRETE.
10. ROAD HAS CONTROLLED ACCESS. ACCESS UNDER APPROVAL FROM CITY ENGINEER.
11. CROSS-SECTIONS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.
12. STREETLIGHTS ARE DIAGRAPHIC. LIGHTING LEVELS TO BE IN ACCORDANCE WITH SECTION 10.
13. LANDSCAPING TO BE IN ACCORDANCE WITH SECTION 14.

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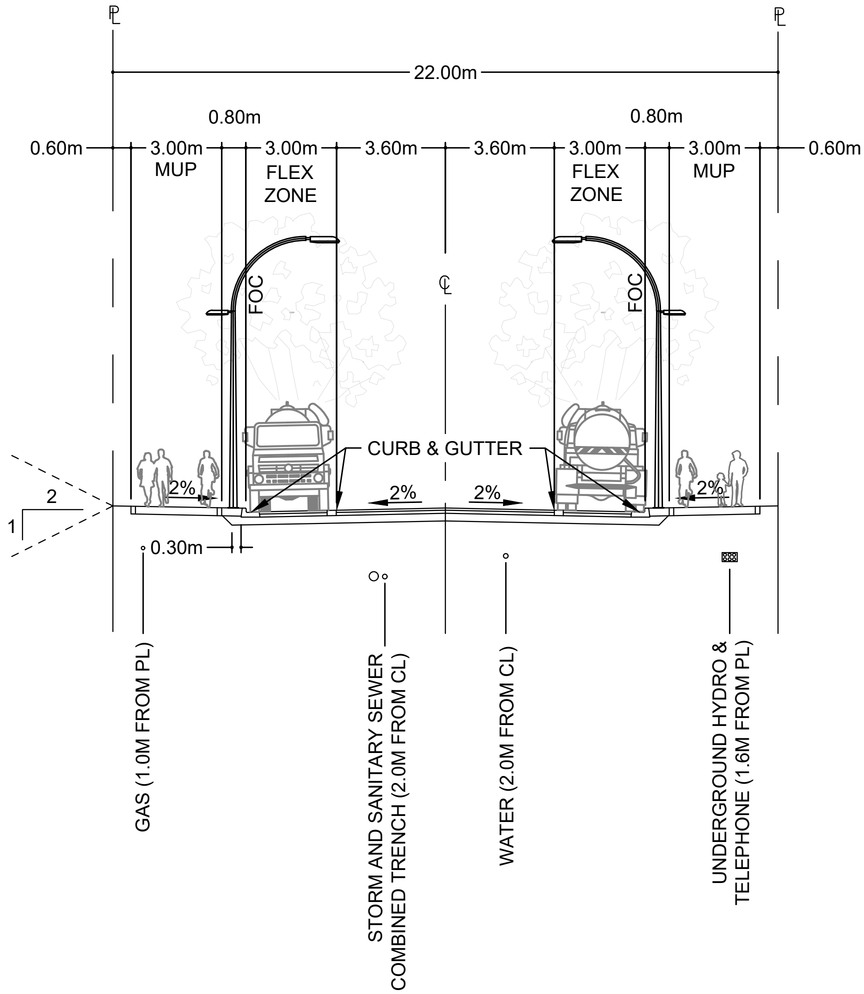
7.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
INDUSTRIAL COLLECTOR

Scale:	NTS
Created:	AUG 2019
Rev Date:	MAY 2020
Dwg No:	IC-XS1



NOTES:

1. PAVED SURFACE - 100mm ASPHALT (COMPACTED THICKNESS)
2. BASE - 200mm AS PER SECTION 9
3. SUB-BASE - 250mm AS PER SECTION 9
4. BARRIER CURB AND GUTTER TO BE USED IN ACCORDANCE WITH STANDARD DRAWING CS-1.
5. POCKET PARKING DELINEATION CURB TO BE OPTIONAL UNLESS PARKING HAS BEEN DESIGNED WITH A REVERSE CROSSFALL. ROLLOVER OR VALLEY CURB TO BE USED AS GRADE BREAK FOR DRAINAGE PURPOSES.
6. DEPTHS OF SURFACING AND BASE GRAVELS ARE MINIMUM AND IN SOME CASES WILL HAVE TO BE INCREASED TO MEET MAXIMUM ALLOWABLE BENKELMAN BEAM DEFLECTION.
7. FLEX ZONE TO BE UTILIZED FOR: LANDSCAPING, STREET TREES, POCKET PARKING, TRANSIT STOPS, BUS SHELTERS, BIKE PARKING, FURNITURE, UTILITY BOXES/CABINETS, HYDRANTS, POWER POLES, STREETLIGHTS, STORMWATER MANAGEMENT, OR WASTE RECEPTACLES.
8. BANDING, BUFFERS, POCKET PARKING DOOR ZONES, OR OTHER HARD SURFACES TO USE COLOURED AND/OR STAMPED CONCRETE.
9. CROSS-SECTIONS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.
10. STREETLIGHTS ARE DIAGRAPHIC. LIGHTING LEVELS TO BE IN ACCORDANCE WITH SECTION 10.
11. LANDSCAPING TO BE IN ACCORDANCE WITH SECTION 14.

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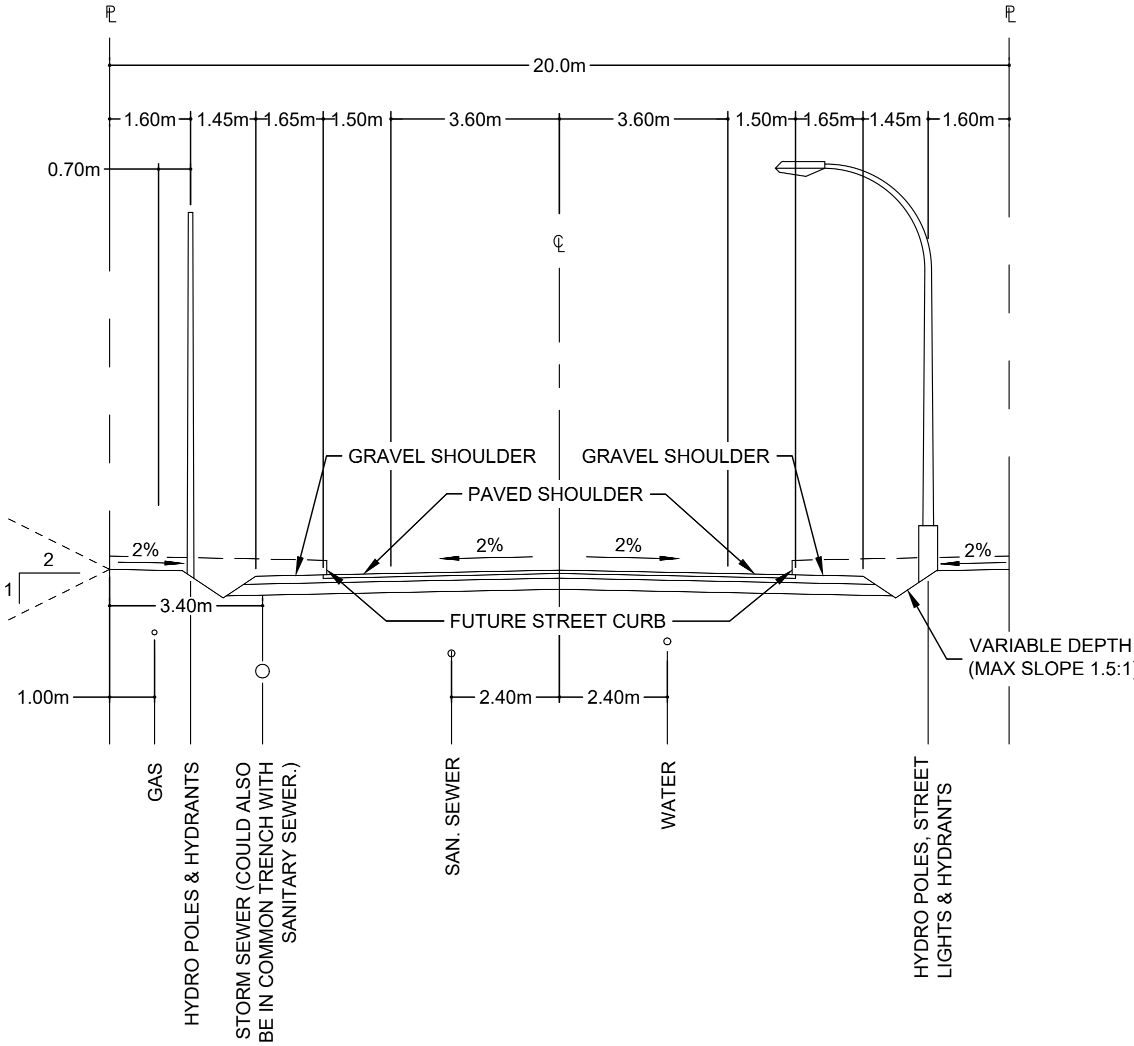
7.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
INDUSTRIAL LOCAL

Scale:	NTS
Created:	AUG 2019
Rev Date:	MAY 2020
Dwg No:	IL-XS1



NOTES:

1. PAVED SURFACE - 75mm ASPHALT (COMPACTED THICKNESS)
2. BASE - 100mm AS PER SECTION 9
3. SUB-BASE - 250mm AS PER SECTION 9
4. SHOULDER - CRUSHED GRAVEL AS PER SECTION 9
5. DEPTHS OF SURFACING AND BASE GRAVELS ARE MINIMUM AND IN SOME CASES WILL HAVE TO BE INCREASED TO MEET MAXIMUM ALLOWABLE BENKELMAN BEAM DEFLECTION.
6. STREETLIGHTS ARE DIAGRAPHIC. LIGHTING LEVELS TO BE IN ACCORDANCE WITH SECTION 10.
7. ACTIVE TRANSPORTATION REQUIREMENTS TO BE DETERMINED BY THE CITY TRANSPORTATION ENGINEER.

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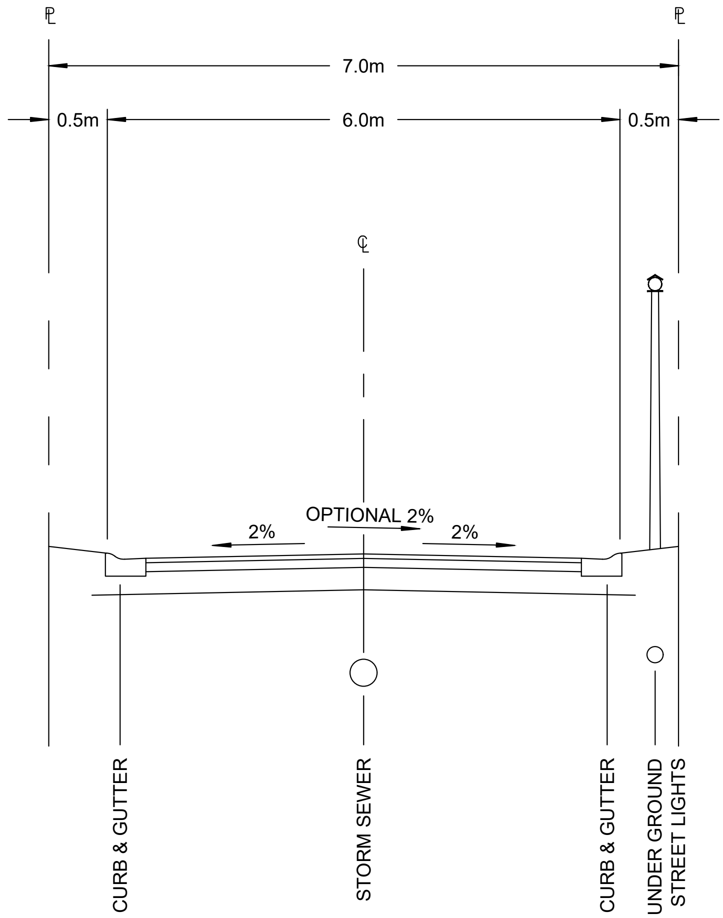
7.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
RURAL LOCAL

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	RL-XS1



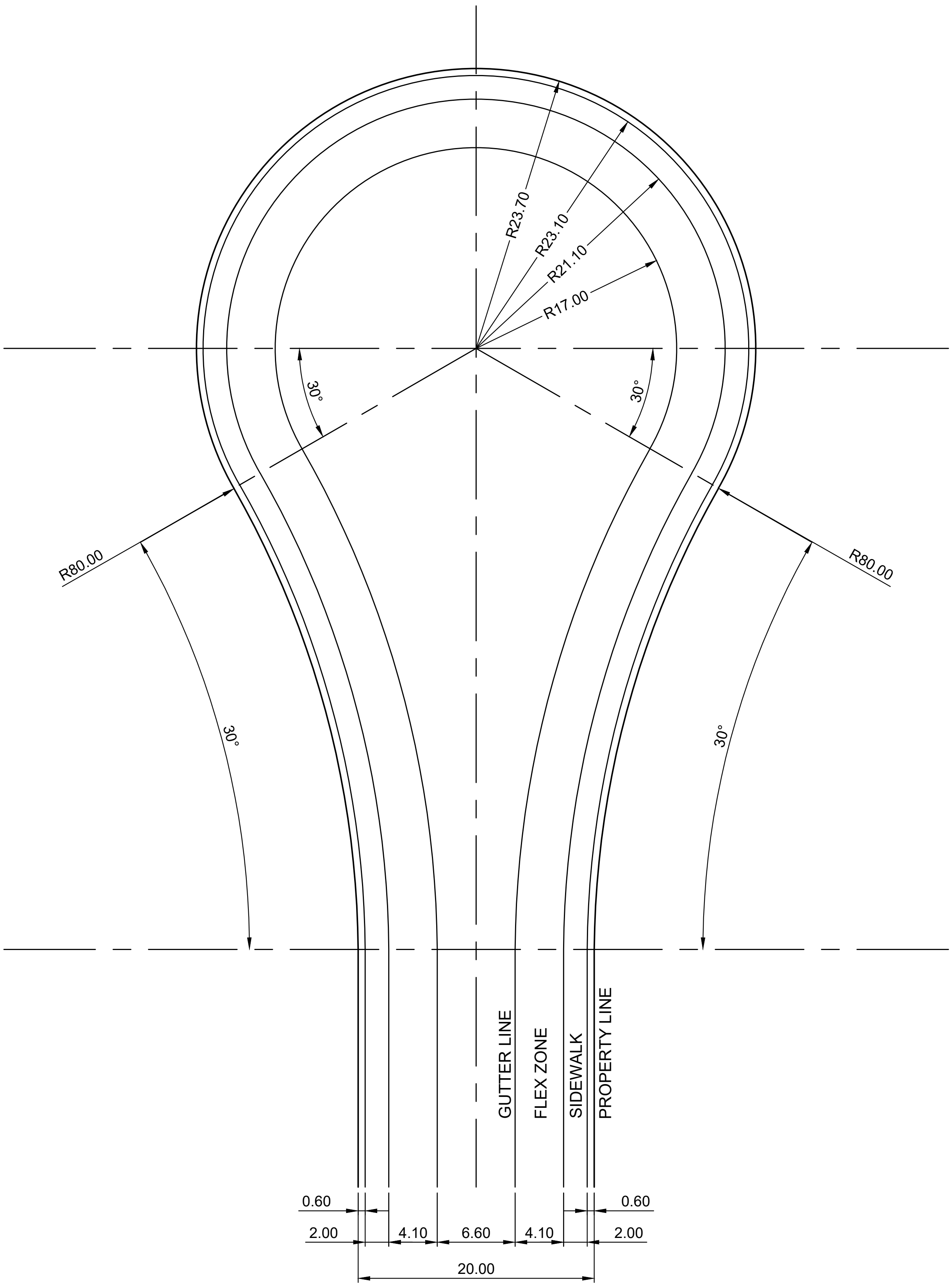
NOTES:

1. PAVED SURFACE - 75mm ASPHALT (COMPACTED THICKNESS)
2. BASE - 100mm AS PER SECTION 9
3. SUB-BASE - 250mm AS PER SECTION 9
4. BARRIER CURB AND GUTTER TO BE USED IN ACCORDANCE WITH STANDARD DRAWING CS-1.
5. DEPTHS OF SURFACING AND BASE GRAVELS ARE MINIMUM AND IN SOME CASES WILL HAVE TO BE INCREASED TO MEET MAXIMUM ALLOWABLE BENKELMAN BEAM DEFLECTION.
6. STREETLIGHTS ARE DIAGRAPHIC. LIGHTING LEVELS TO BE IN ACCORDANCE WITH SECTION 10.

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
LANE

Scale:	NTS
Created:	NOV 2009
Rev Date:	MAY 2020
Dwg No:	L-XS1



NOTE:

1. ALL DIMENSIONS SHOWN ARE MINIMUM.
2. ALL DIMENSIONS IN METERS UNLESS OTHERWISE SHOWN.

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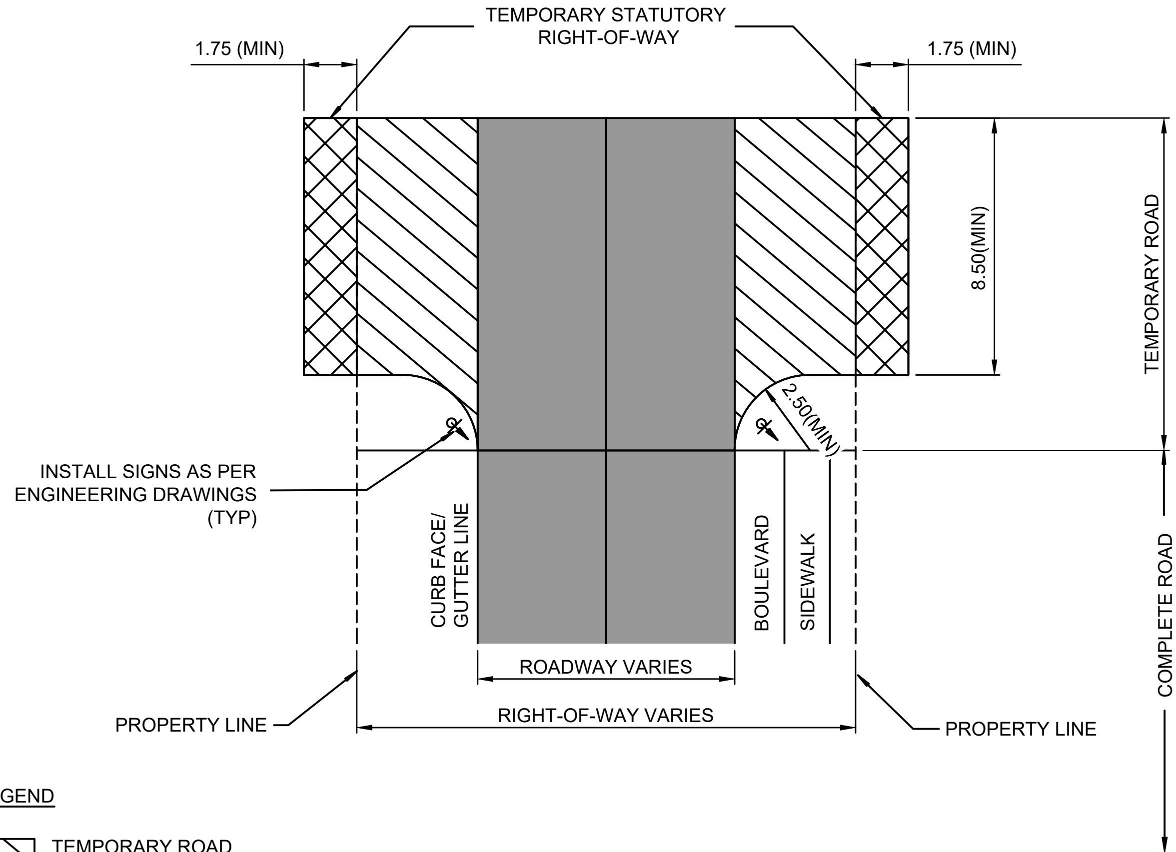
7.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
CUL-DE-SAC

Scale:	NTS
Created:	MAY 2020
Rev Date:	MAY 2020
Dwg No:	R-CDS



LEGEND

- TEMPORARY ROAD WITH FULL DEPTH ROAD STRUCTURE
- COMPLETE ROAD
- TEMPORARY STATUTORY RIGHT-OF-WAY OR TEMPORARY ROAD DEDICATION, WILL BE RELEASED WHEN ROAD IS CONNECTED.

TEMPORARY TURNABOUT

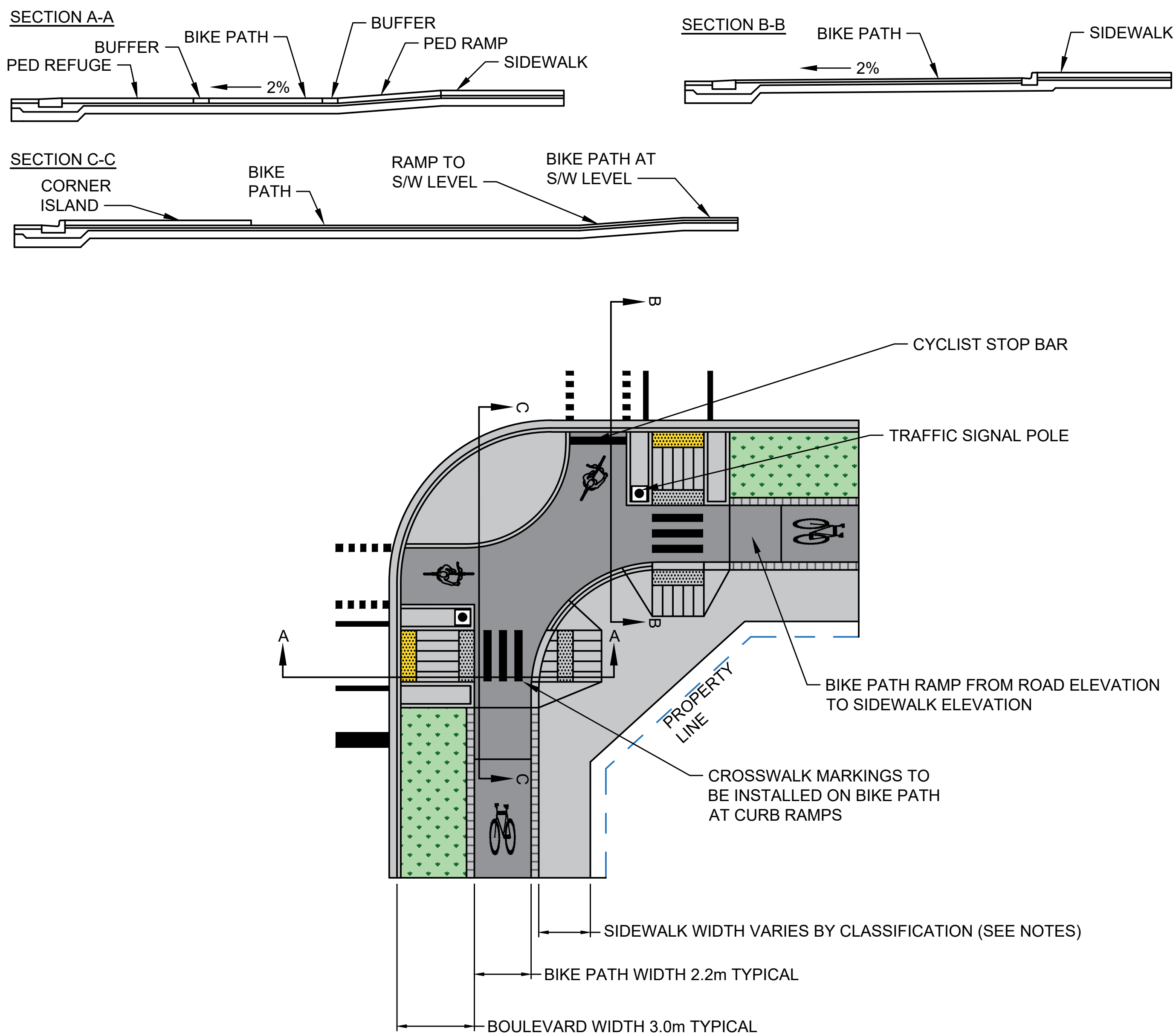
NOTES:

1. STANDARD TEMPORARY TURNAROUND SHALL BE USED FOR LOCAL LOW VOLUME ROADS AND A TEMPORARY STATUTORY RIGHT-OF-WAY SHALL BE APPLIED UNTIL THE ROAD IS CONNECTED. A TEMPORARY ROAD DEDICATION SHALL BE APPLIED UNTIL THE ROAD IS CONNECTED WHEN SUITABLE.
2. PARKING IS NOT PERMITTED WITHIN THE TEMPORARY TURNAROUND, REGULATORY SIGNAGE SHALL BE INSTALLED.
3. ALL DIMENSIONS IN METERS UNLESS OTHERWISE SHOWN.
4. IF PROPERTY DOES NOT HAVE SUFFICIENT FIRE TRUCK ACCESS ON-SITE, THE DESIGN WILL REQUIRE FIRE DEPARTMENT APPROVAL.

CITY OF NANAIMO
THE HARBOUR CITY

STREET TYPES & CROSS SECTIONS
TEMPORARY TURNAROUND

Scale:	NTS
Created:	OCT 2012
Rev Date:	MAY 2020
Dwg No:	R-TT



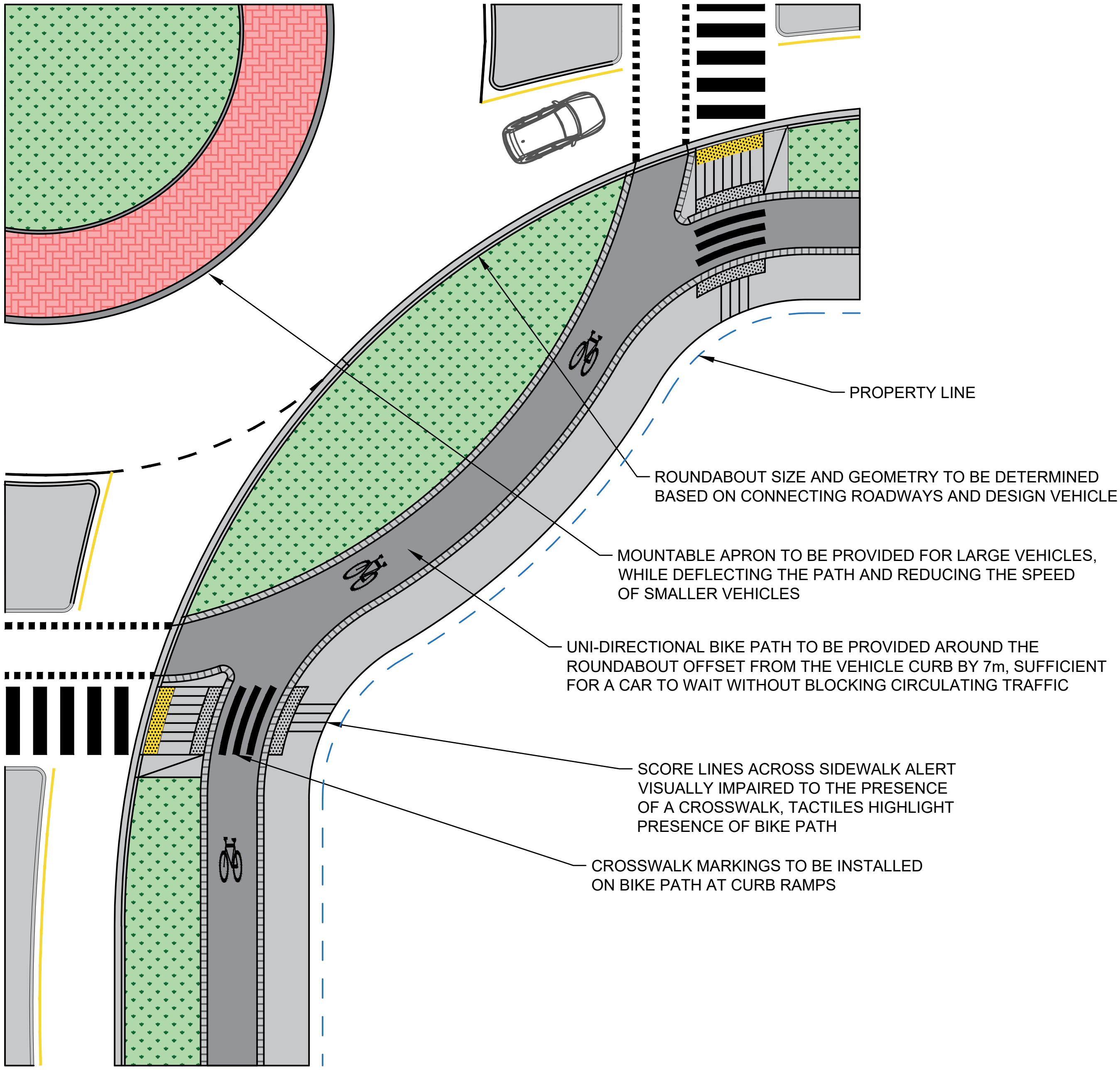
NOTES:

1. PROTECTED INTERSECTIONS REQUIRED AT ALL COLLECTOR AND ARTERIAL INTERSECTIONS WITH PROTECTED BIKE LANES.
2. BOULEVARD SHALL BE 3.0m WHERE BUS STOPS OR PARKING POCKETS ARE PRESENT. BOULEVARD SHALL BE NO LESS THAN 1.5m WHERE DRIVEWAYS ARE PRESENT.
3. WHERE PARKING POCKETS ARE PRESENT, DISTANCE BETWEEN FACE OF CURB AND BIKE PATH MUST BE NO LESS THAN 0.6m TO PROVIDE A DOOR ZONE.
4. BANDING/BUFFER ON EITHER SIDE OF THE BIKE PATH SHALL BE 0.3m STAMPED CONCRETE WITH TRANSVERSE SCORE LINES AT 0.3m INTERVALS. WHERE PAVERS MAY BE PREFERRED FOR AESTHETIC REASONS, THEY SHALL BE SET IN CONCRETE TO AVOID MOVEMENT. WHERE VERTICAL SEPARATION IS PREFERRED, MOUNTABLE MONOLITHIC CURB MAY BE UTILIZED.
5. SIDEWALK WIDTH VARIES BY CLASSIFICATION, 2.0m MIN. FOR URBAN OR INDUSTRIAL STREETS, 4.0m MIN. FOR MOBILITY STREETS.
6. SCORE LINES AND TWSIs TO BE INSTALLED WHERE PEDESTRIANS WILL BE CROSSING PATHS WITH VEHICLES, AS PER SECTION 8.
7. SCORE LINES AND STAMPED OR METAL ATTENTION DOMES TO BE INSTALLED WHERE PEDESTRIANS WILL BE CROSSING PATHS WITH CYCLISTS.
8. PLACEMENT OF PUBLIC REALM AMENITIES MUST NOT IMPEDE SIGHT LINES.
9. INTERSECTION QUADRANTS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.

CITY OF NANAIMO
THE HARBOUR CITY

INTERSECTIONS
PROTECTED

Scale:	NTS
Created:	AUG 2019
Rev Date:	MAY 2020
Dwg No:	R-PI



NOTES:

1. ROUNDABOUT MAY BE USED IN PLACE OF A PROTECTED SIGNALIZED INTERSECTION WHERE SPACE PERMITS AND ITS DETERMINED TO OFFER BENEFITS OVER A SIGNALIZED INTERSECTION.
2. BOULEVARD SHALL BE 3.0m WHERE BUS STOPS OR PARKING POCKETS ARE PRESENT. BOULEVARD SHALL BE NO LESS THAN 1.5m WHERE DRIVEWAYS ARE PRESENT.
3. WHERE PARKING POCKETS ARE PRESENT, DISTANCE BETWEEN FACE OF CURB AND BIKE PATH MUST BE NO LESS THAN 0.6m TO PROVIDE A DOOR ZONE.
4. BANDING/BUFFER ON EITHER SIDE OF THE BIKE PATH SHALL BE 0.3m STAMPED CONCRETE WITH TRANSVERSE SCORE LINES AT 0.3m INTERVALS. WHERE PAVERS MAY BE PREFERRED FOR AESTHETIC REASONS, THEY SHALL BE SET IN CONCRETE TO AVOID MOVEMENT. WHERE VERTICAL SEPARATION IS PREFERRED, MOUNTABLE MONOLITHIC CURB MAY BE UTILIZED.
6. SCORE LINES AND TWSIs TO BE INSTALLED WHERE PEDESTRIANS WILL BE CROSSING PATHS WITH VEHICLES, AS PER SECTION 8.
7. SCORE LINES AND STAMPED OR METAL ATTENTION DOMES TO BE INSTALLED WHERE PEDESTRIANS WILL BE CROSSING PATHS WITH CYCLISTS.
8. PLACEMENT OF PUBLIC REALM AMENITIES MUST NOT IMPEDE SIGHT LINES.
9. INTERSECTION QUADRANTS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.

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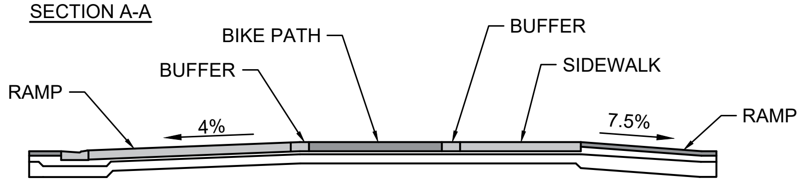
3.3.2020

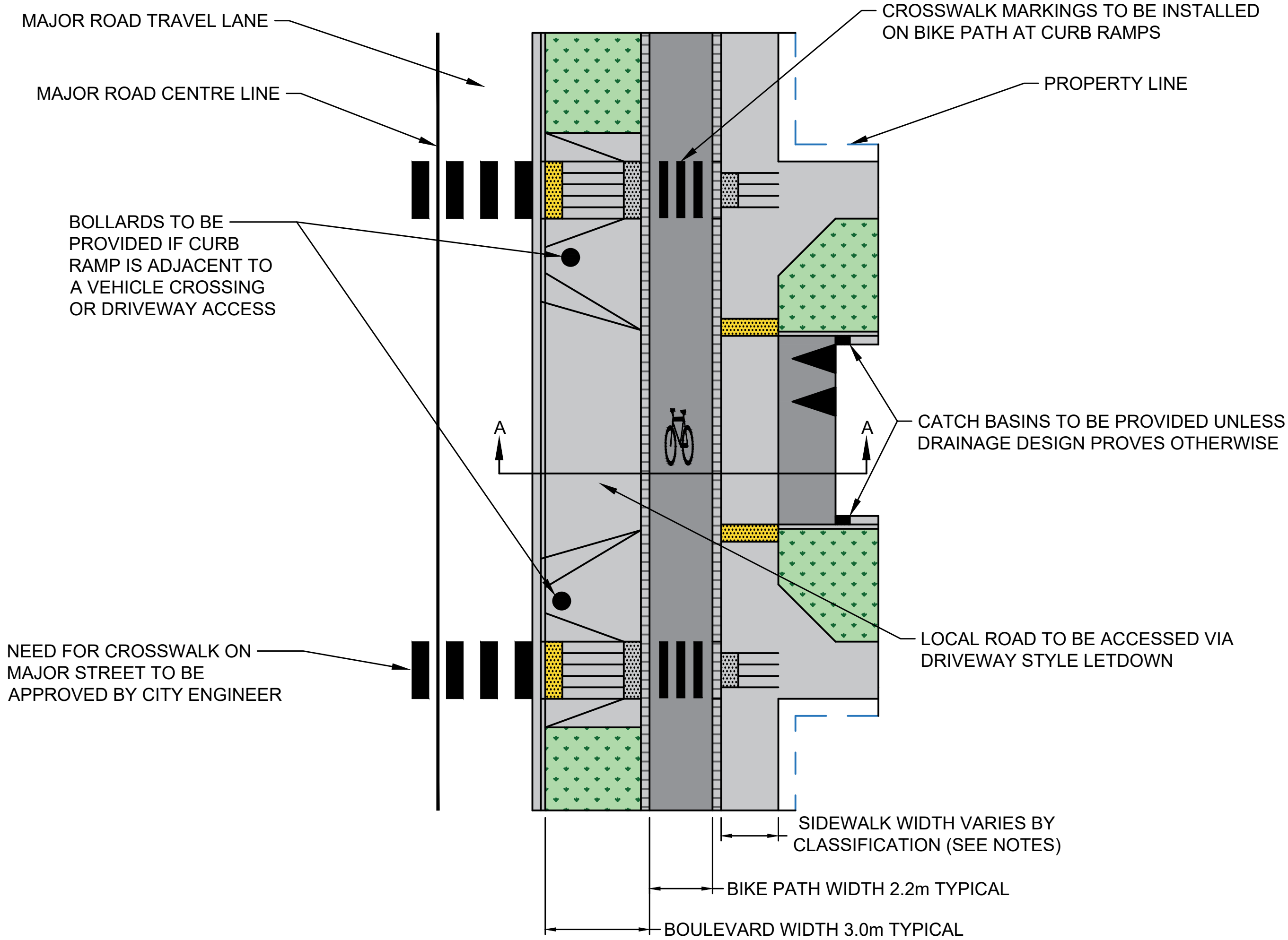
CITY OF NANAIMO
THE HARBOUR CITY

INTERSECTIONS
PROTECTED ROUNDABOUT

Scale:	NTS
Created:	AUG 2019
Rev Date:	MAY 2020
Dwg No:	R-PRI

SECTION A-A





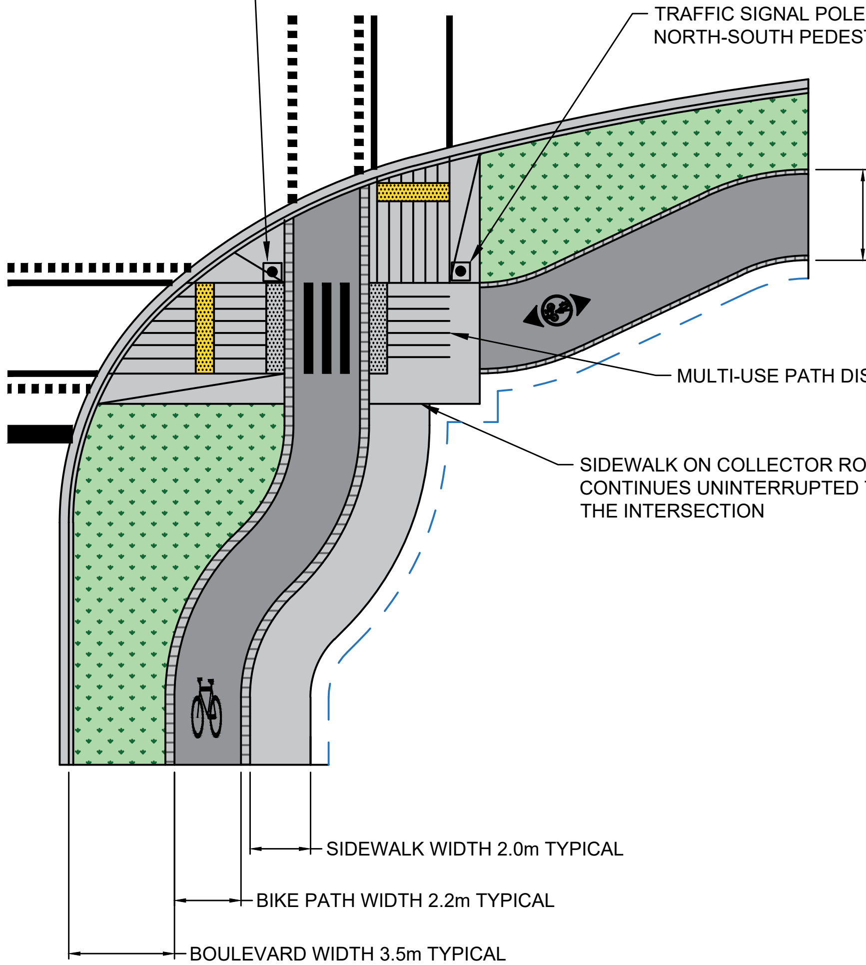
NOTES:

1. BIKE PATH AND SIDEWALK TO REMAIN AT LEVEL GRADE THROUGH INTERSECTION.
2. CONCRETE SURFACES TO BE A MINIMUM THICKNESS OF 100mm AND 150mm WHERE VEHICLE TRAFFIC IS ANTICIPATED.
3. WHERE LOCAL ROAD IS ONLY PRESENT ON ONE SIDE OF THE STREET AND MAJOR ROAD HAS BIKE PATHS, PROVIDE LETDOWN OPPOSITE LOCAL ROAD TO PROVIDE ACCESS FROM THE LOCAL ROAD TO THE OPPOSITE BIKE PATH.
4. BOULEVARD SHALL BE 3.0m WHERE BUS STOPS OR PARKING POCKETS ARE PRESENT. BOULEVARD SHALL BE NO LESS THAN 1.5m WHERE DRIVEWAYS ARE PRESENT.
5. WHERE PARKING POCKETS ARE PRESENT, DISTANCE BETWEEN FACE OF CURB AND BIKE PATH MUST BE NO LESS THAN 0.6m TO PROVIDE A DOOR ZONE.
6. BANDING/BUFFER ON EITHER SIDE OF THE BIKE PATH SHALL BE 0.3m STAMPED CONCRETE WITH TRANSVERSE SCORE LINES AT 0.3m INTERVALS. WHERE PAVERS MAY BE PREFERRED FOR AESTHETIC REASONS, THEY SHALL BE SET IN CONCRETE TO AVOID MOVEMENT. WHERE VERTICAL SEPARATION IS PREFERRED, MOUNTABLE MONOLITHIC CURB MAY BE UTILIZED.
7. SIDEWALK WIDTH VARIES BY CLASSIFICATION, 2.0m MIN. FOR URBAN OR INDUSTRIAL STREETS, 4.0m MIN. FOR MOBILITY STREETS.
8. SCORE LINES AND TWSIs TO BE INSTALLED WHERE PEDESTRIANS WILL BE CROSSING PATHS WITH VEHICLES, AS PER SECTION 8.
9. SCORE LINES AND STAMPED OR METAL ATTENTION DOMES TO BE INSTALLED WHERE PEDESTRIANS WILL BE CROSSING PATHS WITH CYCLISTS.
10. PLACEMENT OF PUBLIC REALM AMENITIES MUST NOT IMPEDE SIGHT LINES.
11. INTERSECTION QUADRANTS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.

CITY OF NANAIMO
THE HARBOUR CITY

INTERSECTIONS
RAISED LOCAL

Scale:	NTS
Created:	AUG 2019
Rev Date:	MAY 2020
Dwg No:	R-RLI



NOTES:

1. BOULEVARD SHALL BE MINIMUM 3.0m WHERE BUS STOPS ARE PRESENT
2. BOULEVARD SHALL BE MINIMUM 3.5m WHERE PARKING POCKETS ARE PRESENT TO ALLOW WIDER PARKING SPACES.
3. WHERE PARKING POCKETS ARE PRESENT, DISTANCE BETWEEN FACE OF CURB AND BIKE PATH MUST BE NO LESS THAN 0.6m TO PROVIDE A DOOR ZONE.
4. BOULEVARD SHALL BE NO LESS THAN 1.5m WHERE DRIVEWAYS ARE PRESENT.
5. BANDING/BUFFER ON EITHER SIDE OF THE BIKE PATH SHALL BE 0.3m STAMPED CONCRETE WITH TRANSVERSE SCORE LINES AT 0.3m INTERVALS. WHERE PAVERS MAY BE PREFERRED FOR AESTHETIC REASONS, THEY SHALL BE SET IN CONCRETE TO AVOID MOVEMENT.
6. MULTI-USE PATH ON INDUSTRIAL LOCAL ROADS WILL FEATURE 0.3m STAMPED CONCRETE EDGES WITH TRANSVERSE SCORE LINES AT 0.3m INTERVALS.
7. SCORE LINES AND TWSIs TO BE INSTALLED WHERE PEDESTRIANS WILL BE CROSSING PATHS WITH VEHICLES, AS PER SECTION 8.
8. SCORE LINES AND STAMPED OR METAL ATTENTION DOMES TO BE INSTALLED WHERE PEDESTRIANS WILL BE CROSSING PATHS WITH CYCLISTS.
9. PLACEMENT OF PUBLIC REALM AMENITIES MUST NOT IMPEDE SIGHT LINES.
10. INTERSECTION QUADRANTS TO BE USED IN CONJUNCTION WITH CITY'S COMPLETE STREET DESIGN GUIDELINES.

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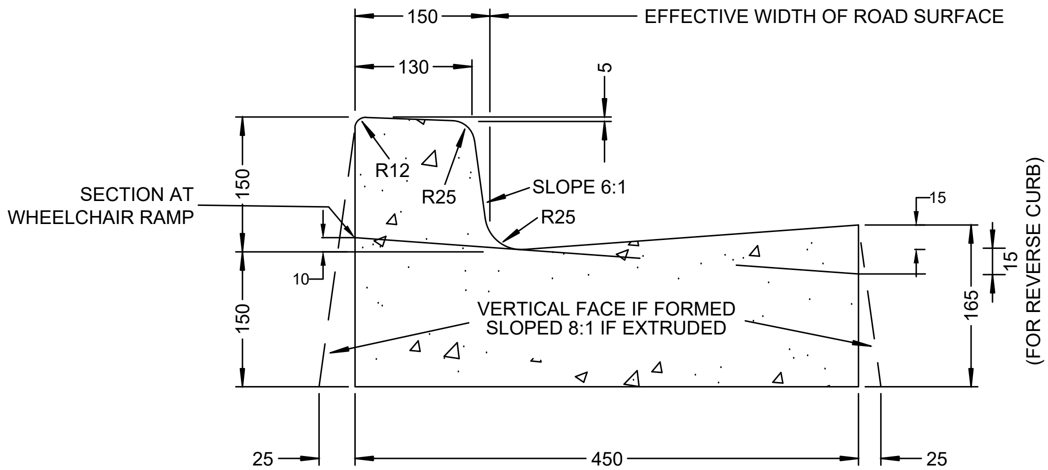
3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

INTERSECTIONS
INDUSTRIAL

Scale:	NTS
Created:	OCT 2019
Rev Date:	MAY 2020
Dwg No:	R-II



BARRIER CURB AND GUTTER

NOTES:

1. FOR BASE AND SUB-BASE REQUIREMENTS, REFER TO SECTION 9.
2. FOR CONCRETE REQUIREMENTS REFER TO SECTION 11.
3. THE LENGTH OF TRANSITION FROM ONE TYPE OF CURB TO ANOTHER SHALL BE THE GREATEST OF:
   a) 50 x DIFFERENCE IN OVERALL CURB HEIGHTS.
   b) 25 x DIFFERENCE IN GUTTER WIDTHS.
   c) 2.0 METERS.
4. REINFORCING BARS OR CONCRETE FOOTING REQUIRED FOR LANE ACCESSES AND FOR COMMERCIAL AND INDUSTRIAL DRIVEWAY ACCESSES.
5. REVERSE CURB SHALL BE APPROVED BY CITY ENGINEER.
6. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

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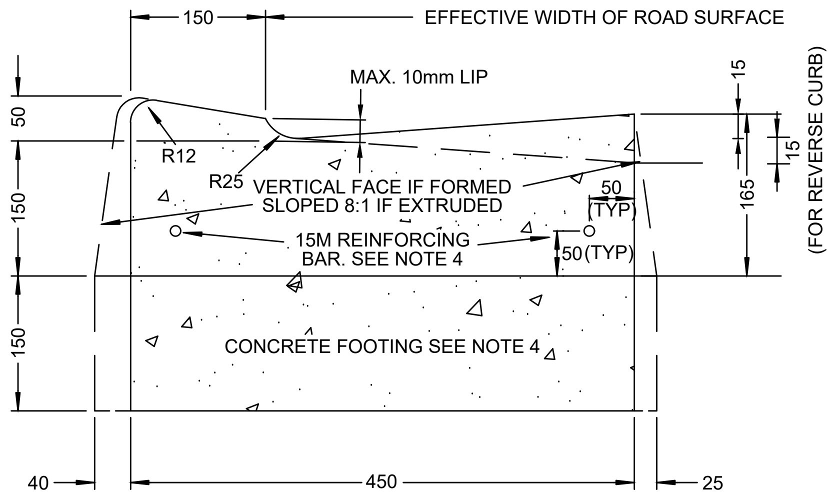
3.20.2020

CITY OF NANAIMO
THE HARBOUR CITY

CURBS
BARRIER CURB AND GUTTER

Scale:	NTS
Created:	SEP 2012
Rev Date:	MAY 2020
Dwg No:	CS-1



DROP CURB AND GUTTER

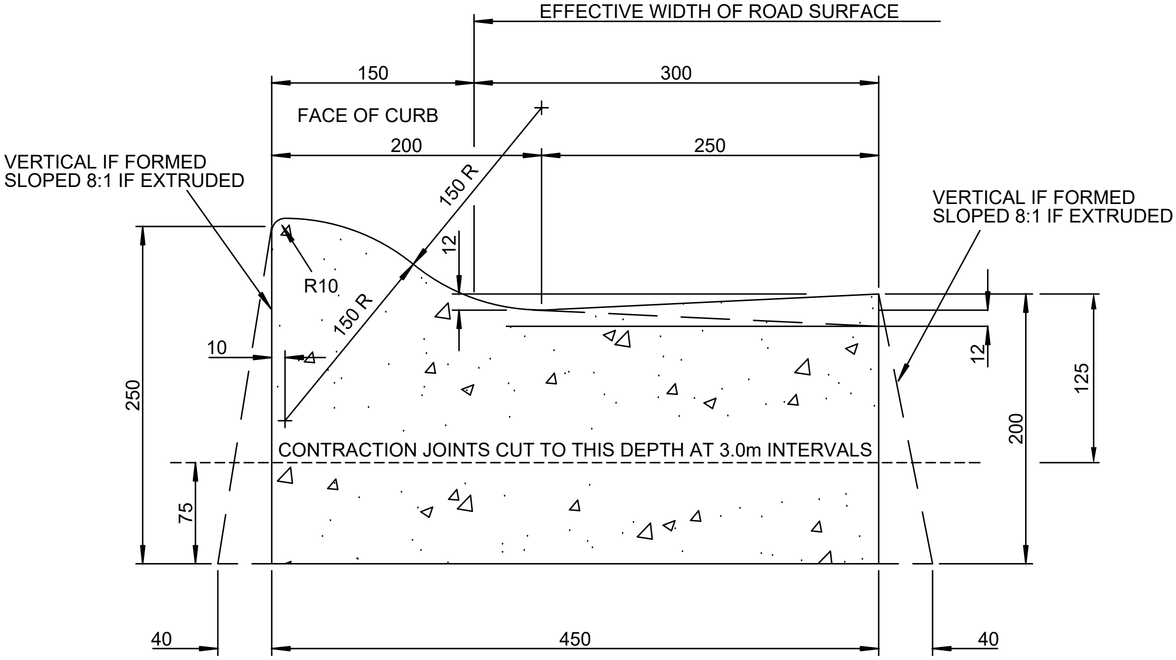
NOTES:

1. FOR BASE AND SUB-BASE REQUIREMENTS, REFER TO SECTION 9.
2. FOR CONCRETE REQUIREMENTS REFER TO SECTION 11.
3. THE LENGTH OF TRANSITION FROM ONE TYPE OF CURB TO ANOTHER SHALL BE THE GREATEST OF:
   a) 50 x DIFFERENCE IN OVERALL CURB HEIGHTS.
   b) 25 x DIFFERENCE IN GUTTER WIDTHS.
   c) 2.0 METERS.
4. REINFORCING BARS OR CONCRETE FOOTING REQUIRED FOR LANE ACCESSES AND FOR COMMERCIAL AND INDUSTRIAL DRIVEWAY ACCESSES.
5. REVERSE CURB SHALL BE APPROVED BY CITY ENGINEER.
6. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

CITY OF NANAIMO
THE HARBOUR CITY

CURBS
DROP CURB AND GUTTER

Scale:	NTS
Created:	SEP 2012
Rev Date:	MAY 2020
Dwg No:	CS-2



ROLLOVER CURB AND GUTTER

NOTES:

1. MOUNTABLE ROLLOVER CONCRETE CURBS SHALL BE USED WITHIN CUL-DE-SACS, POCKET PARKING, OR WHERE APPROVED BY CITY ENGINEER.
2. FOR BASE AND SUB-BASE REQUIREMENTS, REFER TO SECTION 9.
3. FOR CONCRETE REQUIREMENTS REFER TO SECTION 11.
4. THE LENGTH OF TRANSITION FROM ONE TYPE OF CURB TO ANOTHER SHALL BE THE GREATEST OF:
   a) 50 x DIFFERENCE IN OVERALL CURB HEIGHTS.
   b) 25 x DIFFERENCE IN GUTTER WIDTHS.
   c) 2.0 METERS.
5. REVERSE CURB SHALL BE APPROVED BY CITY ENGINEER.
6. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

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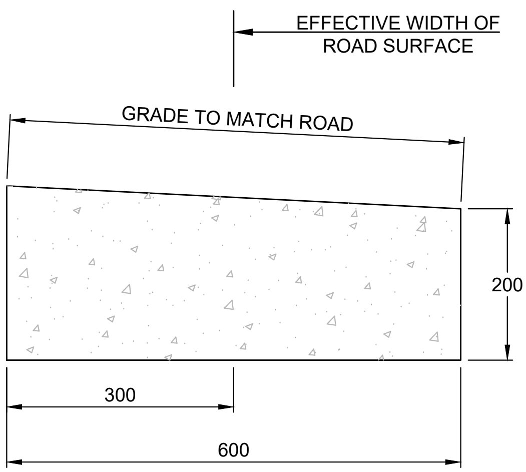
3.20.2020

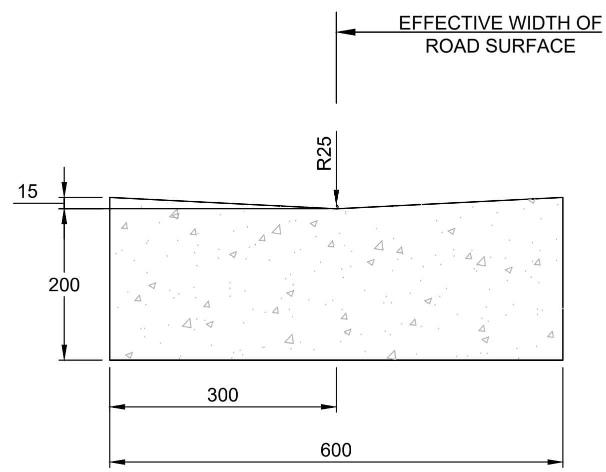
CITY OF NANAIMO
THE HARBOUR CITY

CURBS
ROLLOVER CURB AND GUTTER

Scale:	NTS
Created:	SEP 2012
Rev Date:	MAY 2020
Dwg No:	CS-3



FLAT GUTTER



VALLEY GUTTER

NOTES:

1. FOR BASE AND SUB-BASE REQUIREMENTS, REFER TO SECTION 9.
2. FOR CONCRETE REQUIREMENTS REFER TO SECTION 11.
3. AT LOCATIONS OTHER THAN PEDESTRIAN CURB RAMPS, THE LENGTH OF TRANSITION FROM ONE TYPE OF CURB TO ANOTHER SHALL BE THE GREATEST OF:
   a) 50 x DIFFERENCE IN OVERALL CURB HEIGHTS.
   b) 25 x DIFFERENCE IN GUTTER WIDTHS.
   c) 2.0 METERS.
4. MIDPOINT OF CURB SHALL ALIGN WITH THE UPSTREAM AND DOWN STREAM CURB FACES.
5. REINFORCEMENT BARS OR CONCRETE FOOTING REQUIRED FOR COMMERCIAL AND INDUSTRIAL APPLICATIONS.
6. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

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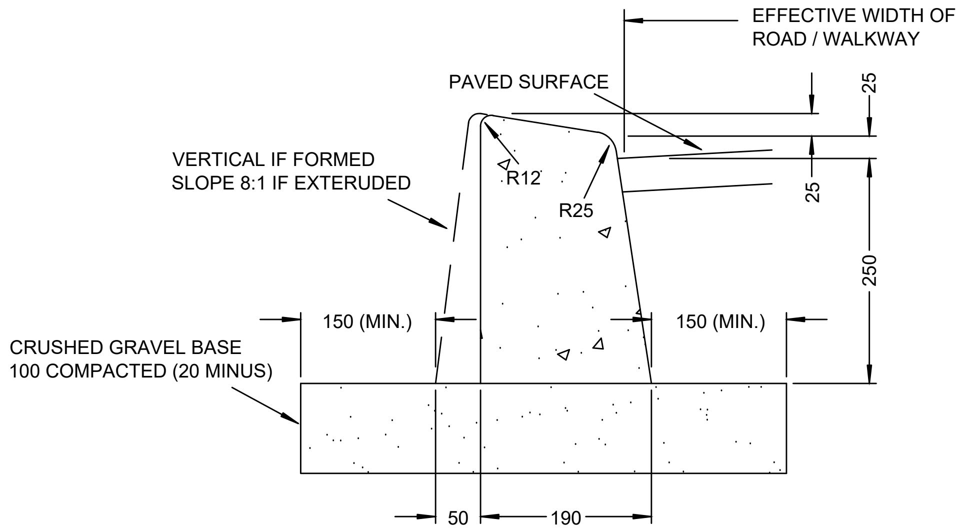
3.18.2020

CITY OF NANAIMO
THE HARBOUR CITY

CURBS
FLAT AND VALLEY GUTTER

Scale:	NTS
Created:	NOV 2012
Rev Date:	MAY 2020
Dwg No:	CS-4



TEMPORARY CURB - TYPE 1

NOTES:

1. FOR BASE AND SUB-BASE REQUIREMENTS, REFER TO SECTION 9.
2. FOR CONCRETE REQUIREMENTS REFER TO SECTION 11.
3. THE LENGTH OF TRANSITION FROM ONE TYPE OF CURB TO ANOTHER SHALL BE THE GREATEST OF:
    a) 50 x DIFFERENCE IN OVERALL CURB HEIGHTS.
    b) 25 x DIFFERENCE IN GUTTER WIDTHS.
    c) 2.0 METERS.
4. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

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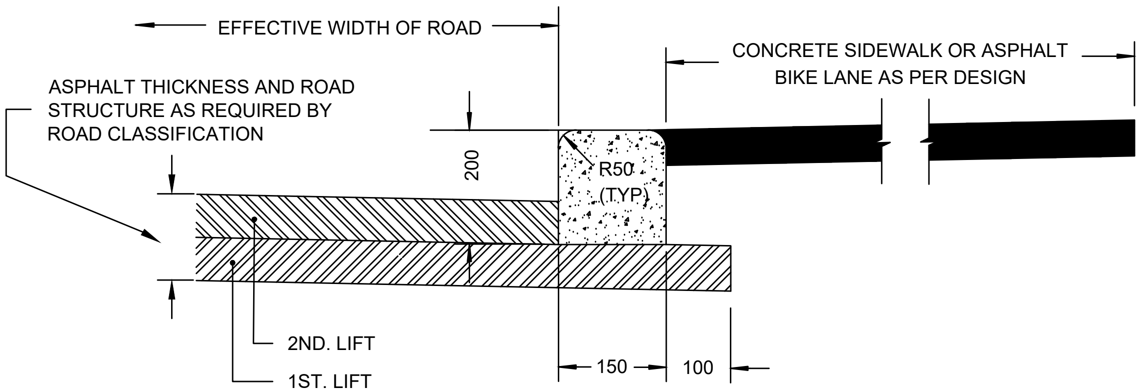
3.18.2020

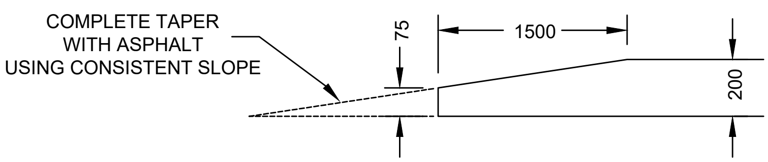
CITY OF NANAIMO
THE HARBOUR CITY

CURBS
TEMPORARY CURB - TYPE 1

Scale:	NTS
Created:	OCT 1993
Rev Date:	MAY 2020
Dwg No:	CS-5



TEMPORARY CURB - TYPE 2



LETDOWN DETAIL

NOTES:

1. APPLICATION OF THIS STANDARD AT THE DISCRETION OF THE CITY ENGINEER.
2. PROVIDE 1500mm TAPER TO ZERO HEIGHT AT DROP LOCATIONS.
3. CURB HEIGHT 150mm IF INSTALLED ON FINAL LIFT AND 200mm IF INSTALLED ON BOTTOM LIFT.
4. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

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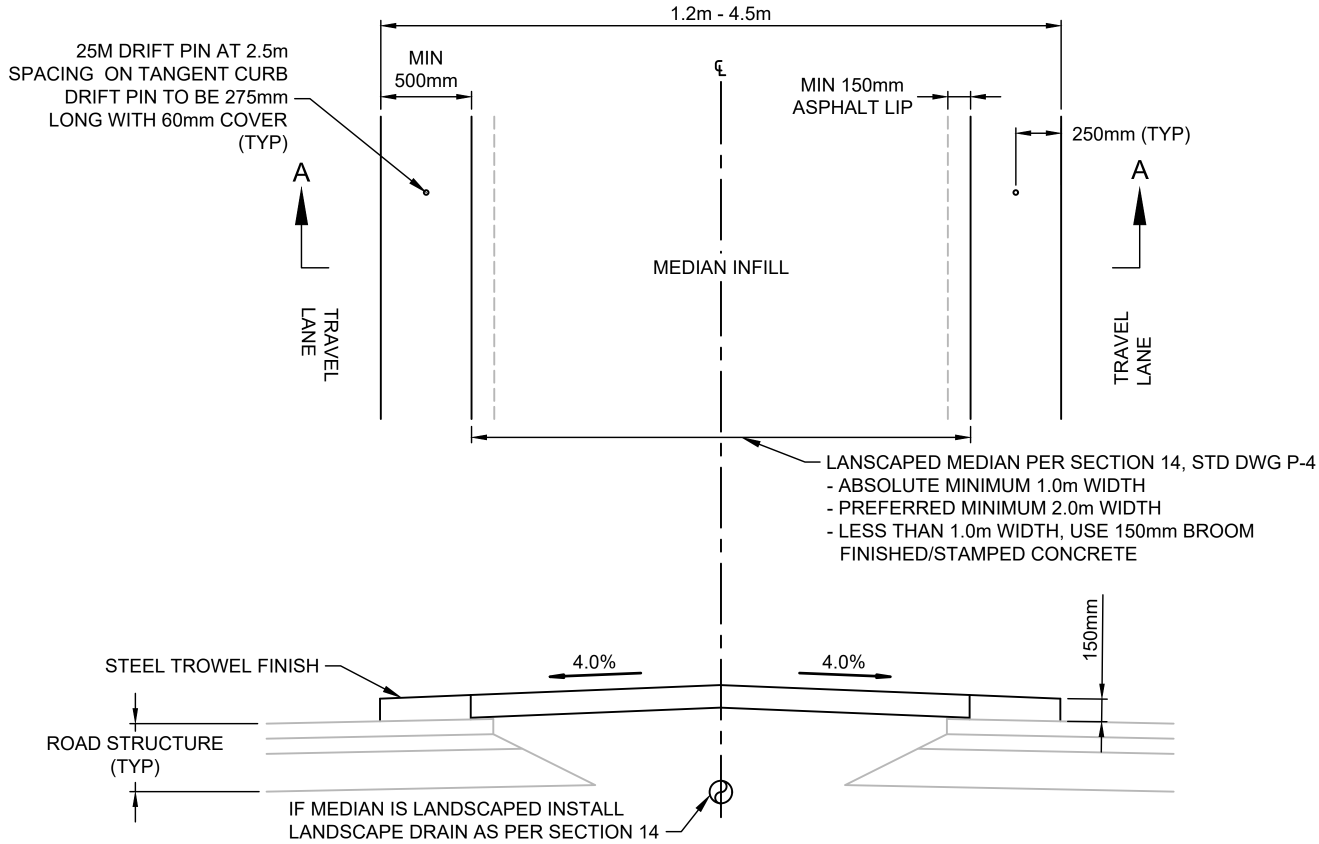
3.18.2020

CITY OF NANAIMO
THE HARBOUR CITY

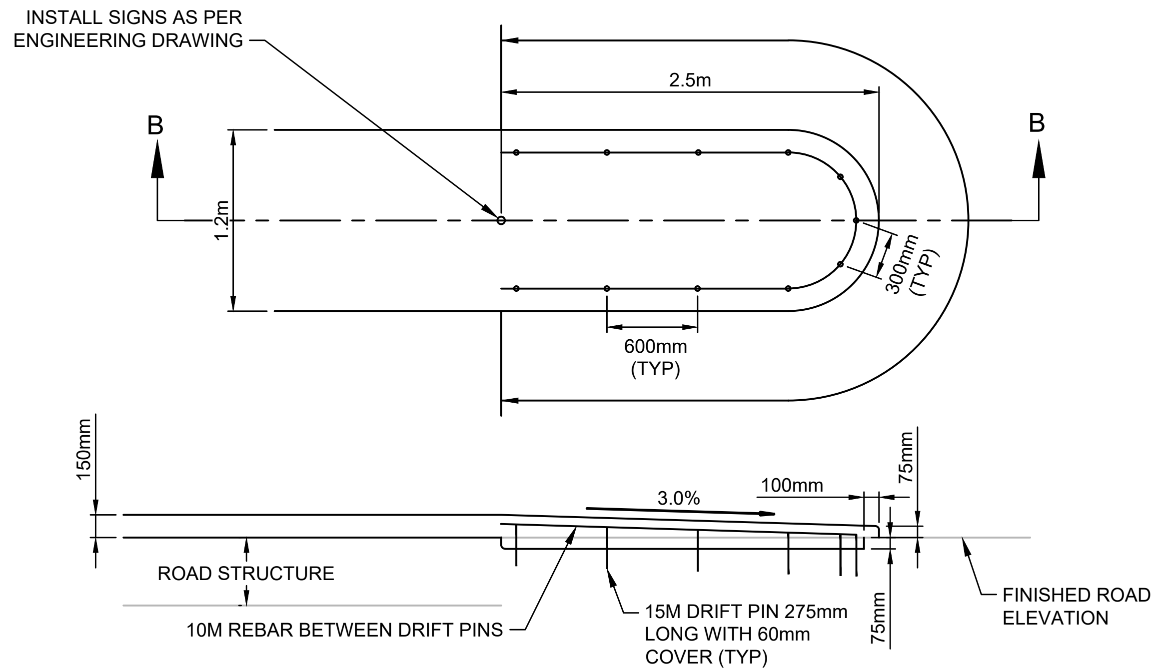
CURBS
TEMPORARY CURB - TYPE 2

Scale:	NTS
Created:	SEP 2012
Rev Date:	MAY 2020
Dwg No:	CS-6



SECTION A-A

TYPICAL MEDIAN DETAILS



SECTION B-B

TYPICAL MEDIAN END TREATMENT DETAILS

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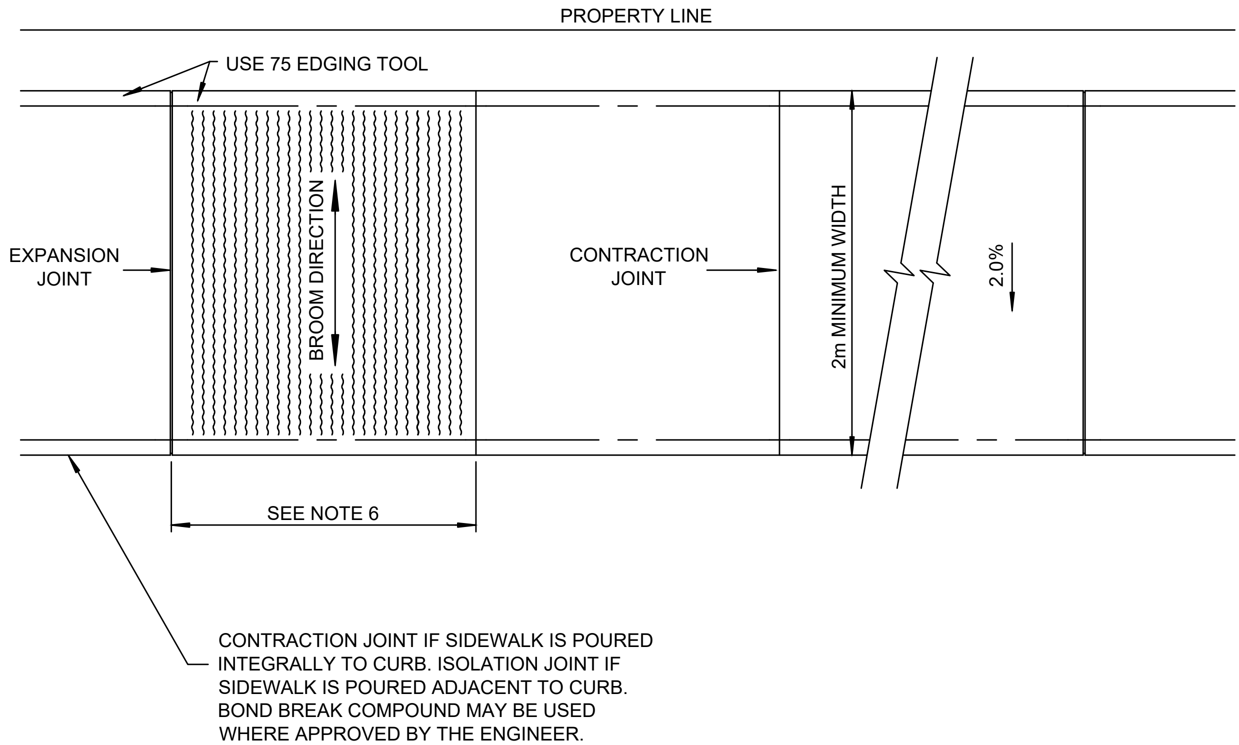
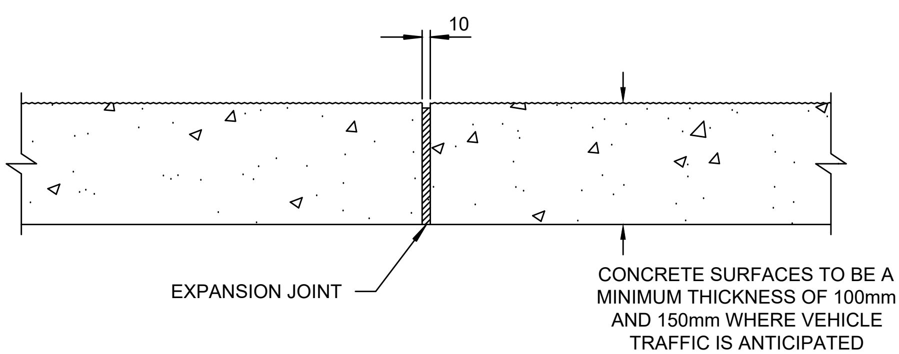
3.18.2020

CITY OF NANAIMO
THE HARBOUR CITY

MEDIANS AND ISLANDS
RAISED CENTRE MEDIAN

Scale:	NTS
Created:	OCT 2019
Rev Date:	MAY 2020
Dwg No:	CS-7





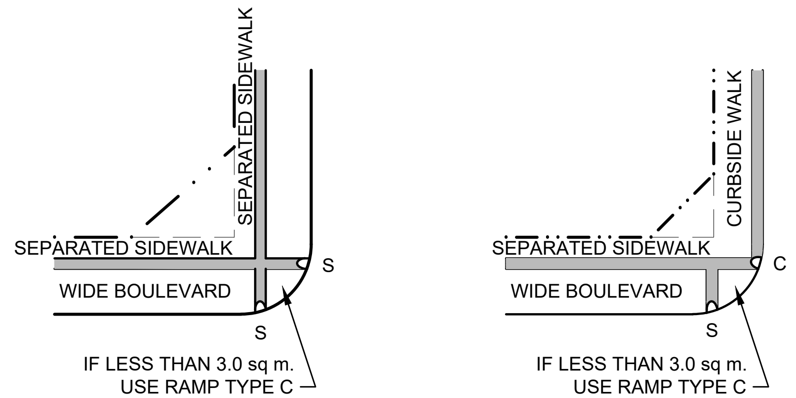
NOTES:

1. FOR DRIVEWAY CROSSING DETAIL SEE DWG. CS-24, CS-25, & CS-26.
2. SIDEWALKS SHALL HAVE BROOMED FINISH.
3. FOR CONCRETE DETAILS SEE SECTION 11.
4. FOR BASE AND SUB-BASE REQUIREMENTS SEE SECTION 9.
5. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
6. DIMENSIONS SHOULD BE OF EQUAL SPACING ALONG SIDEWALK TO BE AS CLOSE TO SQUARE AS POSSIBLE.

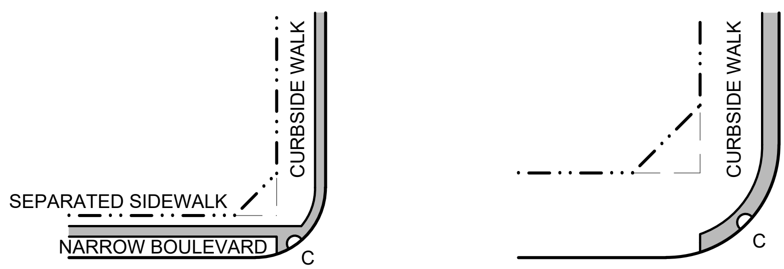
CITY OF NANAIMO
THE HARBOUR CITY

SIDEWALKS
SIDEWALK FINISHING DETAILS

Scale:	NTS
Created:	NOV 2012
Rev Date:	MAY 2020
Dwg No:	CS-8

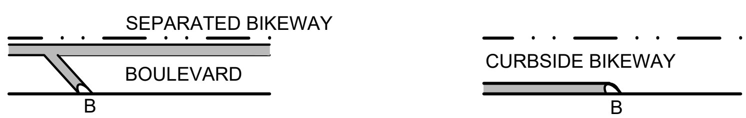


TYPE S - SEPARATED



TYPE C - CONSTRAINED

TYPE M - MID-BLOCK



TYPE B - BIKEWAY

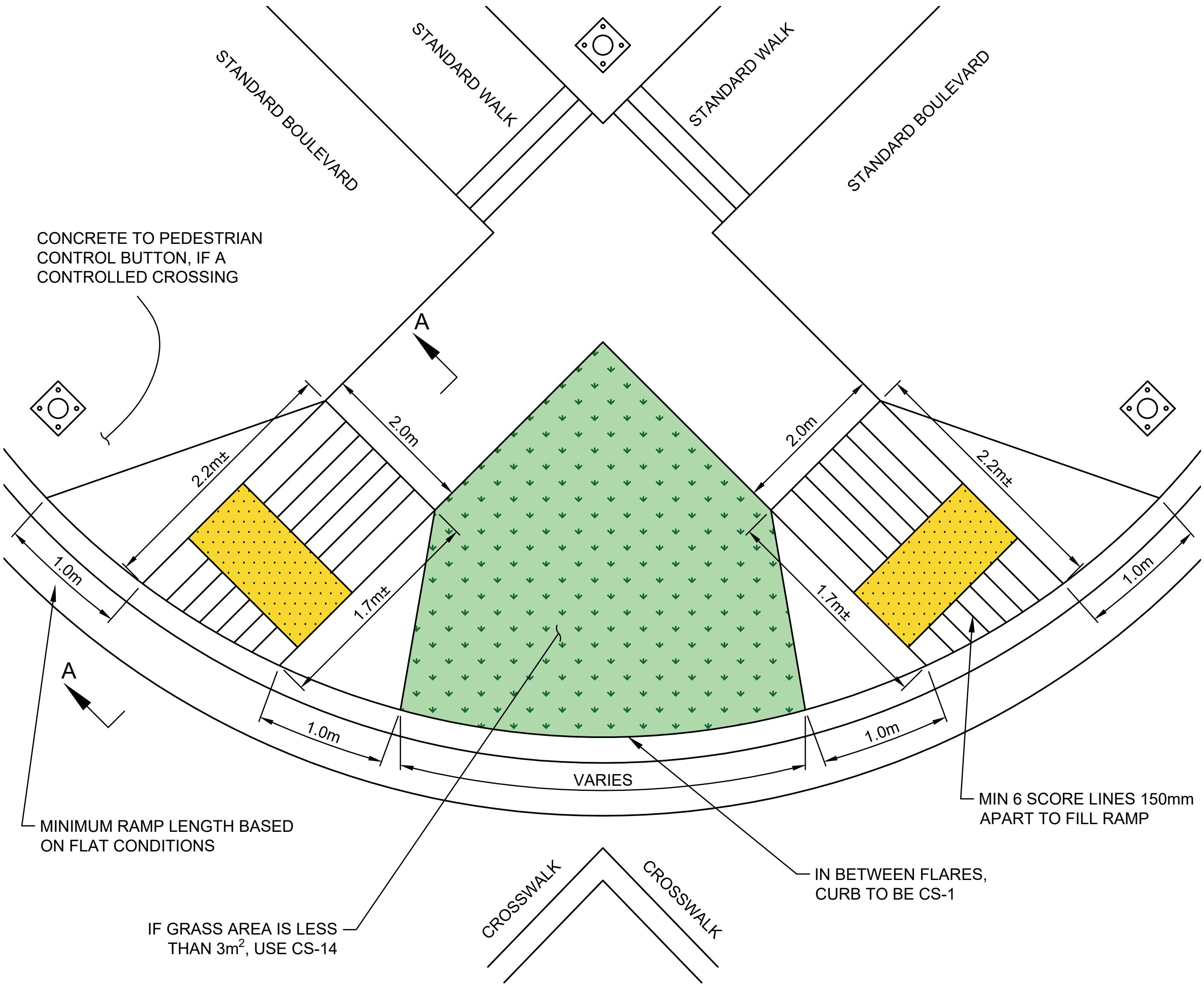
NOTES:

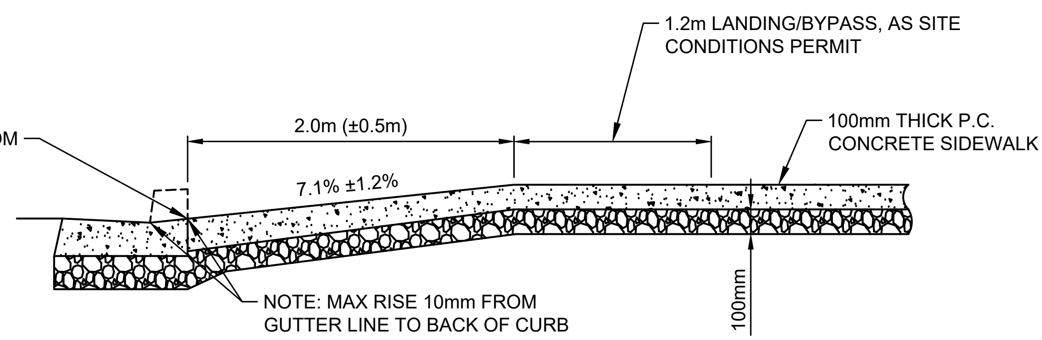
1. CORNER CUT REQUIREMENTS DEPENDENT ON GEOMETRIC DESIGN AND SIGHT LINE REQUIREMENTS

CITY OF NANAIMO
THE HARBOUR CITY

CURB RAMPS
ORIENTATIONS

Scale:	NTS
Created:	OCT 2019
Rev Date:	MAY 2020
Dwg No:	CS-12





SECTION A-A

NOTES:

1. PEDESTRIAN SIDEWALK RAMP DIMENSIONS SHALL BE DETERMINED BY THE ENGINEER.
2. TOOLED LINES ARE TO BE CENTERED IN THE CROSSWALK AND ARE TO POINT IN DIRECTION OF THE RECEIVING CURB RAMP.
3. CATCH BASINS ARE NOT PERMITTED IN CURB LET DOWN AND SHOULD BE LOCATED UP STREAM OF CROSSWALK.
4. ALL TWSIs TO BE DESIGNED AND INSTALLED AS PER SECTION 8.
5. POLE LOCATIONS ARE DIAGRAMMATIC. EXACT LOCATIONS TO BE DETERMINED BY ENGINEER.

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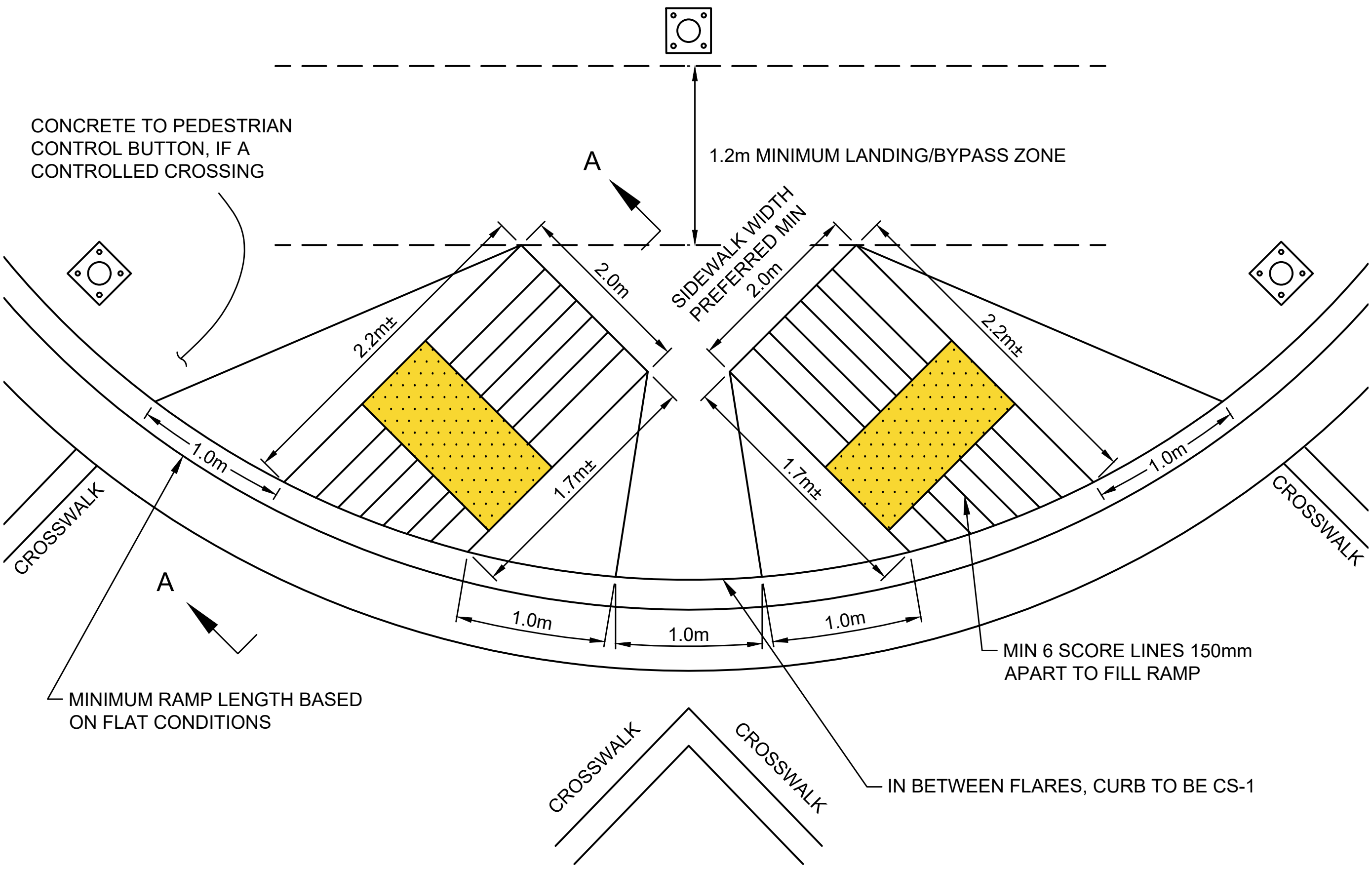
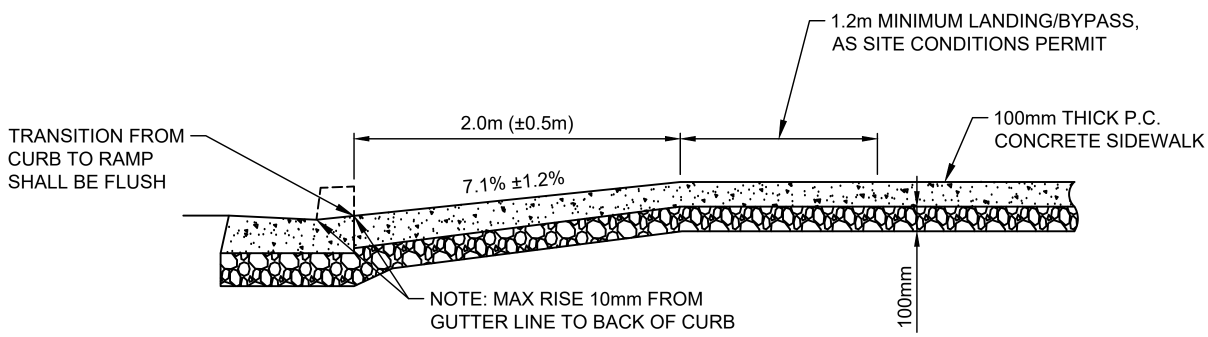
CITY OF NANAIMO
THE HARBOUR CITY

CURB RAMPS
TYPE S - SEPARATED

Scale:	NTS
Created:	OCT 2019
Rev Date:	MAY 2020
Dwg No:	CS-13





SECTION A-A

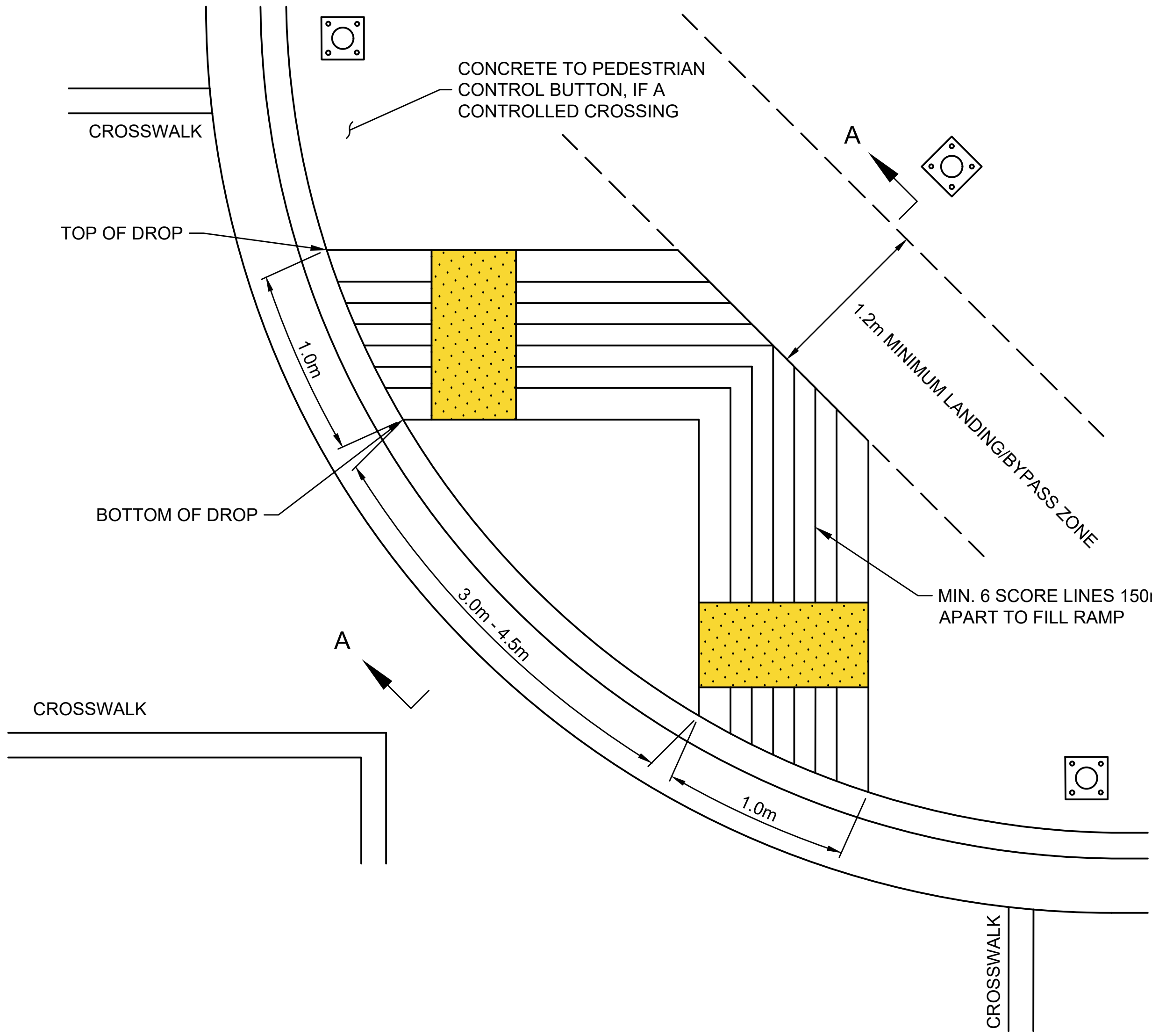
NOTES:

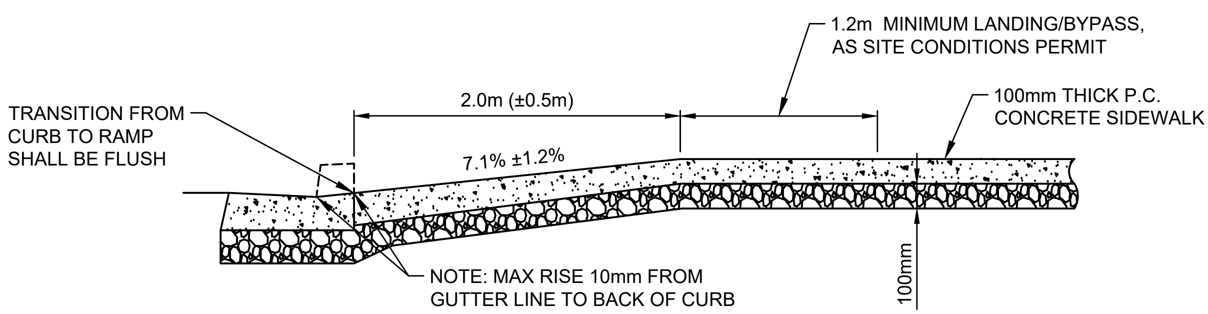
1. PEDESTRIAN SIDEWALK RAMP DIMENSIONS SHALL BE DETERMINED BY THE ENGINEER.
2. TOOLED LINES ARE TO BE CENTERED IN THE CROSSWALK AND ARE TO POINT IN DIRECTION OF THE RECEIVING CURB RAMP.
3. CATCH BASINS ARE NOT PERMITTED IN CURB LET DOWN AND SHOULD BE LOCATED UP STREAM OF CROSSWALK.
4. ALL TWSIs TO BE DESIGNED AND INSTALLED AS PER SECTION 8.
5. POLE LOCATIONS ARE DIAGRAMMATIC. EXACT LOCATIONS TO BE DETERMINED BY ENGINEER.

CITY OF NANAIMO
THE HARBOUR CITY

CURB RAMPS
TYPE C - CONSTRAINED (PREFERRED)

Scale:	NTS
Created:	OCT 2019
Rev Date:	MAY 2020
Dwg No:	CS-14





SECTION A-A

NOTES:

1. PEDESTRIAN SIDEWALK RAMP DIMENSIONS SHALL BE DETERMINED BY THE ENGINEER.
2. TOOLED LINES ARE TO BE CENTERED IN THE CROSSWALK AND ARE TO POINT IN DIRECTION OF THE RECEIVING CURB RAMP.
3. CATCH BASINS ARE NOT PERMITTED IN CURB LET DOWN AND SHOULD BE LOCATED UP STREAM OF CROSSWALK.
4. ALL TWSIs TO BE DESIGNED AND INSTALLED AS PER SECTION 8.
5. POLE LOCATIONS ARE DIAGRAMMATIC. EXACT LOCATIONS TO BE DETERMINED BY ENGINEER.

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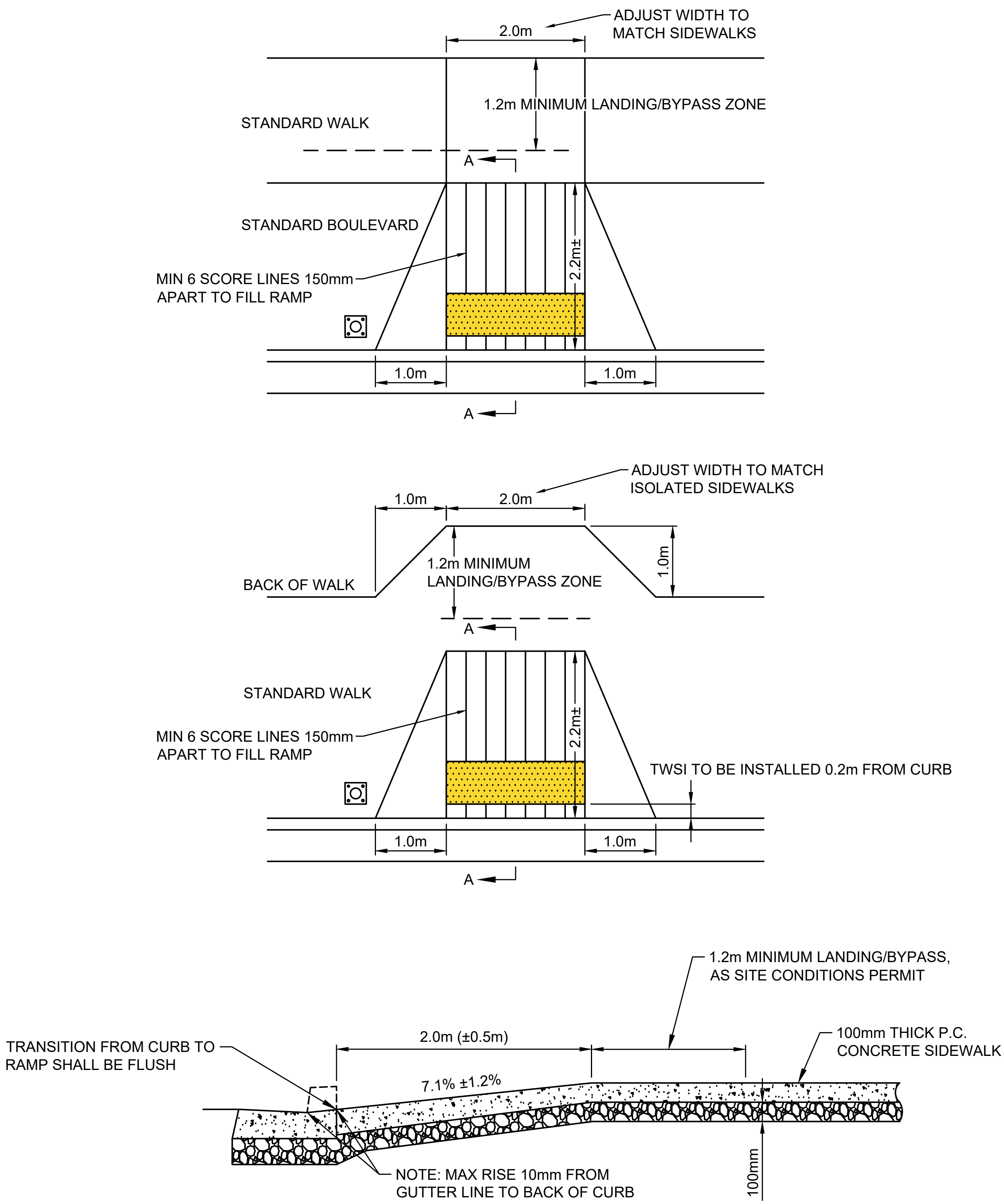
CITY OF NANAIMO
THE HARBOUR CITY

CURB RAMPS
TYPE C - CONSTRAINED

Scale:	NTS
Created:	OCT 2019
Rev Date:	MAY 2020
Dwg No:	CS-15



SECTION A-A

NOTES:

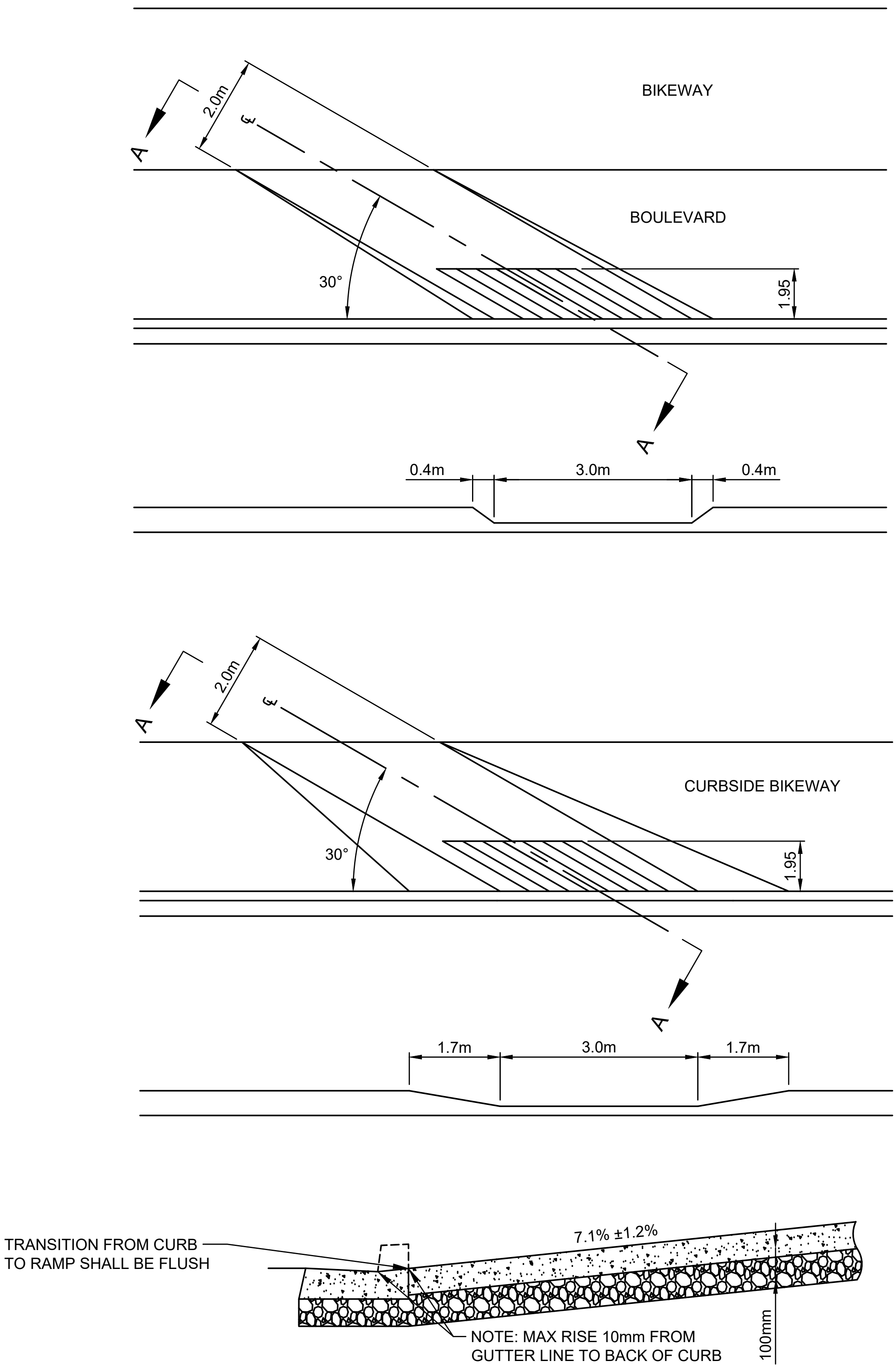
1. PEDESTRIAN SIDEWALK RAMP DIMENSIONS SHALL BE DETERMINED BY THE ENGINEER.
2. TOOLED LINES ARE TO BE CENTERED IN THE CROSSWALK AND ARE TO POINT IN DIRECTION OF THE RECEIVING CURB RAMP.
3. CATCH BASINS ARE NOT PERMITTED IN CURB LET DOWN AND SHOULD BE LOCATED UP STREAM OF CROSSWALK.
4. ALL TWSIs TO BE DESIGNED AND INSTALLED AS PER SECTION 8.
5. POLE LOCATIONS ARE DIAGRAMMATIC. EXACT LOCATIONS TO BE DETERMINED BY ENGINEER.

6.24.2020

CITY OF NANAIMO
THE HARBOUR CITY

CURB RAMPS
TYPE M - MIDBLOCK

Scale:	NTS
Created:	OCT 2019
Rev Date:	MAY 2020
Dwg No:	CS-16



SECTION A-A

NOTES:

1. BIKEWAY SLIP RAMP DIMENSIONS SHALL BE DETERMINED BY THE ENGINEER.
2. CATCH BASINS ARE NOT PERMITTED IN CURB LET DOWN AND SHOULD BE LOCATED UP STREAM OF CROSSWALK.

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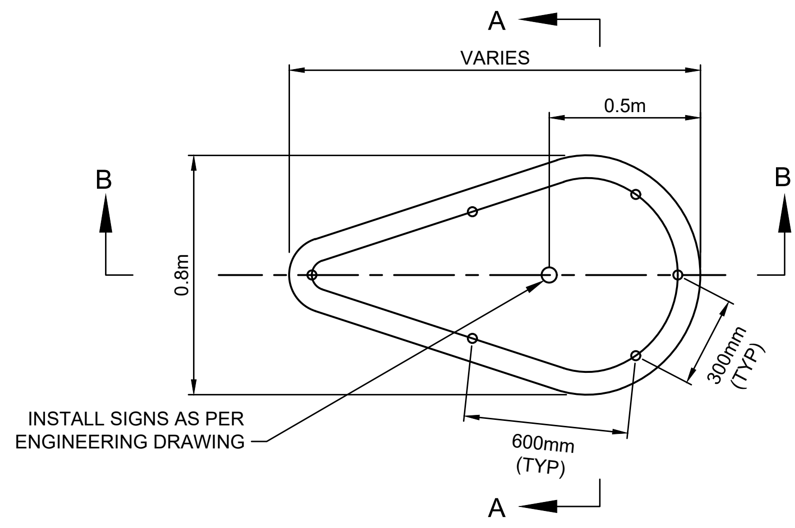
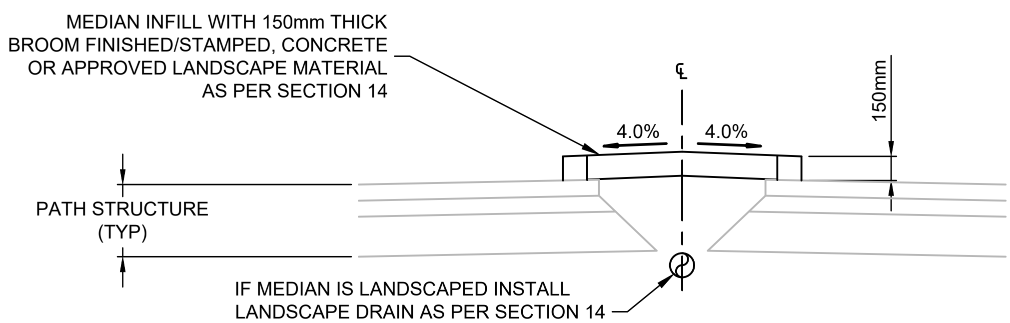
CITY OF NANAIMO
THE HARBOUR CITY

CURB RAMPS
TYPE B - BIKEWAY

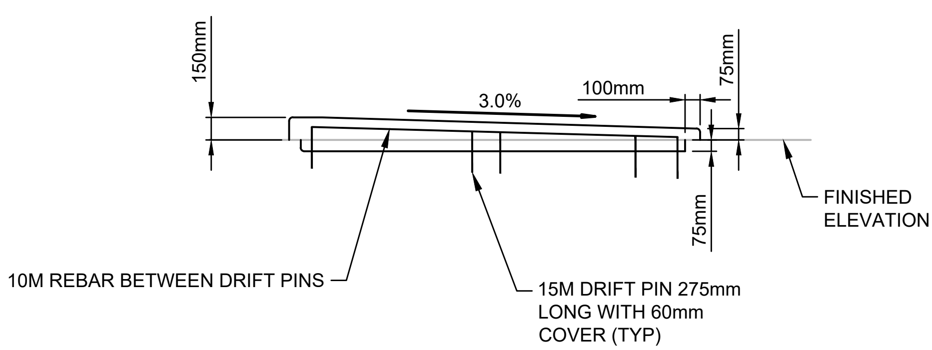
Scale:	NTS
Created:	OCT 2019
Rev Date:	MAY 2020
Dwg No:	CS-17





SECTION A-A

MULTI-USE PATH SPLITTER ISLAND DETAILS



SECTION B-B

MULTI-USE PATH SPLITTER ISLAND END TREATMENT DETAILS

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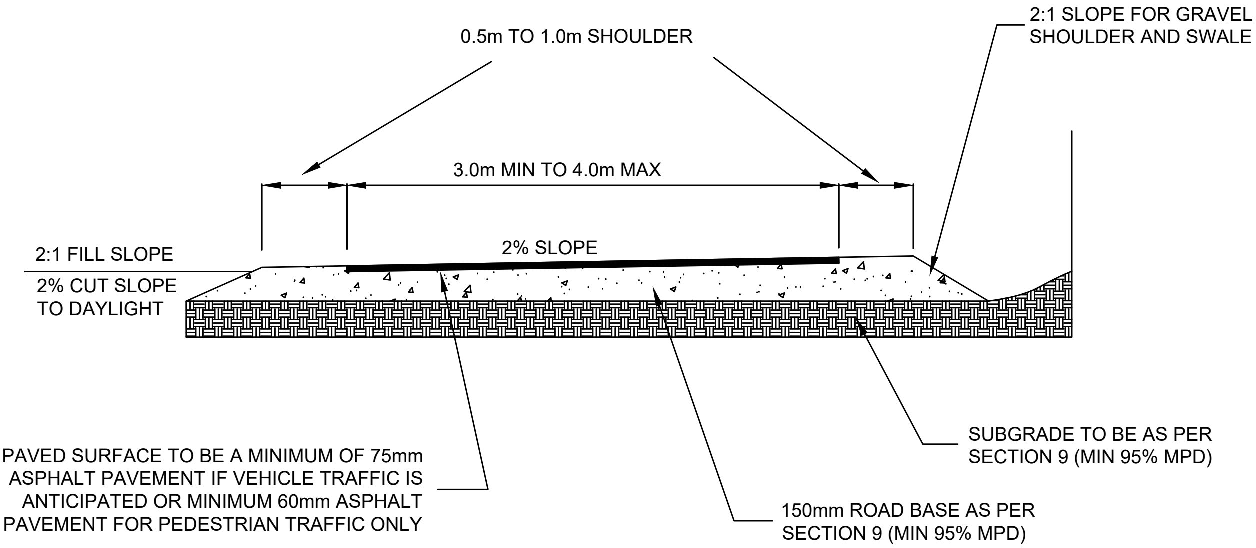
3.18.2020

CITY OF NANAIMO
THE HARBOUR CITY

MULTI-USE PATHS
SPLITTER ISLAND

Scale:	NTS
Created:	OCT 2019
Rev Date:	MAY 2020
Dwg No:	CS-20



NOTES:

1. VEGETATION CLEARANCE SHALL BE A MINIMUM VERTICAL CLEARANCE OF 2.5m AND A MINIMUM 0.5m HORIZONTAL CLEARANCE.
2. MAXIMUM TRAIL GRADES:
   - 3% SUSTAINED GRADE
   - 5% GRADE FOR DISTANCES 30m OR LESS
   - 10% GRADE FOR DISTANCES 15m OR LESS
3. MINIMIZE HORIZONTAL CURVES AND ENSURE ADEQUATE SITE LINES ON CORNERS. REFER TO BICYCLE FACILITY DESIGN GUIDELINES (2.3 - 2.4).
4. RESIDENTIAL BUFFER SHALL BE A MINIMUM OF 2.0m TO A MAXIMUM 5.0m.
5. REFER TO CITY OF NANAIMO - TRAIL PLAN - DESIGN GUIDELINES (MAY 2007) FOR ADDITIONAL DESIGN INFORMATION.
6. ALL TWSIs TO BE DESIGNED AND INSTALLED AS PER SECTION 8.

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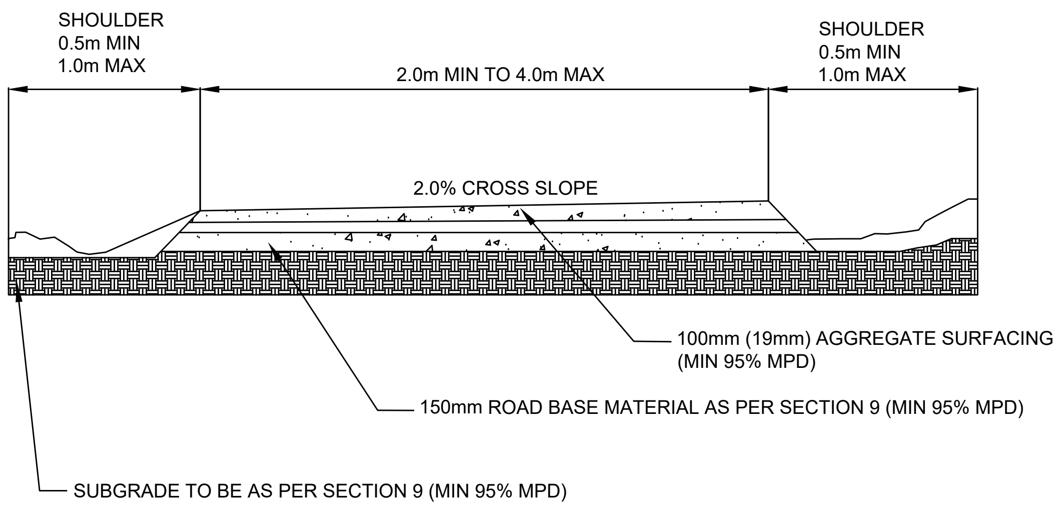
CITY OF NANAIMO
THE HARBOUR CITY

MULTI-USE PATHS
PATH OR WALKWAY (HARD SURFACE)

Scale:	NTS
Created:	JUN 2012
Rev Date:	MAY 2020
Dwg No:	CS-21



NOTES:

1. VEGETATION CLEARANCE SHALL BE A MINIMUM VERTICAL CLEARANCE OF 2.5m AND A MINIMUM 0.5m HORIZONTAL CLEARANCE.
2. MAXIMUM TRAIL GRADES:
   - 3% SUSTAINED GRADE
   - 5% GRADE FOR DISTANCES 30m OR LESS
   - 10% GRADE FOR DISTANCES 15m OR LESS
   - SOME STAIRS ALLOWED
3. ENSURE ADEQUATE SITE LINES ON CORNERS. REFER TO BICYCLE FACILITY DESIGN GUIDELINES (2.3 - 2.4).
4. RESIDENTIAL BUFFER SHALL BE A MINIMUM OF 2.0m TO A MAXIMUM 5.0m.
5. REFER TO CITY OF NANAIMO - TRAIL PLAN - DESIGN GUIDELINES (MAY 2007) FOR ADDITIONAL DESIGN INFORMATION.

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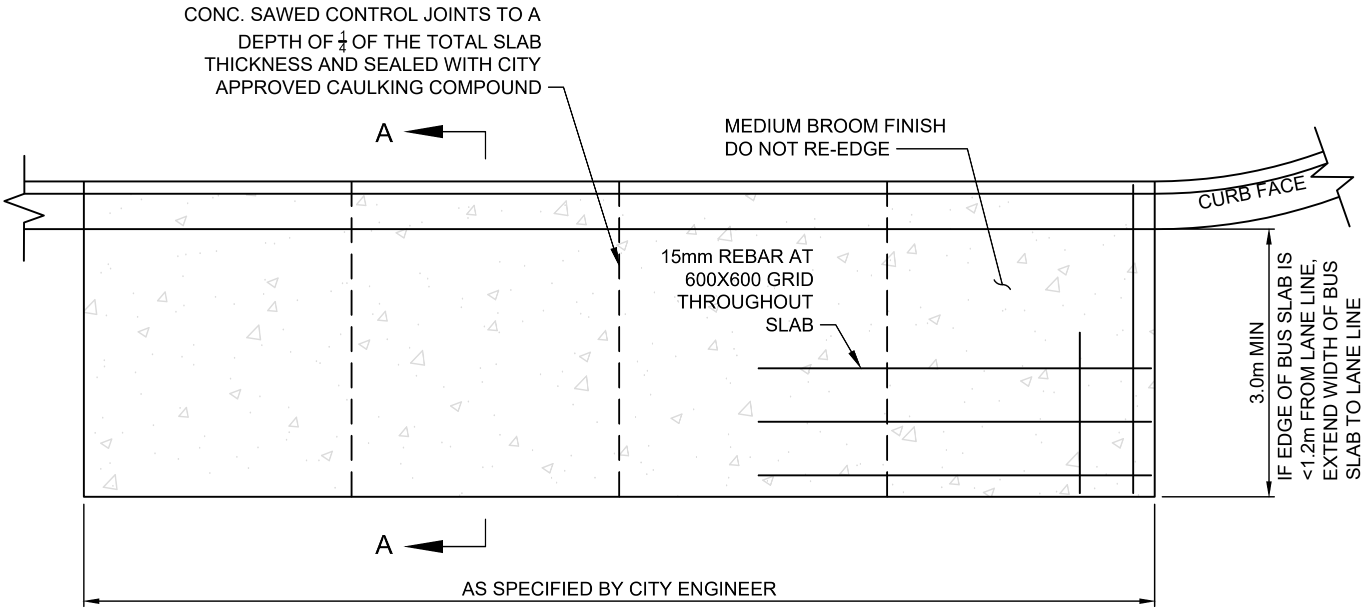
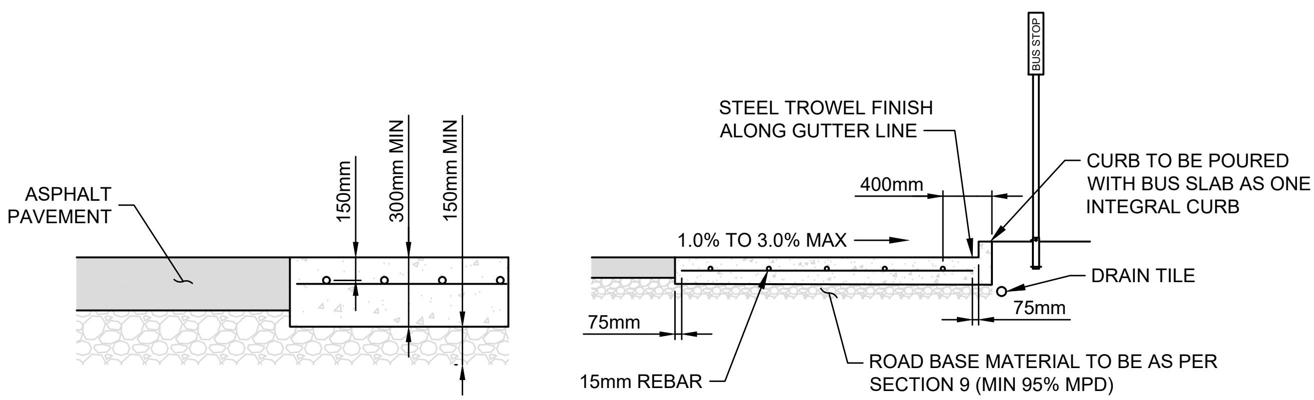
3.18.2020

CITY OF NANAIMO
THE HARBOUR CITY

MULTI-USE PATHS
PATH OR WALKWAY (SOFT SURFACE)

Scale:	NTS
Created:	JUN 2012
Rev Date:	MAY 2020
Dwg No:	CS-22





SECTION A-A

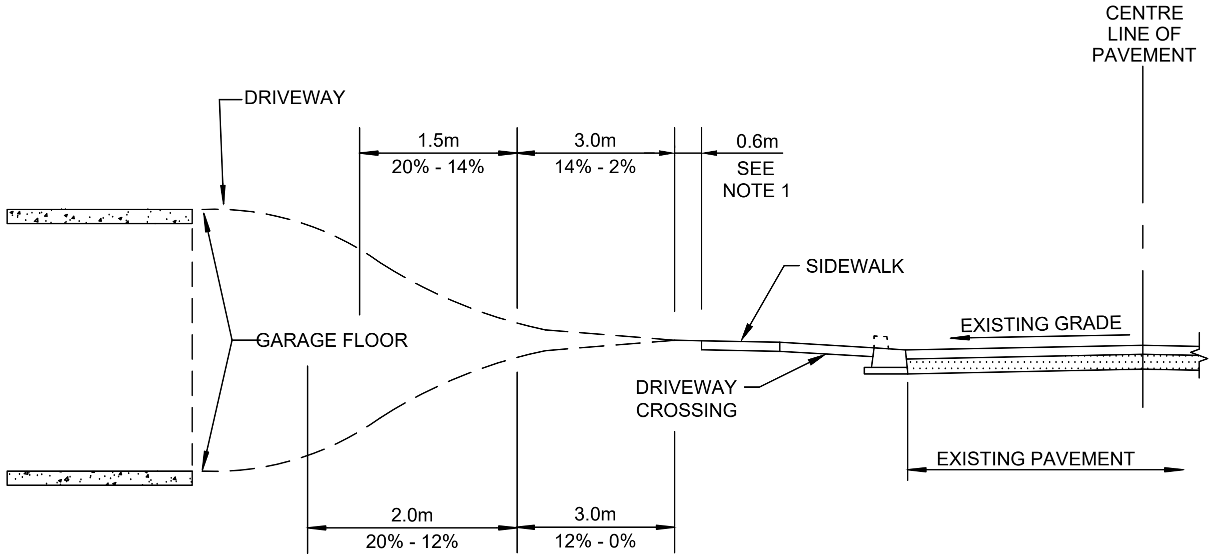
NOTES:

1. THE BUS SLAB SHOULD BE INSTALLED AS A CONTINUOUS POUR. IF THE BUS SLAB IS INSTALLED IN NO MORE THAN TWO SEPARATE POURS, THEN THE EDGE OF THE POUR MUST BE KEYED OR REBAR INSERTS USED TO TIE BOTH PADS TOGETHER.
2. USE 15mm REBAR WITH MINIMUM 75mm COVER.
3. PLACE REBAR MAT AT 150mm BELOW TOP OF CONCRETE.
4. MILL AND RE-CONTOUR AC TO MATCH CONCRETE BUS SLAB CROSS FALL.

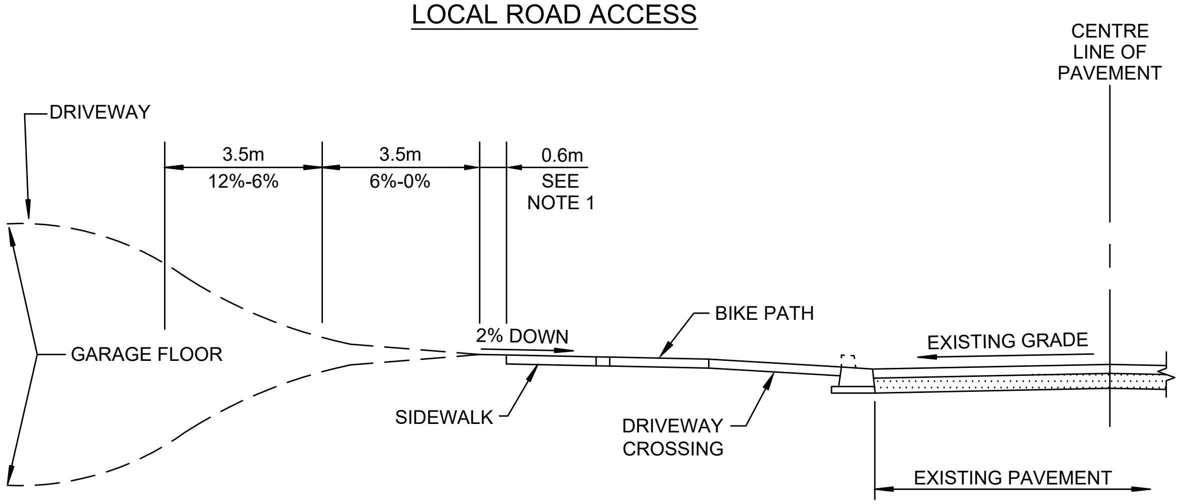
CITY OF NANAIMO
THE HARBOUR CITY

TRANSIT FACILITIES
REINFORCED BUS SLAB

Scale:	NTS
Created:	OCT 2019
Rev Date:	MAY 2020
Dwg No:	CS-23



LOCAL ROAD ACCESS



COLLECTOR OR ARTERIAL ROAD ACCESS

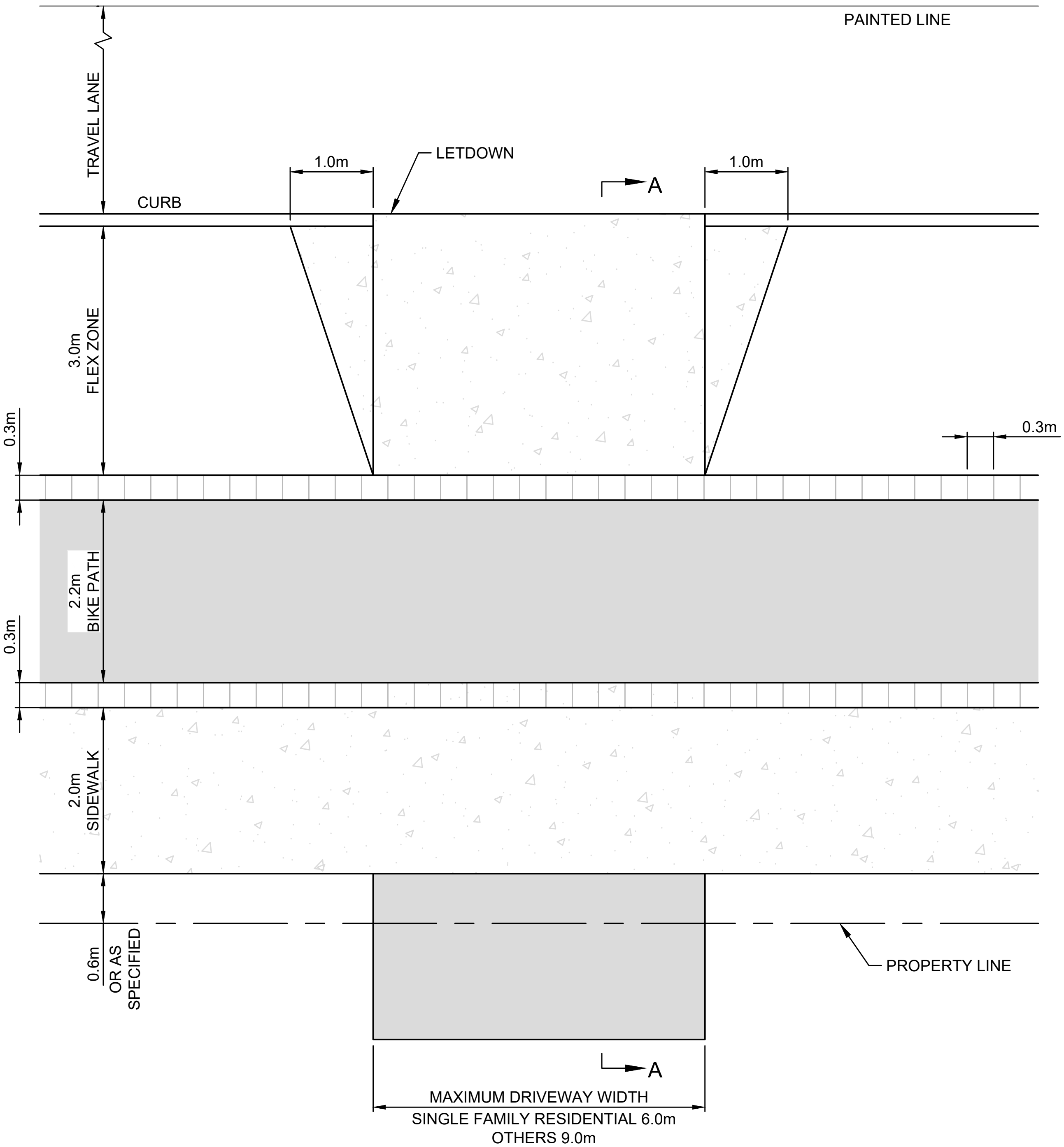
NOTES:

1. THE RISE OR FALL OF THE DRIVEWAY SHALL BEGIN BEHIND THE SIDEWALK TOWARDS THE PROPERTY.
2. SEE SECTION 8.04.4A FOR MAXIMUM SLOPES FOR DRIVEWAY EDGES.
3. IN THE CASE OF SUBDIVISION WHERE A DRIVEWAY WILL PROVIDE ACCESS TO THREE OR MORE PARCELS, THE DRIVEWAY SHALL BE DESIGNED BY A PROFESSIONAL ENGINEER; AS PER CITY OF NANAIMO GUIDELINES FOR THE APPROVAL, THE DESIGN AND THE CONSTRUCTION OF PRIVATELY OWNED COMMON ACCESS DRIVEWAYS.

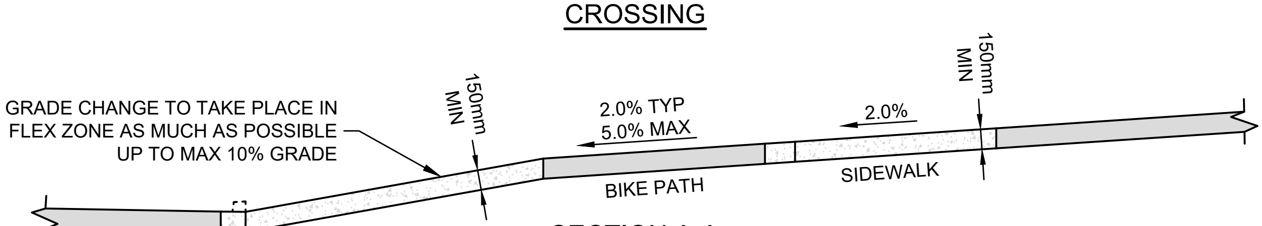
CITY OF NANAIMO
THE HARBOUR CITY

DRIVEWAYS AND CROSSINGS
GRADES

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	CS-24



CROSSING



SECTION A-A

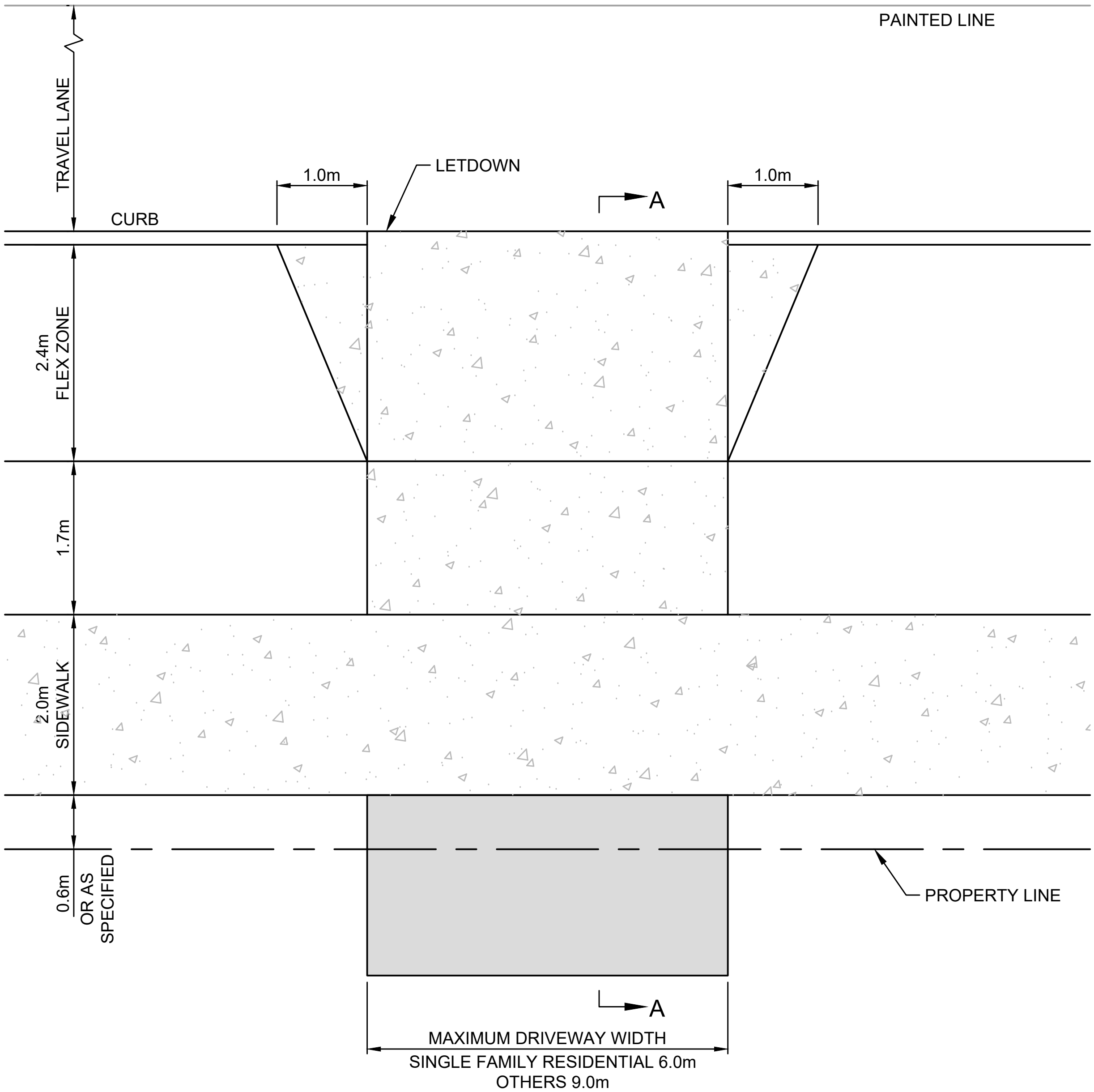
NOTES:

1. USE OF TWSI's TO BE DETERMINED BY ENGINEER.
2. FOR CONCRETE FINISHING DETAILS SEE DWG. CS-7.
3. CONCRETE SURFACES TO BE A MINIMUM THICKNESS OF 100mm AND 150mm WHERE VEHICLE TRAFFIC IS ANTICIPATED.

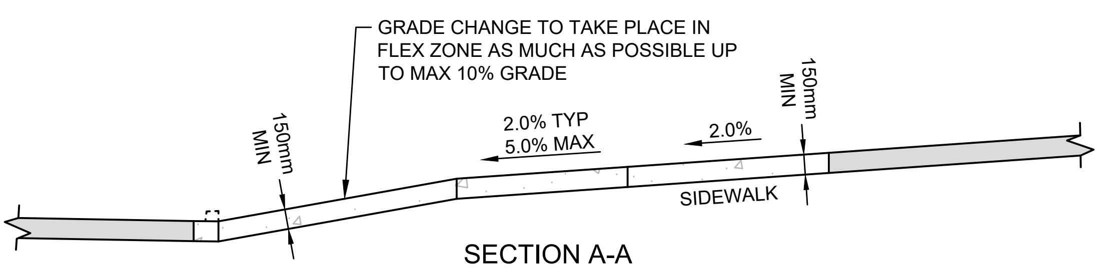
CITY OF NANAIMO
THE HARBOUR CITY

DRIVEWAYS AND CROSSINGS
TYPICAL URBAN COLLECTOR

Scale:	NTS
Created:	OCT 2019
Rev Date:	MAY 2020
Dwg No:	CS-25



CROSSING



SECTION A-A

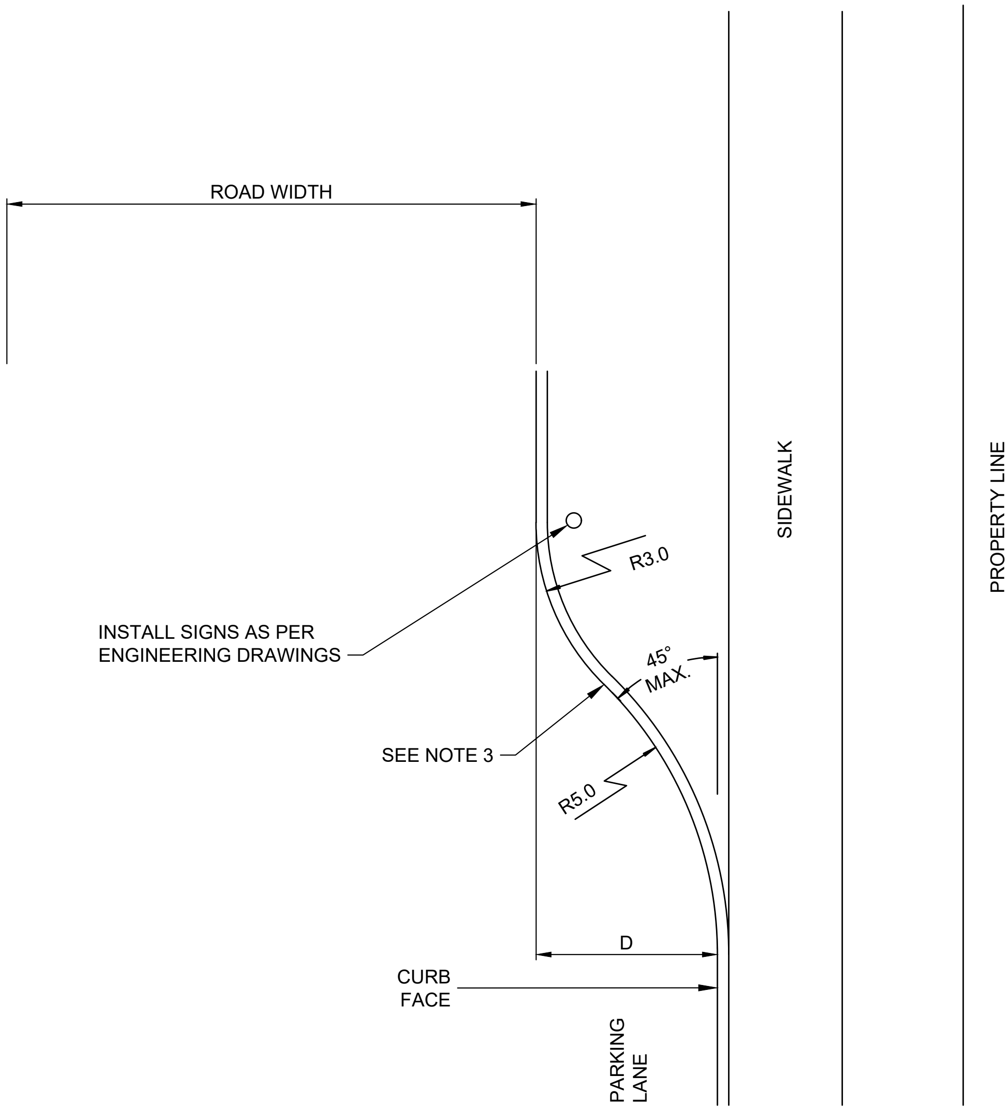
NOTES:

1. USE OF TWSI's TO BE DETERMINED BY ENGINEER.
2. FOR CONCRETE FINISHING DETAILS SEE DWG. CS-7.
3. CONCRETE SURFACES TO BE A MINIMUM THICKNESS OF 100mm AND 150mm WHERE VEHICLE TRAFFIC IS ANTICIPATED.

CITY OF NANAIMO
THE HARBOUR CITY

DRIVEWAYS AND CROSSINGS
TYPICAL URBAN LOCAL

Scale:	NTS
Created:	OCT 2019
Rev Date:	MAY 2020
Dwg No:	CS-26



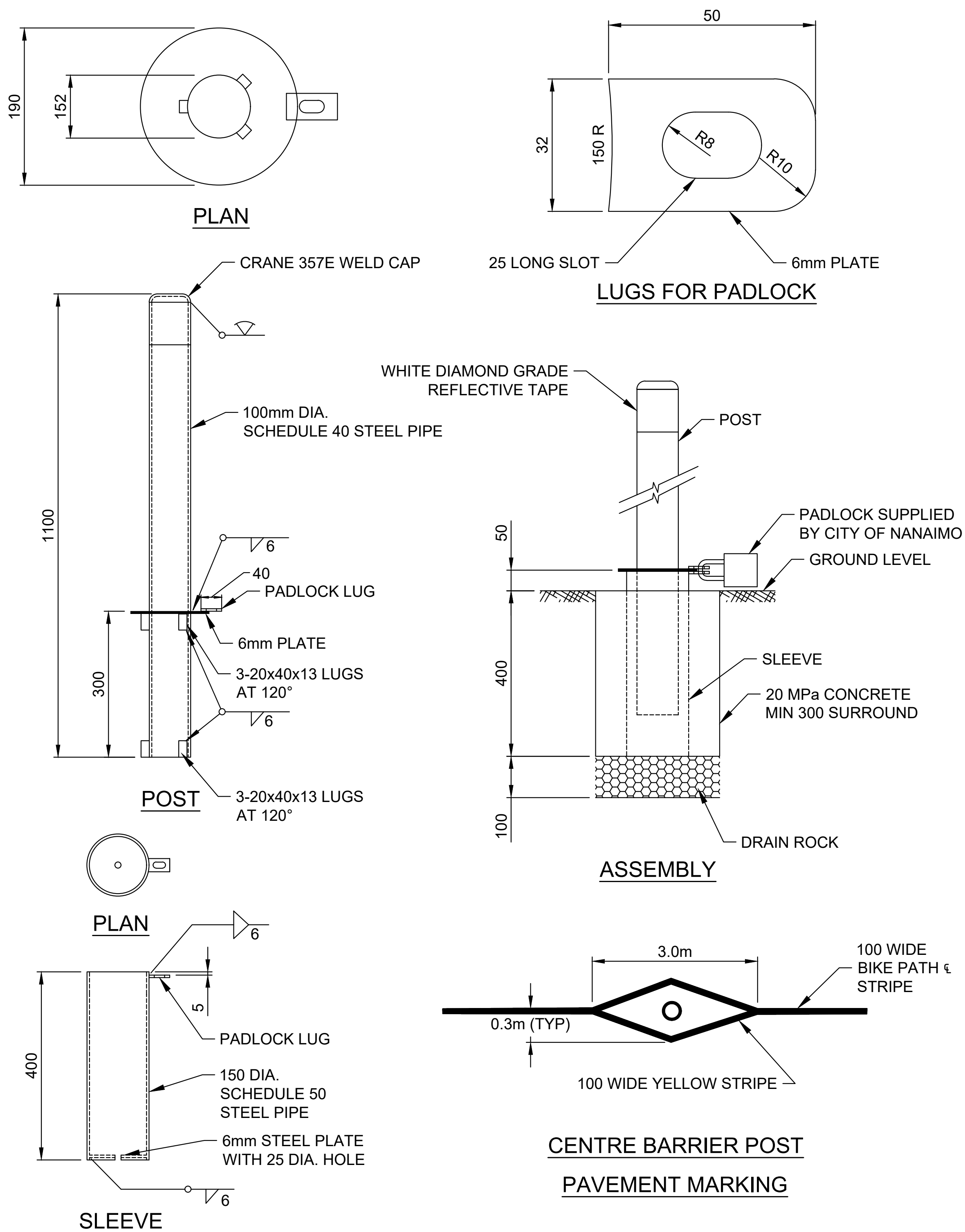
NOTES:

1. "D"=DEPTH OF CURB EXTENSION SHOULD BE SIMILAR TO THE WIDTH OF THE PARKING LANE (TYPICALLY. 2.4m RESIDENTIAL OR 3.0m INDUSTRIAL)
2. INCLUDE A TANGENT AT 45° TO THE CURB FACE BETWEEN RADII WHERE "D" IS GREATER THAN 2.4m.
3. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE NOTED.

CITY OF NANAIMO
THE HARBOUR CITY

DRIVEWAYS AND CROSSINGS
CURB EXTENSION

Scale:	NTS
Created:	APR 2012
Rev Date:	MAY 2020
Dwg No:	CS-27



NOTES:

1. FOR USE ON MULTI-USE PATHWAYS WHEN NECESSARY TO PREVENT VEHICLE ACCESS.
2. ALL STEEL TO BE BLACK POWDER COATED TO ASTM D7803.
3. PADLOCK TO BE INSTALLED IN THE DIRECTION OF THE TRAIL AND NOT ON THE SIDE BLOCKING THE THROUGH ZONE.

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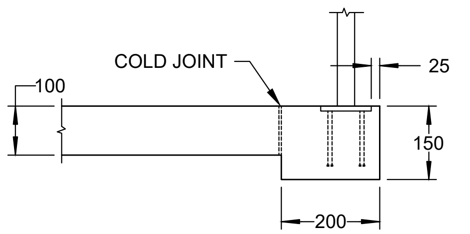
3.18.2020

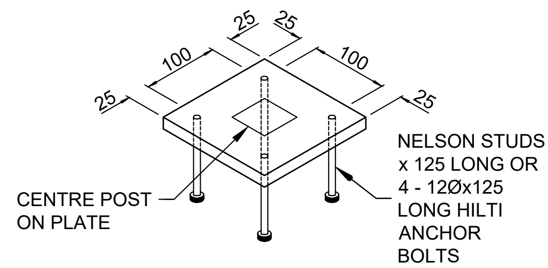
CITY OF NANAIMO
THE HARBOUR CITY

BOLLARDS
REMOVABLE BARRIER POST

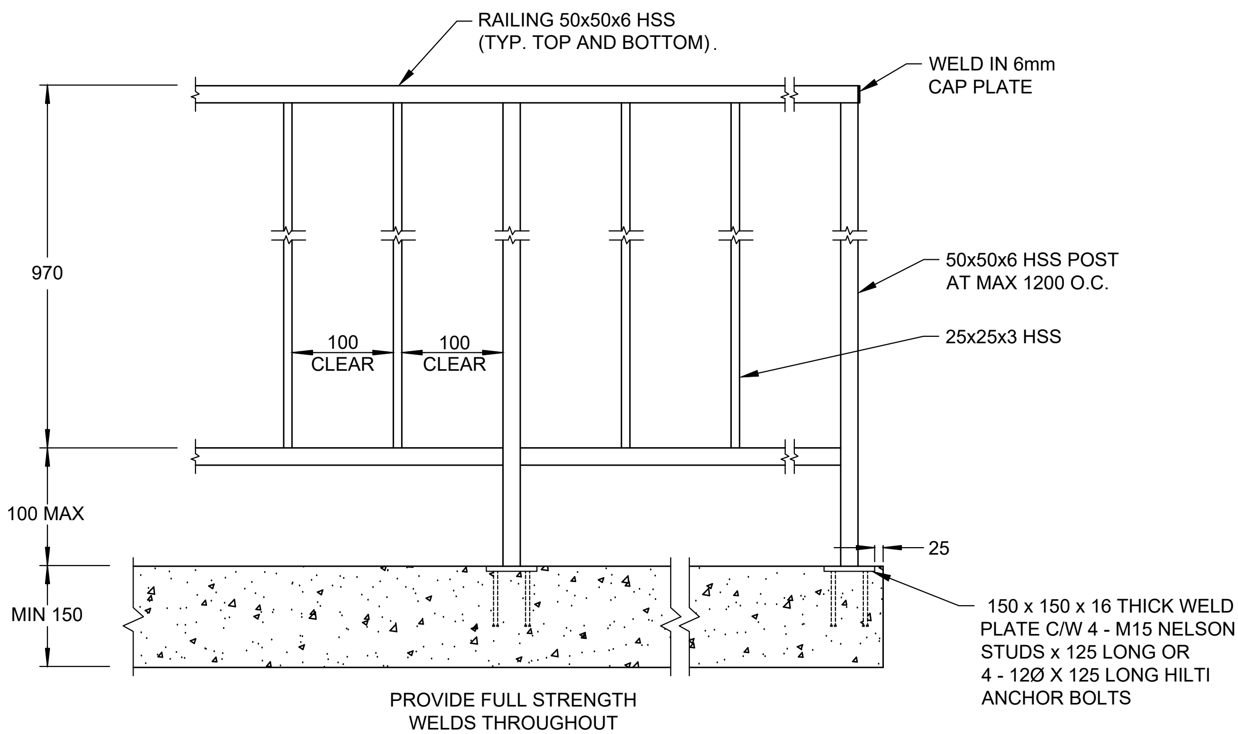
Scale:	NTS
Created:	MAY 2001
Rev Date:	MAY 2020
Dwg No:	CS-30



DETAIL FOR LOCATIONS WITH 100mm THICK SIDEWALK ADJACENT



DETAIL- WELD PLATE FOR RAILING POST



ELEVATION OF RAILING

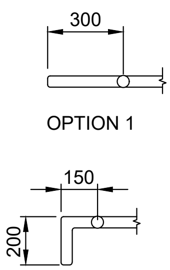
NOTES:

1. SUPPLY, FABRICATION, ERECTION, STRUCTURAL DESIGN AND DETAILING OF ALL MISCELLANEOUS STEEL ARE TO BE IN ACCORDANCE WITH CSA S16.
2. ALL WELDING IS TO CONFORM TO CSA W59 AND TO BE PERFORMED ONLY BY FABRICATION SHOPS APPROVED BY THE CANADIAN WELDING BUREAU TO CSA W47.1 FOR DIVISION 1 OR 2 REQUIREMENTS. PROVIDE FULL STRENGTH WELDS AND ALL WELDS ARE TO BE CONTINUOUS FOR THE LENGTH OF EACH JOINT. GRIND AND FILE WELDS SMOOTH AND FLUSH.
3. ALL STEEL IS TO CONFORM TO THE REQUIREMENTS OF THE FOLLOWING STANDARDS:
   a) ROLLED SECTIONS AND PLATE: CAN/CSA-G40.21, GRADE 300W.
   b) HSS SECTIONS: CAN/CSA-G40.21, GRADE 350W, CLASS C OR CLASS H.
   c) WELDING ELECTRODES: CSA W48 SERIES AND APPLICABLE AWS-A5 SERIES.
4. ALL STEEL TO BE BLACK POWDER COATED TO ASTM D7803.
5. DAMAGED SURFACES SHALL BE THOROUGHLY CLEANED AND PAINTED WITH 2 COATS OF ORGANIC ZINC RICH PAINT.
6. ALUMINUM MAY BE SUBSTITUTED IN PLACE OF STEEL AS AN ALTERNATE.

CITY OF NANAIMO
THE HARBOUR CITY

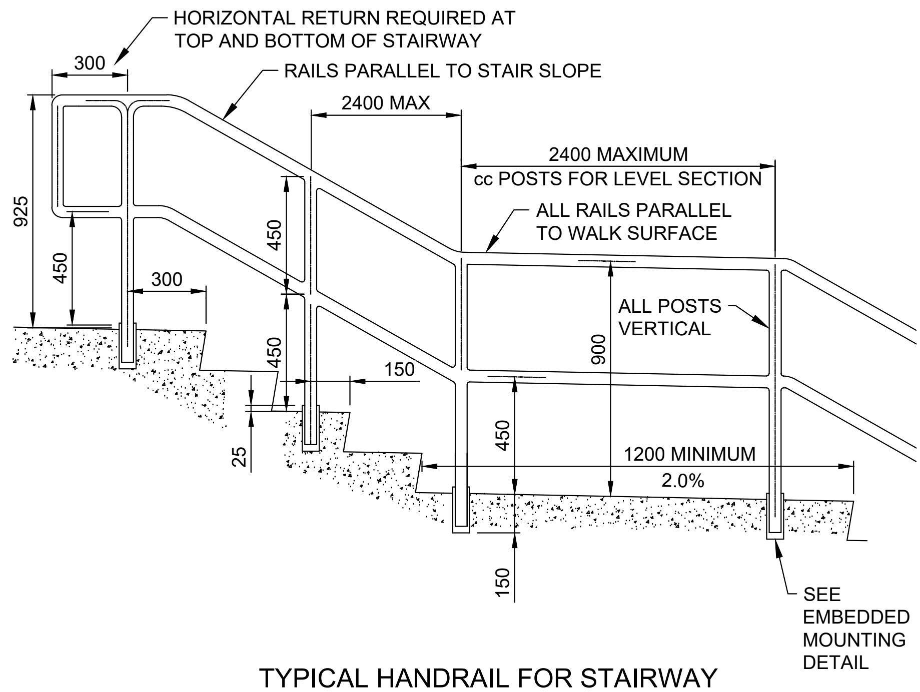
HANDRAILS AND STAIRWAYS
SIDEWALK HANDRAIL

Scale:	NTS
Created:	SEP 2012
Rev Date:	MAY 2020
Dwg No:	CS-31

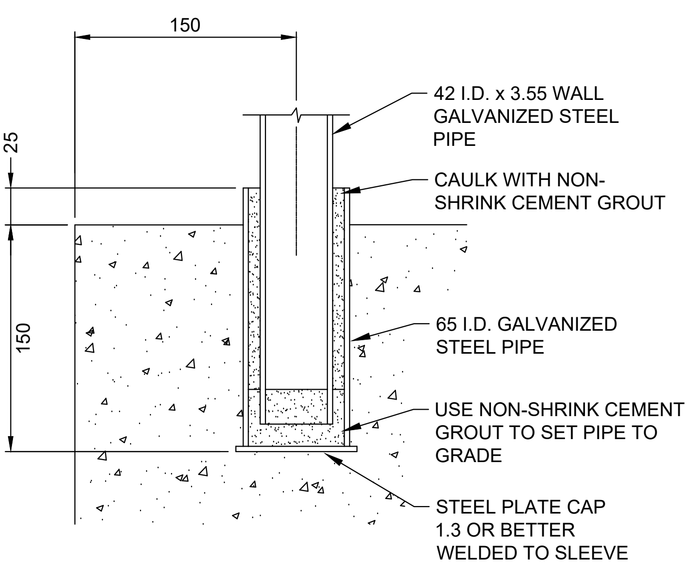


NOTE:
OPTION 2 TO BE USED WHEN OPTION 1 CANNOT BE INSTALLED WITHOUT ENCROACHING ON PEDESTRIAN SIDEWALK OR WALKWAY.

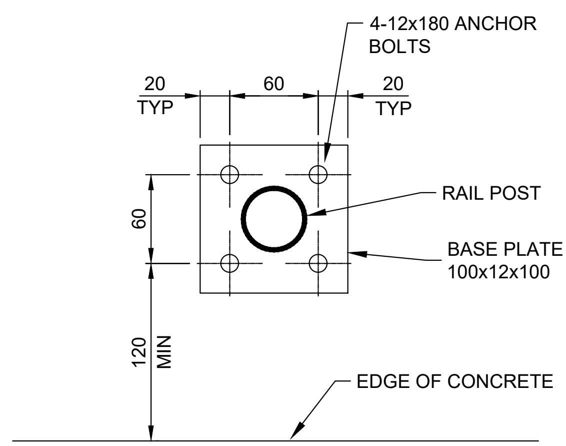
HANDRAIL END PLAN VIEW OPTIONS 1 & 2



TYPICAL HANDRAIL FOR STAIRWAY



EMBEDDED MOUNTING



ATTACHED MOUNTING

NOTES:

1. ALL HANDRAILS SHALL BE FABRICATED FROM 42 I.D. x 3.55 WALL STEEL PIPE.
2. ALL JOINTS SHALL BE MITRED, WELDED ALL AROUND AND FILED SMOOTH.
3. ALL BENDS SHALL BE SMOOTH CIRCULAR CURVES.
4. ALL COMPONENTS SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION TO CSA - 6164.
5. HANDRAILS REQUIRED ON BOTH SIDES OF STAIRWAY.
6. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

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CITY OF NANAIMO
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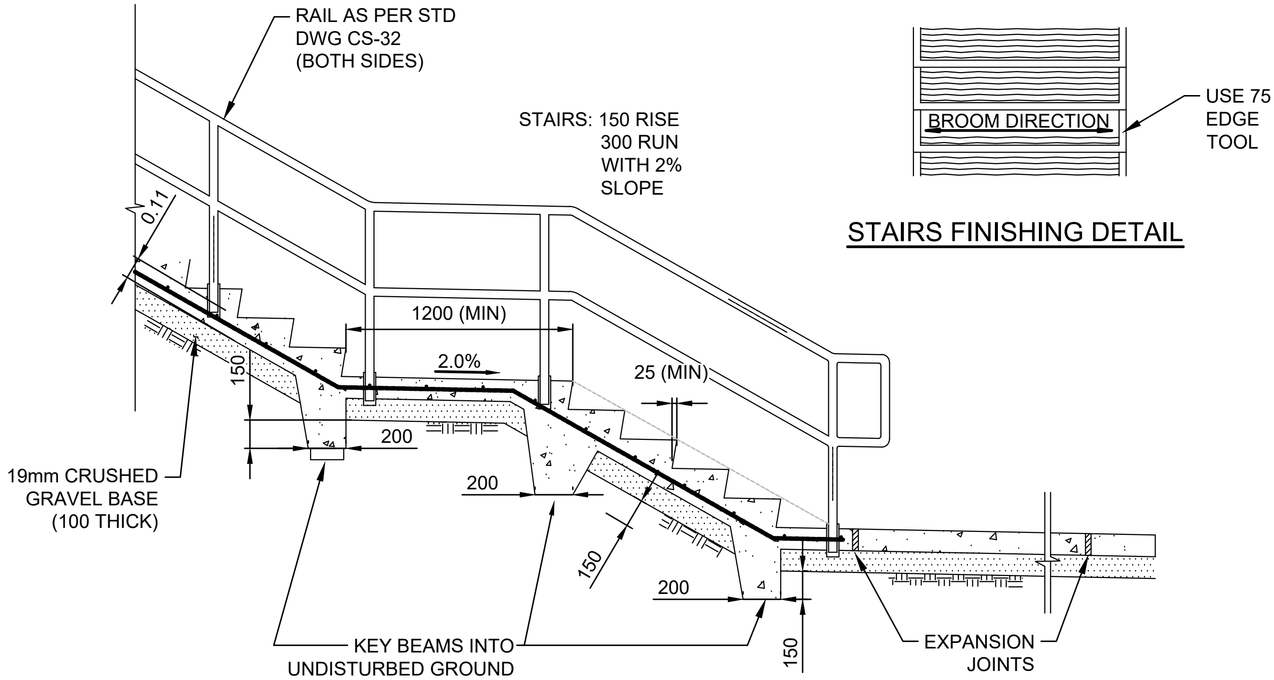
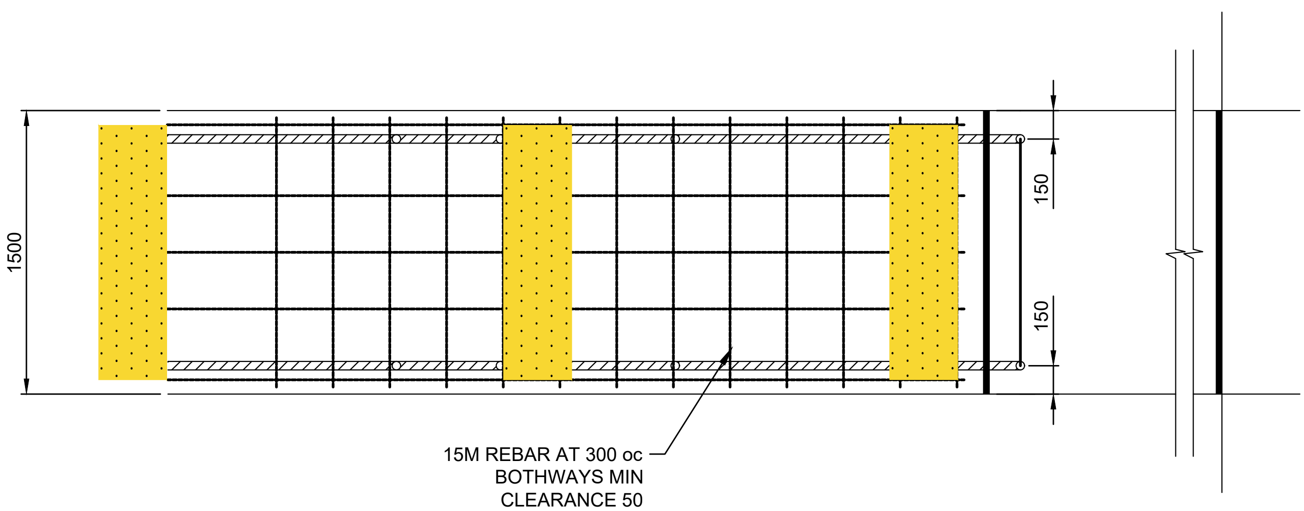
HANDRAILS AND STAIRWAYS
HANDRAIL FOR CONCRETE STAIRWAY

Scale:	NTS
Created:	NOV 2016
Rev Date:	MAY 2020
Dwg No:	CS-32



STAIRS FINISHING DETAIL

CONCRETE STAIRWAY ELEVATION



CONCRETE STAIRWAY PLAN

NOTES:

1. MAXIMUM OF 12 RISERS PER FLIGHT BETWEEN LANDINGS.
2. MAXIMUM WALKWAY GRADIENT IS 12%.
3. FOR CONCRETE MIX DESIGN CRITERIA REFER TO SECTION 8.
4. REINFORCING BARS TO CSA G30.18 GRADE 400.
5. FOR HANDRAIL DETAILS SEE STD. DWG CS-32.
6. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
7. TWSIs TO BE INSTALLED AT EVERY STAIR LANDING AS PER SECTION 8.
8. LIGHTING LEVELS TO BE IN ACCORDANCE WITH SECTION 10.

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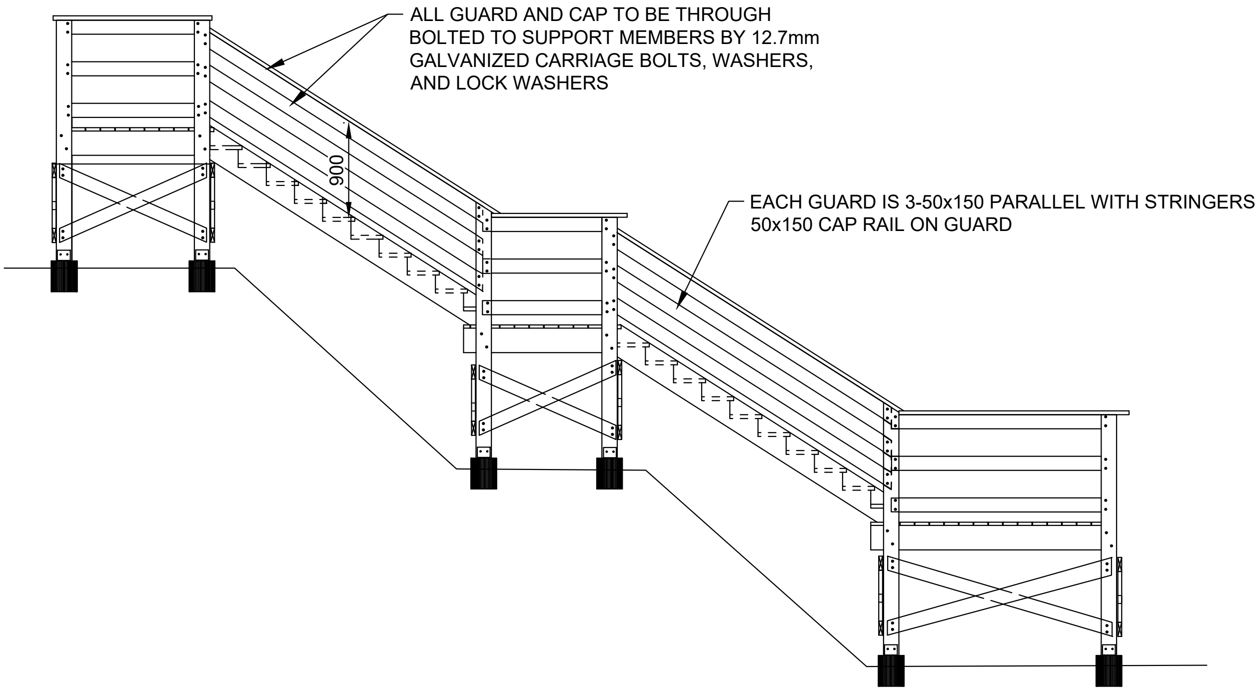
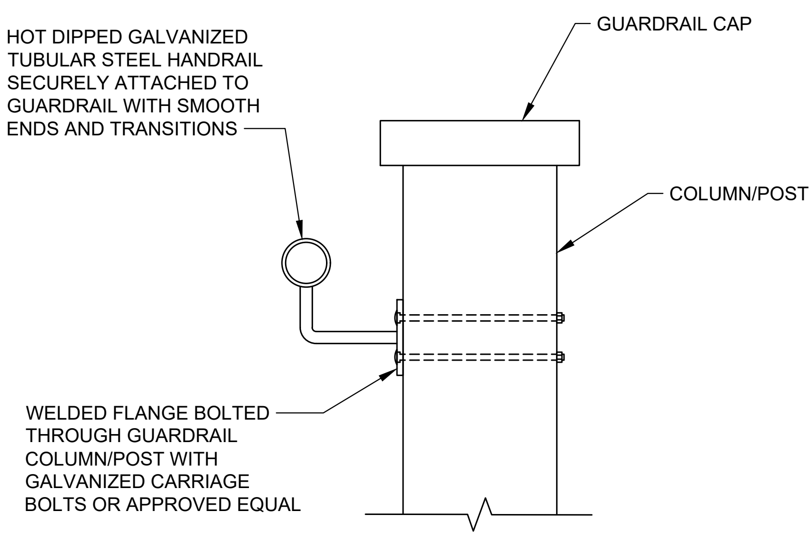
CITY OF NANAIMO
THE HARBOUR CITY

HANDRAILS AND STAIRWAYS
CONCRETE STAIRWAY AND LANDING

Scale:	1:40
Created:	NOV 2016
Rev Date:	MAY 2020
Dwg No:	CS-33



WOODEN STAIRWAY ELEVATION



TYPICAL HANDRAIL SECTION

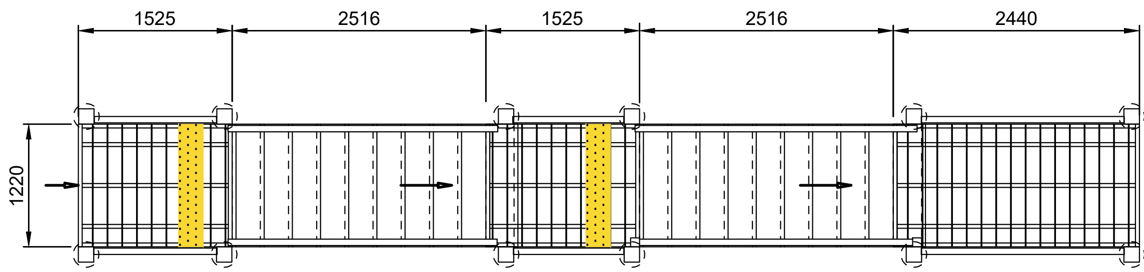
NOTES:

1. ALL TIMBER TO BE PRESSURE TREATED OR APPROVED EQUAL.
2. ALL GUARDRAILS TO BE CONSTRUCTED AS SHOWN.
3. GUARDRAILS REQUIRED ON BOTH SIDES OF STAIRWAY.
4. NO NAILS ON EXTERIOR DECK. SCREWS ONLY FOR ATTACHING CAP RAIL AND POSTS.
5. HANDRAILS TO BE INSTALLED ON STAIRS WITH MORE THAN THREE RISERS.
6. HANDRAILS MUST BE GRASPABLE 34" MIN - 42" MAX MEASURED VERTICALLY FROM STAIR NOSING LINE.
7. HANDRAILS TO BE HOT DIPPED GALVANIZED STEEL TUBULAR SECTION 48mm DIA x 3.55mm WALL OR APPROVED EQUAL.
8. FOR STAIRWAY DETAILS REFER TO STD. DWG. CS-35.
9. DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

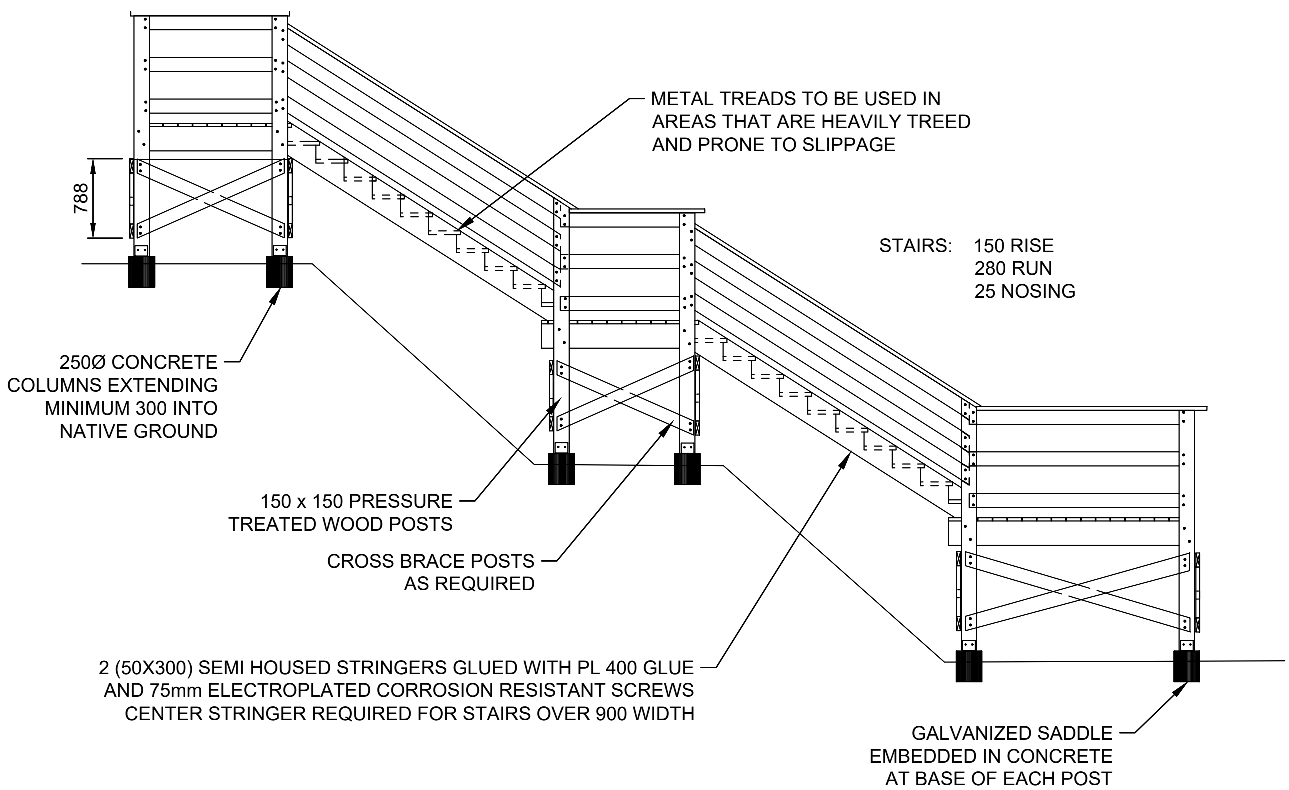
CITY OF NANAIMO
THE HARBOUR CITY

HANDRAILS AND STAIRWAYS
GUARDRAIL FOR WOODEN STAIRWAY

Scale:	NTS
Created:	NOV 2016
Rev Date:	MAY 2020
Dwg No:	CS-34



WOODEN STAIRWAY PLAN



WOODEN STAIRWAY ELEVATION

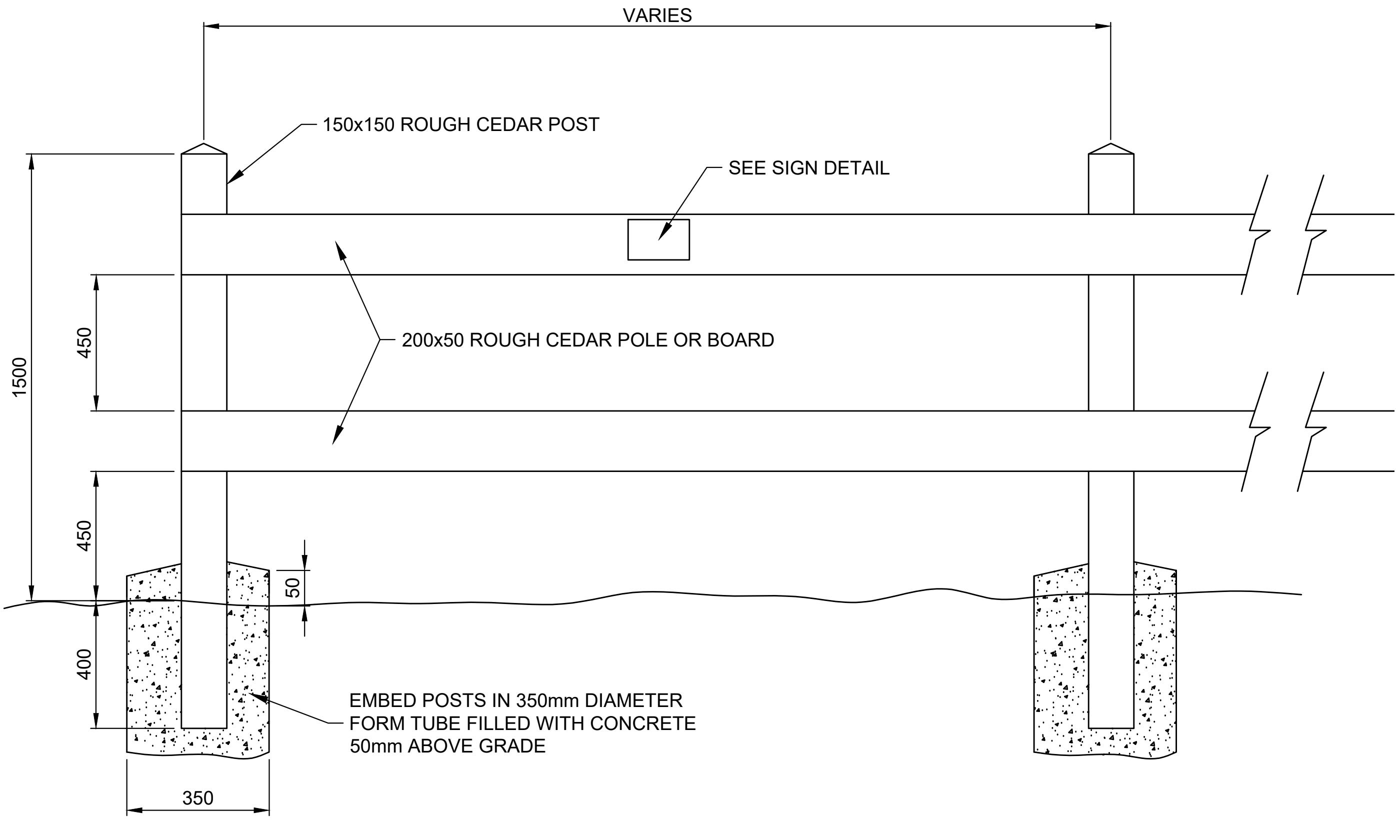
NOTES:

1. ALL TIMBER TO BE PRESSURE TREATED OR APPROVED EQUAL.
2. VEGETATION CLEARANCE TO BE 0.5m MINIMUM HORIZONTAL AND 2.0m VERTICAL.
3. ENSURE ADEQUATE SIGHTLINES ON CORNERS.
4. RESIDENTIAL BUFFER TO BE 5.0m.
5. REFER TO CITY OF NANAIMO - TRAIL PLAN - DESIGN GUIDELINES (MAY 2007) FOR ADDITIONAL DESIGN INFORMATION.
6. FOR GUARDRAIL AND HANDRAIL DETAILS REFER TO STD. DWG. CS-34.
7. STRUCTURAL CERTIFICATION REQUIRED WITH STAIR DESIGN SUBMISSION SEALED BY A PROFESSIONAL ENGINEER.
8. TWSIs TO BE INSTALLED AT EVERY STAIR LANDING AS PER SECTION 8.
9. ENGINEERED ALTERNATIVES FOR STAIR FOOTINGS MAY BE APPROVED.
10. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

CITY OF NANAIMO
THE HARBOUR CITY

HANDRAILS AND STAIRWAYS
WOODEN STAIRWAY AND LANDING

Scale:	NTS
Created:	NOV 2016
Rev Date:	MAY 2020
Dwg No:	CS-35



NOTES:

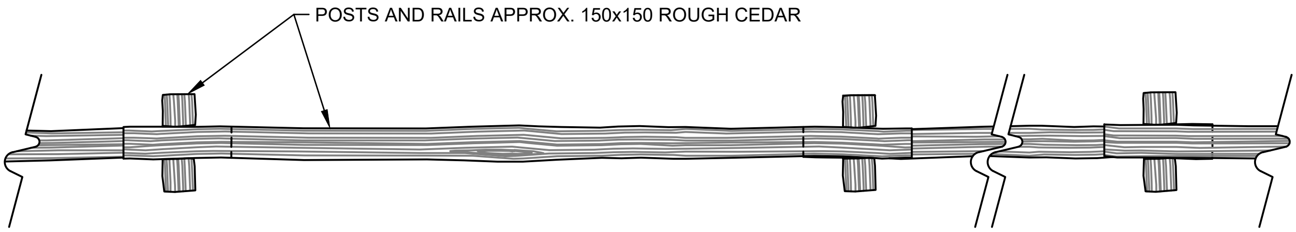
1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.
2. TO BE INSTALLED AT EDGE OF SLOPE, 0.5m FROM EDGE OF PATHWAY
3. WHEN INSTALLED AS AN AQUATIC SETBACK FENCE, THE FOLLOWING MUST BE COMPLETED:
   a) TO BE INSTALLED AT THE EDGE OF ALL AQUATIC SETBACK BOUNDARIES TO ENSURE THE SETBACK IS DELINEATED.
   b) SIGN TO BE MOUNTED TO FENCE TO ENSURE THE SETBACK AREA IS PROTECTED.
   c) SIGN TO BE INSTALL AT THE REAR OF EVERY LOT BACKING ONTO THE SETBACK AREA OR AT A 30m SPACING.

ENVIRONMENTALLY PROTECTED AREA SIGN

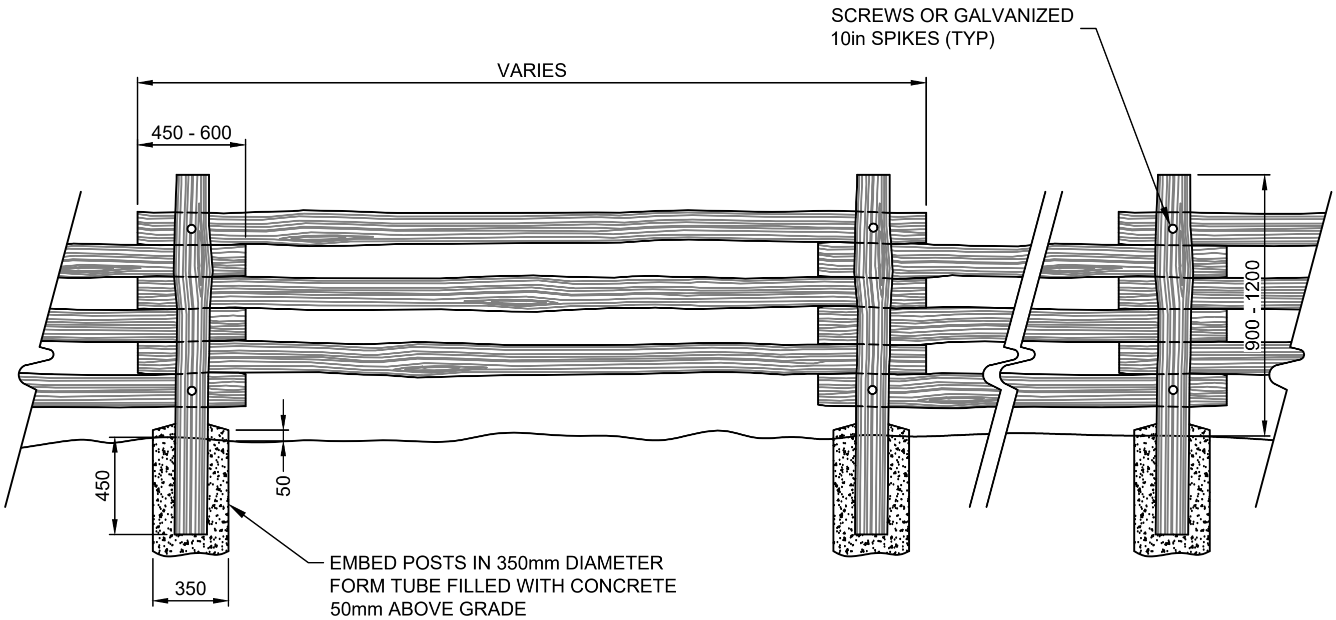
CITY OF NANAIMO
THE HARBOUR CITY

FENCES
WOOD RAIL

Scale:	NTS
Created:	NOV 2012
Rev Date:	MAY 2020
Dwg No:	CS-36



SPLIT RAIL FENCE PLAN



SPLIT RAIL FENCE ELEVATION

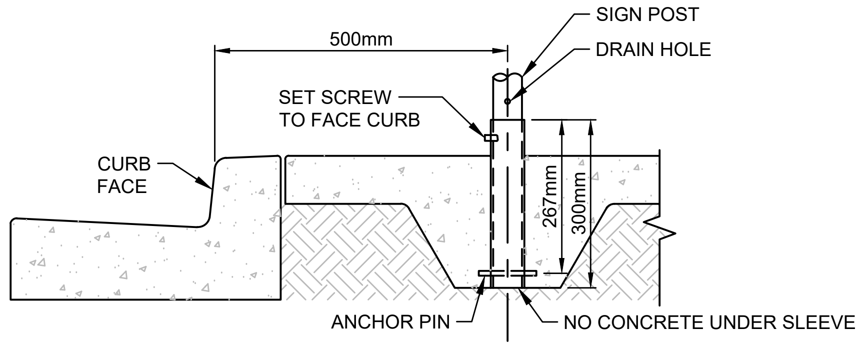
NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. TOP OF POSTS TO BE SECURED TOGETHER WITH WIRE.

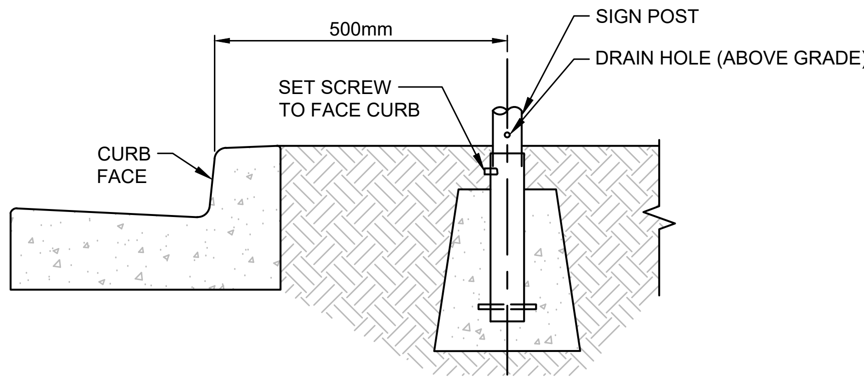
CITY OF NANAIMO
THE HARBOUR CITY

FENCES
SPLIT RAIL

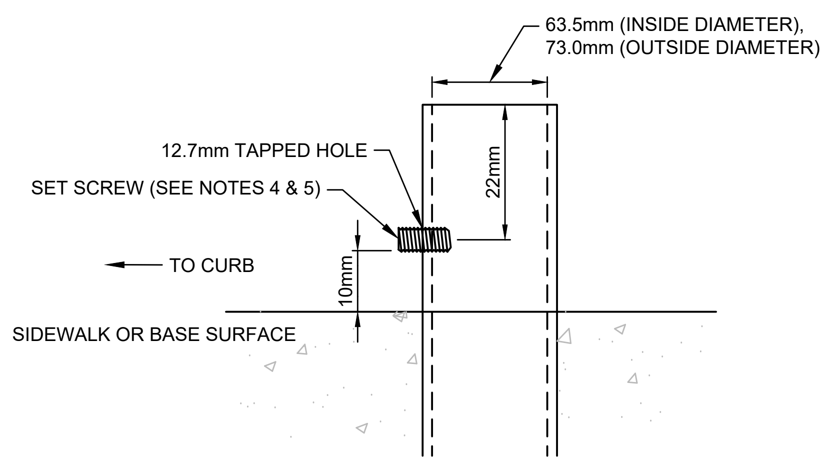
Scale:	NTS
Created:	DEC 2019
Rev Date:	MAY 2020
Dwg No:	CS-37



POST AND SLEEVE INSTALLATION



POST AND BASE INSTALLATION



SLEEVE DETAIL

NOTES:

1. CAUTION MUST BE TAKEN TO ENSURE THAT NO CONCRETE OR DEBRIS GET INSIDE THE SLEEVE.
2. THE SLEEVE IS TO BE ABSOLUTELY PLUMB.
3. ALTERNATIVE SIGN LOCATIONS MAY BE NECESSARY IN INSTANCES OF CONFLICT WITH UNDERGROUND UTILITIES.
4. POST AND SLEEVE: 12.7mm DIAMETER x 12.7mm LENGTH CUP POINT STAINLESS STEEL ALLEN KEY SET SCREW.
5. POST AND BASE: 12.7mm DIAMETER x 19.1mm LENGTH CUP POINT STAINLESS STEEL ALLEN KEY SET SCREW.

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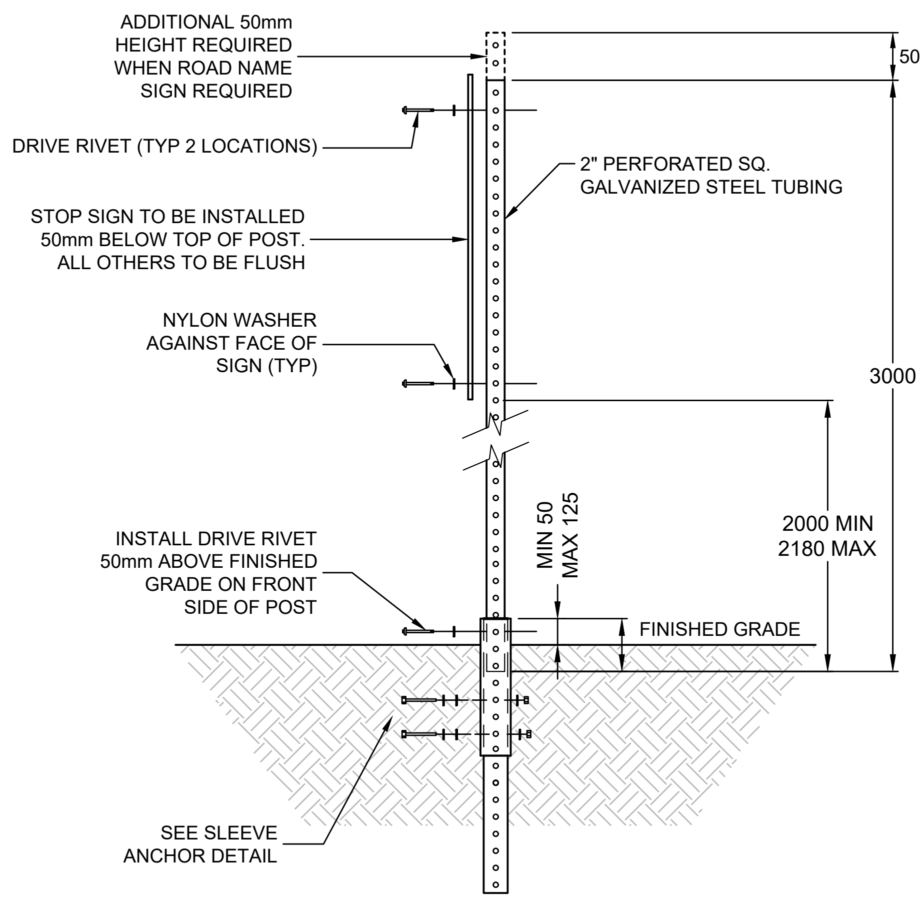
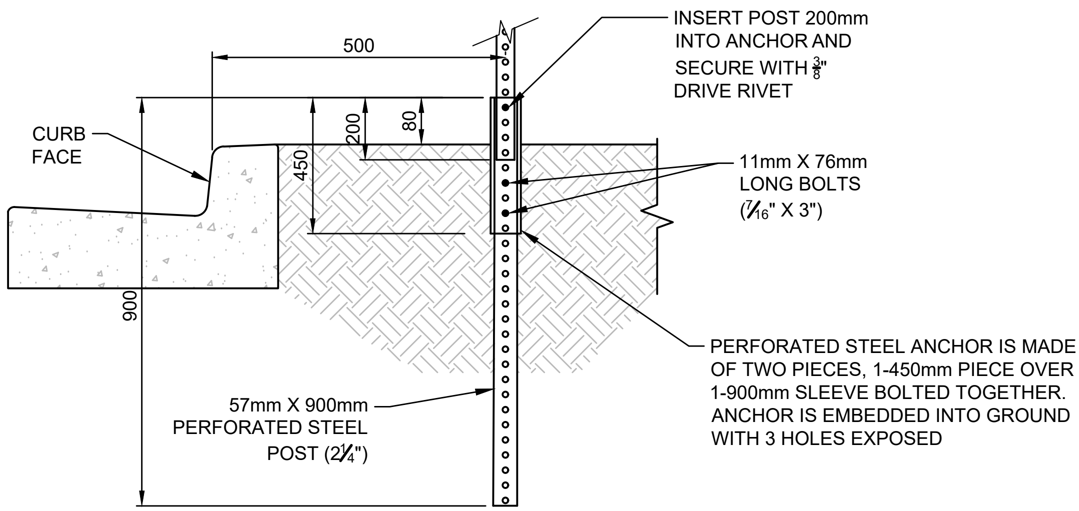
CITY OF NANAIMO
THE HARBOUR CITY

TRAFFIC SIGNAGE
ROUND STOCK SIGN

Scale:	NTS
Created:	OCT 2019
Rev Date:	MAY 2020
Dwg No:	CS-40



PERFORATED STEEL SIGN POST



SLEEVE ANCHOR DETAIL

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS SHOWN OTHERWISE.

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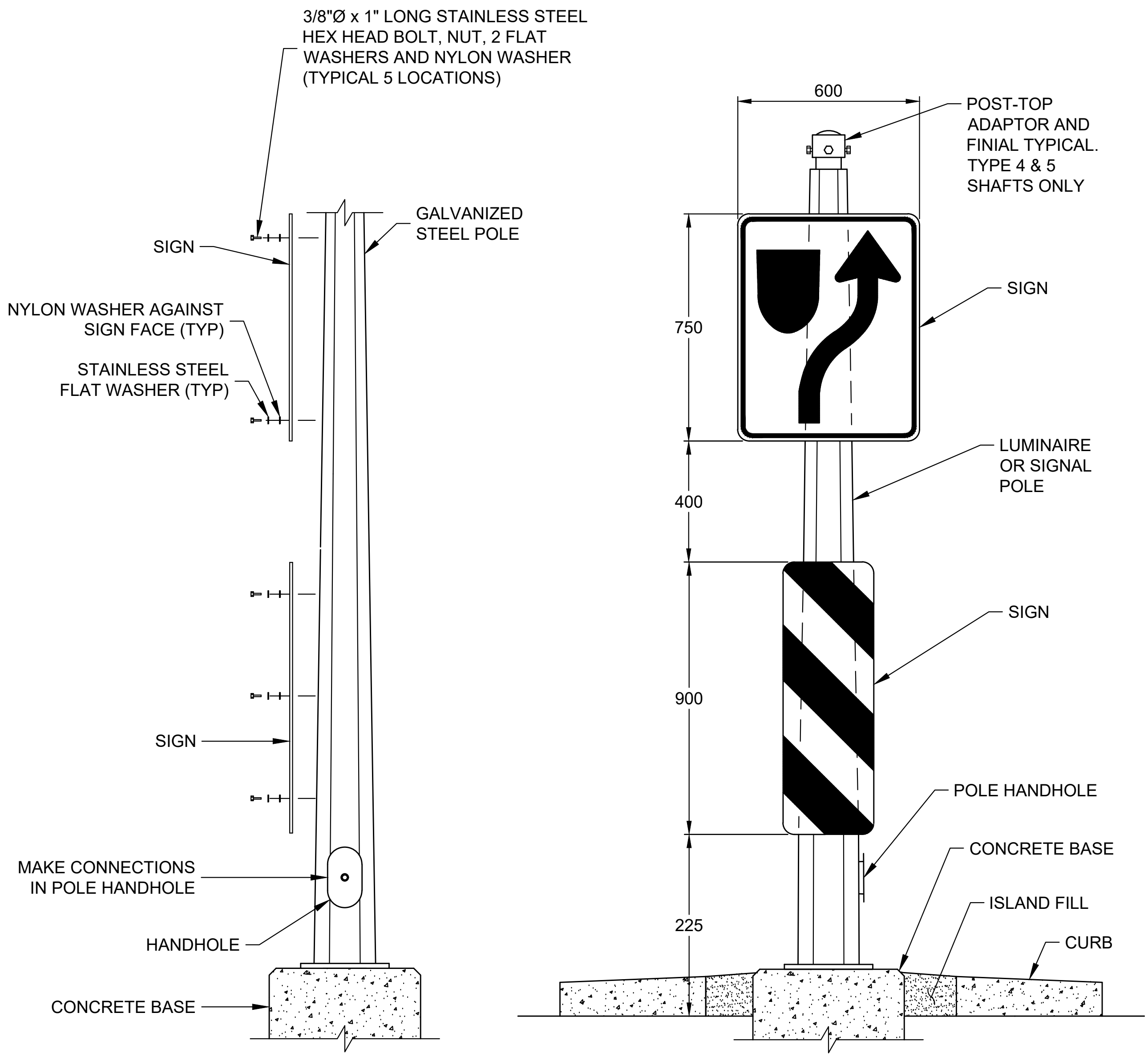
CITY OF NANAIMO
THE HARBOUR CITY

TRAFFIC SIGNAGE
PERFORATED STEEL SIGN

Scale:	NTS
Created:	APR 2013
Rev Date:	MAY 2020
Dwg No:	CS-41



SIDE VIEW

FRONT ELEVATION

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSION IN MILLIMETERS UNLESS OTHERWISE NOTED.

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3.18.2020

CITY OF NANAIMO
THE HARBOUR CITY

TRAFFIC SIGNAGE
SIGNS ON STEEL POLES

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	CS-42

SECTION 9 – AGGREGATES AND GRANULAR MATERIAL
CONTENTS

SECTION 9 – AGGREGATES AND GRANULAR MATERIAL
DESIGN CRITERIA

9.01 SCOPE

.1 Aggregates and Granular Material section refers to the work that is unique to the specification and installation of aggregates. ***(REVISED MAY 2020)***

.2 For design criteria not specified in this section, refer to Section 8.0 – Transportation or the most current version of the Geometric Design Guide for Canadian Roads, distributed by the Transportation Association of Canada (TAC). All design criteria from the Geometric Design Guide for Canadian Roads must be approved by the City Engineer prior to design stage. ***(REVISED MAY 2020)***

9.02 MINIMUM BASE AND PAVEMENT STRENGTHS ***(REVISED MAY 2020)***

.1 The minimum standards shall be as shown. Pavement and road structure design shall be based on Benkelman Beam rebound values as outlined in the most current edition of the "Pavement Design and Management Guide", distributed by the Transportation Association of Canada. The maximum Benkelman Beam deflection tested shall be corrected for seasonal variation. If required, the minimum standards shall be increased to meet the maximum Benkelman Beam deflection. Proof of minimum strengths shall be required.

	Local	**Collector**	**Arterial and all Industrial**
Coarse Gravel Sub-base, compacted 75mm minus	250 mm	250 mm	250 mm
Crushed Gravel Base, compacted 20mm minus	100 mm	150 mm	200 mm
Hot plant-mix asphalt pavement, compacted	75 mm	100 mm	125 mm
Maximum Benkelman Beam deflection	1.5 mm	1.25 mm	0.75 mm
Minimum compaction of sub-base and base gravel	95% modified proctor	95% modified proctor	95% modified proctor

(REVISED MAY 2020)

.2 Where works are to be constructed in and/or adjacent to existing streets and existing pavements do not meet the maximum Benkelman Beam deflection or is found to have road structure that does not meet current standards, the City of Nanaimo may require its removal and replacement with new road and pavement structure to meet the current standard.

SECTION 9 – AGGREGATES AND GRANULAR MATERIAL SPECIFICATION

9.20 SCOPE

.1 This specification refers to preparations and construction of the road subgrade, sub-base, and base course. Only those products approved by the City Engineer. will be accepted for installation. ***(REVISED MAY 2020)***

9.21 TESTING

.1 The Contractor 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. All testing shall be completed at the Contractor's expense. ***(REVISED MAY 2020)***

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

.3 The following tests are required at a minimum: ***(REVISED MAY 2020)***

(a) Gradation determined by washed sieve analysis must be completed on the actual material (stock pile) to be incorporated into the work. The testing shall be conducted no more than one week before the arrival of material on the job site. Further testing is required for every additional 1000 tonnes, or if more than two weeks has passed since the last test, or if the material supplier or stockpile has changed. The two weeks may be extended for stockpiles on the job site or at a secure and controlled location. Testing to be in accordance with ASTM C136/C136M and ASTM C117. ***(REVISED MAY 2020)***
(b) Determination of optimum moisture content and Modified Proctor Density (ASTM D1557) on all materials supplied to the project to be used for subgrade, sub-base and base course construction.
(c) Field moisture content and compaction determined by a minimum of one field density test of sub-base, and granular base per 500 m^2 for roads and per 50 lineal m for sidewalks, will be performed as per ASTM D6938. All backfill materials in travelled areas to be compacted to a minimum 95% modified proctor density. ***(REVISED MAY 2020)***
(d) Benkelman beam tests to be done on the prepared base only.
(e) Other aggregate property tests as per the requirements specified in Section 9.29 to Section 9.32. ***(REVISED MAY 2020)***
(f) Other testing as required by the Engineer.

.4 Proof Rolling: ***(REVISED MAY 2020)***

(a) Before proceeding further with the work, each finished layer of subgrade shall be proof rolled by receiving complete coverage using a single axle truck having an 8000 kg rear axle load and a tire pressure of 550 kPa. Benkelman Beam testing may be required in conjunction with proof rolling. Should any areas of rutting or displacement result, they shall be excavated and refilled as specified in Section 4.09A Authorized Overexcavation. If, in the opinion of the Engineer, the excavation is necessitated as a result of the Contractor's operations it will be classified as unauthorized excavation. Excavated and refilled areas shall be retested to confirm rutting and/or displacement has been eliminated. ***(REVISED MAY 2020)***

(b) Intermediate tests will be conducted on the sub-base prior to placement of road base material, and on the road base immediately prior to paving. Results of the intermediate tests will be supplied to the Contractor as a quality control guide, but will not constitute acceptance or rejection of the work.

(c) It shall be the Contractor's responsibility to provide a single axle, dual wheel truck and driver for the tests. The truck shall be equipped with 250 x 500mm, 12-ply tires inflated to a pressure of 550 kPa. The truck shall have an 8000 kg rear axle load distribution on both wheels.

(d) Where proof rolling is likely to damage works or access is limited, determination of moisture content and Modified Proctor Density on the re-molded subgrade, sub-base and base materials shall be performed as per Section 9.21 – Testing.

.5 Benkelman Beam Testing: (REVISED MAY 2020)

(a) Prior to paving, the finished base course shall be checked by the Engineer for deflections utilizing a Benkelman Beam or other approved testing device.

(b) If the calculated deflections are in excess of the maximum Benkelman Beam deflections, as outlined in Section 9.02 – Minimum Base and Pavement Strengths, measures shall be taken to strengthen the road base and pavement structure prior to paving. Paving shall not proceed until the test results meet the minimum requirements. (REVISED MAY 2020)

9.22 DESIGN SUBGRADE CROSS SECTION

.1 Design subgrade cross section shall mean the surface of the finished subgrade upon which select granular sub-base material is to be placed.

9.23 OVERBURDEN

.1 Overburden shall mean the surface material which, in the opinion of the Engineer, is not suitable for classifying as topsoil or earth fill.

9.24 TOPSOIL

.1 Topsoil is surface material containing organic components and which, in the opinion of the Engineer, is suitable for landscaping.

9.25 STRIPPING ***(REVISED MAY 2020)***

.1 Stripping is the excavation of topsoil and overburden including the stockpiling of topsoil at a location approved by the Engineer and disposal of overburden as specified in Section 4.11 – Disposal of Excavated Material.

9.26 EARTH FILL ***(REVISED MAY 2020)***

.1 Earth fill shall include all fills comprised of common excavating containing less than 15% by volume of rock larger than 150 mm in size, free of organic and deleterious matter and frozen earth lumps and shall be approved by the Engineer prior to placement.

9.27 IMPORTED EARTH FILL ***(REVISED MAY 2020)***

.1 Imported earth fill is defined as material imported from outside the project site to meet the specifications for earth fill.

9.28 ROCK FILL

.1 Rock fill shall include all fills comprised of material containing more than 85% by volume of rock larger than 150 mm in size, free of organic and deleterious matter. Rock fill shall not contain rocks greater than 600 mm in diameter and be approved by the Engineer prior to placement.

9.29 APPROVED GRANULAR MATERIAL ***(REVISED MAY 2020)***

.1 Granular Material may be used only with the express written permission of the Engineer, and provided that it can be compacted to the requirement stated in Section 9.21 and provided that the materials also meet the following requirements: ***(REVISED MAY 2020)***

(a) Approved Granular Material shall conform to the following gradation when tested in accordance with ASTM C117 and ASTM C136. ***(REVISED MAY 2020)***

US Standard Sieve Size	Gradation Limits (Percent by Weight Passing)
75 mm	100
50 mm	70 – 100
25 mm	50 – 100
4.75 mm	22 – 100
2.36 mm	10 – 85
0.075 mm	2 - 8

(REVISED MAY 2020)

(b) Tbe used only up to the bottom of the subbase layer. ***(REVISED MAY 2020)***
(c) Free of organics and foreign matter: maximum 0.5% by mass. ***(REVISED MAY 2020)***
(d) To be placed in uniform lifts not exceeding 200 mm in loose thickness. ***(REVISED MAY 2020)***
(e) Not to be used in inclement weather. ***(REVISED MAY 2020)***
(f) In-situ moisture content to be within the range determined by the Modified Proctor Test that provides the required compaction. ***(REVISED MAY 2020)***

.2 Prior to any granular material being approved, the grain size and in-situ moisture content must be verified by washed sieve and moisture content test as per ASTM C117, ASTM C136, and ASTM D2216. ***(REVISED MAY 2020)***

.3 When in the opinion of the Engineer and City Engineer, native granular material is unsuitable for reuse, it shall be removed from the construction site and approved granular material shall be used. ***(REVISED MAY 2020)***

9.30 ROAD SUB-BASE GRAVEL COURSE

.1 Road sub-base shall be of uniform quality, crushed to size as necessary and shall consist of sound, tough, durable, highly angular, 100% mechanically crushed fragments with two or more fractured faces having a rough surface texture. It shall be free from an excess of flat or elongated particles, wood, shells, coatings of clay or any other deleterious material. Sub-Base Gravel shall conform to the following limits when tested in accordance with ASTM C117 and ASTM C136/C136M: ***(REVISED MAY 2020)***

US Standard Sieve Size	**Gradation Limits (Percent by Weight Passing)**
75 mm	100
25 mm	50 - 85
0.15 mm	0 - 15
0.075 mm	0 - 8

9.31 ROAD BASE GRAVEL COURSE

Road Base shall be of uniform quality, crushed to size as necessary and shall consist of sound, tough, durable, highly angular, 100% mechanically crushed fragments. A minimum of 50% of the particles retained on the 4.75 mm (No. 4) sieve shall have at least one fractured face as determined by particle count. Soundness shall be tested in accordance with ASTM C88 using magnesium sulfate. Maximum weighted average losses for coarse aggregate shall be 20% and maximum losses for the fine aggregate shall be 25%. The sand equivalent when tested in accordance with ASTM D2419 shall not be less than 40. The LA Abrasion value when tested in accordance with ASTM C131/C131M shall have a maximum loss by mass of 25%. Road Base Gravel shall conform to the following limits when tested in accordance with ASTM C117 and ASTM C136/C136M: ***(REVISED MAY 2020)***

US Standard Sieve Size	Gradation Limits (Percent by Weight Passing)
19 mm	100
12.5 mm	75 - 100
9.5 mm	–60 - 90
4.75 mm	40 -70
2.36 mm	27 - 55
1.18 mm	16 - 42
0.600 mm	–8 - 30
0.300 mm	–5 - 20
0.075 mm	2 - 8

(REVISED MAY 2020)

.1 The Contractor shall submit to the Engineer for approval his proposed base course gradation for the project. Upon approval, this gradation curve shall become the project gradation. All samples of base course aggregate used on the project shall conform to the following requirements:

(a) Deviation between samples and the project gradation shall not exceed the following limits:

US Standard Sieve Size	Gradation Limits (Percent by Weight Passing)
Larger than 2.36 mm	±3.5%
1.18 mm - 2.36 mm	±3.5%
0.3 mm - 0.6 mm	±2%
0.075 mm - 0.15 mm	±1%

(REVISED MAY 2020)

9.32 RECYCLED AGGREGATE MATERIAL (RAM)

.1 Aggregates containing recycled material may be utilized up to the bottom of the sub base layer if approved by the Engineer. In addition to meeting the requirements of this specification, recycled material should not reduce the quality of construction achievable with quarried materials. RAM shall consist only of aggregates, crushed Portland cement concrete or asphalt that is free of impurities. Other construction and demolition materials such as bricks and plaster are not acceptable. The use of any recycled material must be approved by the Engineer prior to use. ***(REVISED MAY 2020)***

.2 RAM shall conform to the requirements of Section 9.30 – Road Sub-Base Gravel Course and Section 9.31 – Road Base Gravel Course, and have the following additional requirements: ***(REVISED MAY 2020)***

(a) Maximum asphalt content 1.0%. ***(REVISED MAY 2020)***
(b) Maximum percent asphalt coated aggregate not to exceed 20%. ***(REVISED MAY 2020)***
(c) Percentage (%) Loss in LA Abrasion – Coarse Aggregate: Maximum 30. ***(REVISED MAY 2020)***
(d) Soundness shall be tested in accordance with ASTM C88 using magnesium sulfate. Maximum weighted average losses for coarse aggregate shall be 20% and maximum losses for the fine aggregate shall be 25%. ***(REVISED MAY 2020)***
(e) California Bearing Ration (CBR) – Minimum 50. ***(REVISED MAY 2020)***

.3 RAM shall meet the following gradations: ***(REVISED MAY 2020)***

(a) 75 mm Minus RAM gradation shall be in accordance with Section 9.30 – Road Sub-Base Gravel Course. ***(REVISED MAY 2020)***

(b) 25 mm Minus RAM gradation shall be in accordance with Section 9.31 – Road Base Gravel Course. ***(REVISED MAY 2020)***

9.33 CLEAR CRUSH

.1 19 mm fracture shall be of uniform quality, crushed to size as necessary and shall consist of sound, tough, durable, highly angular, 100% mechanically crushed fragments with two or more fractured faces having a rough surface texture. It shall be free from an excess of flat or elongated particles, wood, shells, coatings of clay or any other deleterious material. 19 mm fracture shall conform to the following limits when tested in accordance with ASTM C117 and C136/C136M: ***(REVISED MAY 2020)***

US Standard Sieve Size	Gradation Limits (Percent by Weight Passing)
25 mm	100
19 mm	0 – 100
9.5 mm	0 – 5
4.75 m	0

9.34 PEA GRAVEL ***(REVISED MAY 2020)***

.1 Pea Gravel shall consist of round stone and shall conform to the following limits when tested in accordance with ASTM C117 and ASTM C136/C136M:

US Standard Sieve Size	Gradation Limits (Percent by Weight Passing)
9.5 mm	100
4.75 mm	50 – 100
2.36 mm	10 – 35
1.18 mm	5 – 15
0.600 mm	0 – 8
0.300 mm	0 – 5
0.150 mm	0 – 2
0.075 mm	0

9.40 STOCKPILING ***(REVISED MAY 2020)***

.1 All aggregate materials shall be stockpiled prior to use at either the crushing site or such other location on the jobsite subject to the approval of the Engineer. Stockpile sites shall be cleared of all vegetation, trees, brush, rocks and other debris and covered with a uniform layer of pit run gravel prior to deposition of the material.

.2 Stockpiles shall be built up in layers not exceeding 1.0m in thickness to a minimum height of 3m in such a manner as to prevent any appreciable segregation. End dumping over the edge of the stockpile will not be permitted.

.3 Planks or protected runways for vehicles shall be provided as necessary to prevent contamination of the stockpile.

9.41 ROADWAY CONSTRUCTION CONDITIONS ***(REVISED MAY 2020)***

.1 Construction shall not be undertaken during snow, heavy rain, freezing, or other unsuitable conditions. Aggregate shall not be placed upon a frozen, wet, muddy or rutted subgrade or sub-base surface, unless otherwise directed by the Engineer.

9.42 STRIPPING ***(REVISED MAY 2020)***

.1 Prior to commencing excavation operation, those areas designated by the Engineer shall be stripped of all overburden and topsoil. Overburden shall be disposed of as specified in Section 4.11 – Disposal of Excavated Material. Topsoil shall be stockpiled at locations approved by the Engineer. Stumps, boulders, and other deleterious matter shall be removed from the topsoil and disposed of as specified in Section 4.11 – Disposal of Excavated Material.

9.43 SUBGRADE PREPARATION ***(REVISED MAY 2020)***

.1 In areas where, after stripping, a fill in excess of 150 mm is required to bring the finished subgrade to the design subgrade elevation, earth fill or rock fill shall be placed as specified elsewhere herein.

.2 In areas where after stripping, a cut or a fill of 150 mm or less is required to bring the finished subgrade to the design subgrade elevation, the subgrade shall be scarified to a minimum depth of 150 mm below the design subgrade elevation and all material windrowed to one side. The exposed surface shall then be compacted to 90% of Modified Proctor Density (ASTM D1557), the windrowed material moved, and the compaction repeated on the other side. Windrowed material shall then be brought to its optimum moisture content, shaped to line and grade, and compacted to 95% of Modified Proctor Density (ASTM D1557).

.3 At transitions between cut and fill areas, the subgrade in the cut area shall be scarified and recompacted as specified above to a depth of 150 mm for a distance of 20 m beyond the transition from a fill.

.4 The subgrade in cut areas shall be prepared 600 mm wider on each side than the required width of the finished base course. In fill areas, embankments shall be constructed to the required width of the finished base course as shown on the drawings with the specified side slopes. The finished subgrade shall be crowned and sloped as required to prevent ponding of water on the roadway.

.5 Soft or unstable subgrade material shall be excavated and replaced as specified in Section 4.09A – Authorized Overexcavation. If, in the opinion of the Engineer, the overexcavation is necessitated as a result of the Contractor's operations, it will be classified as unauthorized overexcavation. ***(REVISED MAY 2020)***

(REVISED MAY 2020)

9.44 WATERING FOR COMPACTION AND DUST CONTROL ***(REVISED MAY 2020)***

.1 The Contractor shall maintain suitable watering equipment on the site. Watering shall be performed as directed by the Engineer to control dust and to ensure optimum moisture conditions during compaction, determined by Modified Proctor Testing ASTM 1557 for placement of all backfill materials. ***(REVISED MAY 2020)***

.2 ***(REVISED MAY 2020)***Water shall be supplied uniformly from a pressure type distributor equipped with suitable control apparatus and a spray bar and nozzles similar to those used on asphalt distributors. Splash plate type distributors or distributors with spray bars which discharge jets or water require approval by the Engineer.

9.45 EARTH FILLS ***(REVISED MAY 2020)***

.1 Earth fills shall be constructed in such a manner that they will be completely stable at all times during construction. Silts and clays shall not be used without proper aeration and drying. Placing of frozen material in fill areas will not be permitted.

.2 Earth fills not exceeding 600 mm (compacted thickness) shall be constructed in layers not exceeding 150 mm (uncompacted thickness). Each layer shall be compacted to 95% Modified Proctor Density (ASTM D1557).

.3 Earth fills exceeding 600 mm (compacted thickness) shall be constructed in layers not exceeding 200 mm (uncompacted thickness). Each layer shall be compacted to 95% Modified Proctor Density, except the top 600 mm (compacted thickness) which shall be constructed as per Section 9.45.2. ***(REVISED MAY 2020)***

.4 Where shown on the construction drawings, or as directed by the Engineer, the existing side slopes shall be scarified or terraced to ensure proper bond between existing and fill materials. Methods shall be approved by the Engineer prior to commencing work.

.5 Should any soft spots develop during the process of compaction, such areas shall be excavated and replaced as specified in Section 4.09A – Authorized Overexcavation. If in the opinion of the Engineer, the excavation is necessitated as a result of the Contractor's operation, it will be classified as unauthorized overexcavation. ***(REVISED MAY 2020)***

9.46 ROCK FILLS ***(REVISED MAY 2020)***

.1 Rock fills shall be constructed in layers equal in thickness to the largest average size of the material, but not exceeding 600 mm. Material shall be placed and spread in such a manner that the larger rocks are well distributed and the intervening void spaces are filled with sufficient amounts of smaller rocks and fines to create a stable structure. Fill surface voids at the subgrade level to prevent migration of sub-base gravels into the rock fill.

9.47 PLACING AND COMPACTING AGGREGATES ***(REVISED MAY 2020)***

.1 The subgrade shall be approved prior to placement of the sub-base course.

.2 All aggregates and granular materials shall be approved by the Engineer prior to being delivered to the project site. Approval shall require testing as per Section 9.21 – Testing. ***(REVISED MAY 2020)***

.3 Sub-base and base course shall be placed on the approved subgrade in those locations and to the compacted thicknesses and dimensions shown on the drawings or as otherwise directed by the Engineer. Testing shall be in accordance with Section 9.21 – Testing, Section 9.49 – Proof Rolling and Section 9.50 – Benkelman Beam Testing. ***(REVISED MAY 2020)***

.4 Aggregates shall be placed in maximum 300 mm loose lifts unless otherwise specified, and shall be spread in an approved manner such that the aggregate is neither segregated nor contaminated with foreign material. Segregated materials shall be remixed until uniform. The sub-base course shall be approved prior to placement of the base course. ***(REVISED MAY 2020)***

.5 Immediately following spreading, aggregates shall be graded and compacted at optimum moisture content to 95% of Modified Proctor Density (ASTM D1557). ***(REVISED MAY 2020)***

9.48 FINISHED GRADE ***(REVISED MAY 2020)***

.1 The finished grade surface of the compacted subgrade shall be within 15 mm of the design grade and cross section, but not uniformly high or low, when measured with a 3.0 m straightedge parallel or perpendicular to the road centreline.

.2 The finished grade surface of the compacted sub-base course shall be within 15 mm of the design grade and cross section, but not uniformly high or low, when measured with a 3.0 m straightedge parallel or perpendicular to the road centreline.

.3 The finished grade surface of the compacted base course shall be within 10mm of the design grade and cross section, but not uniformly high or low, when measured with a 3.0 m straightedge parallel or perpendicular to the road centreline.

9.49 CLEANUP ***(REVISED MAY 2020)***

.1 Prior to completion of construction, all existing and newly constructed drainage ditches, waterways, and culverts shall be cleaned to restore their full effectiveness. Boulevards and all other areas affected by the construction operation shall be cleaned of all loose rock, boulders and the debris and in all respects prepared suitable for placement of topsoil or as otherwise directed by the Engineer.

9.50 BOULEVARD GRADING ***(REVISED MAY 2020)***

.1 Boulevard areas and other areas within the road allowance or right-of-way shall be sloped, graded with 100 mm of topsoil and seeded with grass as shown on the drawings. The requirement for placement of topsoil and grass seeding shall be determined by the Engineer. As a general statement, top soil placement and grass seeding is not required in boulevards fronting undeveloped lots.

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SECTION 10 – ROADWAY LIGHTING AND TRAFFIC SIGNALS
DESIGN CRITERIA

10.01 ROADWAY LIGHTING

.1 Lighting Levels for Standard Roadways, Intersections, and Traffic Circles:

(a) Roadways, bikeways and pedestrian walkways shall be illuminated for nighttime safety and comfort of motorists, cyclists and pedestrians.

(b) Required roadway illuminance levels and uniformity ratios are listed in Table 1 below. Calculations shall be undertaken using the illuminance method in the most current edition of the ANSI/IESNA RP-8 – Roadway Lighting standard practices. Road classifications are described in Section 8.0 – Transportation. ***(REVISED MAY 2020)***

(c) Sidewalks, bike paths and multi-use paths are to be illuminated as indicated in Table 1. If the roadway lighting does not light pedestrian and cycling areas adequately, supplemental lighting poles or additions to the roadway lighting davit (mounted to the shaft or on a separate arm) may be required. ***(REVISED MAY 2020)***

(d) Required sign illuminance levels and uniformity ratios shall be in accordance with the most current edition of the ANSI/IESNA RP-19 – Roadway Sign Lighting.

(e) The term ‘conflict’ refers to areas where vehicle-to-vehicle or vehicle-to-pedestrian conflicts may occur as defined in IESNA RP8. ***(REVISED MAY 2020)***

(f) Illumination levels for intersecting roadways shall be the sum of the minimum averages of each roadway with the lowest minimum uniformity ratio from the intersecting roadways. This higher lighting zone shall be extended to include the conflicts resulting at crosswalks, sidewalks, bike paths, and multi-use paths. Intersections of lanes with other roadway types are exempt from this requirement. ***(REVISED MAY 2020)***

(g) The maintained average horizontal illuminance level, average to minimum uniformity ratios and roadway classification for each roadway shall be noted on the Design Drawings.

(h) Pedestrian Area Classification level shall be as directed by the City or as determined by the Engineer. ***(REVISED MAY 2020)***

TABLE 1

Road Classification	**Maintained (*) average horizontal illumination level to meet or exceed (lux)**			**Average to minimum uniformity ratio not to exceed**
	High Pedestrian Conflict Area	**Medium** Pedestrian Conflict Area	**Low** Pedestrian Conflict Area	
Arterial	18	14	14	3:1
Collector	12	9	6	3:1
Local	9	7	4	6:1
Sidewalks, Paths, Bike Facilities	10	5	4	6:1
Lane	4	4	4	6:1

(REVISED MAY 2020)

(*) Maintained levels shall include a total Light Loss Factor (LLF) of 0.85 as discussed in Table 4.

.2 Lighting Levels for Roundabouts:

(a) Due to the unique geometry of roundabouts, these intersections involve additional lighting requirements and should be designed in accordance with the principles of Transportation Association of Canada Guide for the Design of Roadway Lighting.
(b) Each approach to a roundabout shall be illuminated in accordance with Section 10.01.1 for a distance of 80m from the roundabout.
(c) The area within the intersection shall have a horizontal illuminance level and uniformity in accordance with Section 10.01.1.
(d) Each crosswalk in the roundabout shall have a minimum vertical illuminance level for the direction of on-coming traffic that is equivalent to the minimum horizontal illuminance level for the intersection.
(e) Vertical illuminance may sometimes be more efficiently achieved with lower pole heights. As such, 7.6m poles should be considered for these applications.

.3 Lighting Levels for Mid-Block Crosswalks:

(a) Mid-block crosswalks can present a higher risk to pedestrians than crosswalks at intersections as drivers may not expect pedestrians at these locations. As such, these crosswalks involve additional lighting requirements and should be designed in accordance with the principles Transportation Association of Canada Guide for the Design of Roadway Lighting.
(b) The area within the crosswalk shall have a horizontal illuminance level and uniformity in accordance with Section 10.01.1.

(c) The crosswalk shall have a minimum vertical illuminance level for the direction of on-coming traffic of 20 lux for low pedestrian conflict, 30 lux for medium pedestrian conflict, and 40 lux for high pedestrian conflict.

(d) Vertical illuminance may sometimes be more efficiently achieved with lower pole heights. As such, 7.6m poles should be considered for these applications.

.4 Lighting Levels for Cul-De-Sacs:

(a) Due to the geometry of cul-de-sacs, maintaining minimum illuminance levels and uniformity commonly results in overlighting the area and excessive light pollution. Due to the reduced traffic and low travel speeds at cul-de-sacs, the requirements are relaxed at these locations.

(b) Lighting levels for a cul-de-sac shall be considered to be met with a single streetlight pole, with the same luminaire and height as the remainder of the street, placed within 5m of the beginning of the cul-de-sac curve.

.5 Luminaire Pole Spacings:

(a) Spacing and location of poles shall be governed by road width, road configuration, intersecting property lines, luminaire photometrics, mounting heights and required illumination levels. In addition maintaining clearances to overhead BC Hydro power lines in accordance with the *Canadian Electrical Code, WorkSafeBC, BC Hydro Standards,* and the *BC Electrical Safety Act* shall also govern pole spacing.

(b) Generally, poles shall be arranged in a one sided or staggered spacing based on the road classifications listed in Table 2. In circumstances where overhead BC Hydro power lines are in conflict with streetlight poles, one sided spacings may be considered if the required illumination level and uniformity ratios can be achieved. Alternate pole spacings shall meet the approval of the City Engineer.

(c) Where possible locate poles on property lines to avoid driveway conflicts.

(d) Streetlight poles shall be offset as shown on the "Typical Cross Section Standard Drawings" in Section 8.0 – Transportation. ***(REVISED MAY 2020)***

(e) Where the posted travel speed for the roadway exceeds 60km/h, poles should be placed outside of the Clear Zone. If absolutely necessary, poles located within the Clear Zone shall be equipped with frangible or breakaway bases in accordance with the Ministry of Transportation and Infrastructure Electrical and Traffic Engineering Manual. The Clear Zone shall be specified by the TAC Geometric Design Guide for Canadian Roads, current edition, unless approved by the City Engineer.

TABLE 2	
Road Classification	**Pole Arrangement**
Arterial	Staggered or Opposite
Collector	Staggered
Local	One Sided
Lane	One Sided
Walkway	One Sided

(REVISED MAY 2020)

.6 Luminaire types, Pole types and Lumen Outputs:

(a) Luminaire types, pole types and lumen outputs are as listed in *Table 3.*

(b) Where tying into an existing system or area luminaire types, wattages and mounting heights should match those previously installed except that LED luminaires shall be used where existing HPS luminaires are present.

(c) Luminaire manufacturers, model numbers, wattages, distributions, voltage, Northing, Easting and elevation shall be noted on the Design Drawings. Refer to Section 1.0 Standard Drawing No. G-7.

(d) Luminaires shall be listed on the City of Nanaimo Approved Product List.

TABLE 3				
Road Classification	**11.0m High Davit Pole with Flat Glass Luminaire**	**9.0m High Davit Pole with Flat Glass Luminaire**	**7.5m High (or Lower) Davit Pole (*) with Flat Glass Luminaire**	**4.5m High Post Top Pole with Post Top Luminaire**
Arterial	15,500 to 18,000 lumens, LED	9,000 to 13,500 lumens, LED		-
Collector	15,500 to 18,000 lumens, LED	9,000 to 13,500 lumens, LED		-
Local		4,900 to 6,100 lumens, LED	4,900 to 6,100 lumens, LED	4,500 to 5,500 lumens, LED
Sidewalks, Bike Paths, Multi-Use Paths, Walkways		2,500 to 5,500 lumens, LED	2,500 to 5,500 lumens, LED	2,500 to 5,500 lumens, LED
Lane		4,900 to 6,100 lumens, LED Equivalent	4,900 to 6,100 lumens, LED	4,500 to 5,500 lumens, LED

(REVISED MAY 2020)

(*) For use to avoid conflicts with overhead powerlines or on local streets or lanes. In all cases the use of davit poles less than 9.0m must meet the approval of the City Engineer. If a 6.7m pole cannot be installed due to conflicts with overhead powerlines, then junction boxes may be installed in place of new street light poles (for future installation of poles) with prior approval from the City Engineer.

.7 Lighting Calculations:

(a) Lighting calculations are based on the illuminance methods described in *ANSI/IESNA RP-8 Roadway Lighting*. Lighting calculations shall be done using a computer lighting program designed to carry out the required calculations and the luminaire manufacturers IES formatted photometric files. The IES photometric files for the City approved luminaires are available in electronic format, through the luminaire manufacturers.

(b) Grid spacing for walkways or bikeways shall be maximum 1m.

(c) Lighting calculations shall be based on maintained levels using initial rated lamp lumens and the total light loss factor (LLF) of 0.79. Refer to *Table 4* for the factors included in the LLF. The LLF shall be considered as the total maintenance factor.

TABLE 4

Lamp Lumen Depreciation (LLD)[1]	Luminaire Dirt Depreciation (LDD)[1]	Luminaire Component Depreciation (LCD)[2]	Equipment Factor (EF)[3]	Total Light Loss Factor (LLF)
0.90	0.94	1.00	1.00	0.85

Notes
(1) Based on a 4 year maintenance cycle
(2) Degradation of the luminaire optics
(3) Effect of ambient temperature on the luminaire including the driver and light source factors
LLF = LLD x LDD x LCD x EF

(REVISED MAY 2020)

(d) A PDF of the lighting calculations shall be submitted to the City along with the Design Drawings if requested. Refer to Section 1.07 Ornamental Street Lighting Traffic Control Signals, Hydro, Phone, Gas and Cablevision Fibre Optics (Commercial and Private) for design drawing requirements.

10.02 TRAFFIC SIGNALS

.1 Traffic signal controllers and cabinets and siren pre-emption equipment shall be supplied through the City of Nanaimo.

.2 For development projects requiring traffic signals the cost for the design and the supply of traffic signal systems including all related signs, structures, controllers, signal pre-emption and related equipment shall be borne by the Developer.

.3 Traffic signals shall be designed in general accordance with Sections 402.6 of the Ministry of Transportation and Infrastructure Electrical and Traffic Engineering Manual, except that the City of Nanaimo uses NEMA phase designations as opposed to the Ministry movement designations (i.e.; A1, A2, B1, etc.).

.4 Traffic signal designs shall also conform to the British Columbia Motor Vehicle Act and the Uniform Traffic Control Devices for Canada.

10.03 CONDUIT

.1 Conduits shall be parallel or perpendicular to the roadway, and routed to run in a direct line between adjacent poles or junction boxes. Street lighting conduits shall be run under sidewalks, unless otherwise noted.

.2 There shall be a maximum 2 - 90° bends in a conduit run. Where this cannot be avoided junction boxes shall be used as noted under Section 10.04 – Junction Boxes.

.3 Street lighting conduit shall be minimum 38mm diameter.

.4 Where conduit(s) cross an existing road, they shall be installed by horizontal directional drilling to avoid cutting pavement and interrupting traffic. Prior to specifying drilling confirm soil condition will accommodate drilling.

10.04 JUNCTION BOXES

.1 Large round plastic junction boxes shall generally be used as follows:

(a) where the maximum number of 90° bends in a conduit run is exceeded.
(b) where branch conduit runs are required.
(c) in conduit runs over 100m.
(d) at service panels.
(e) at post mounted flashers.

.2 Rectangular plastic junction boxes shall be used in narrow traffic islands where a round box will not fit.

.3 Concrete junction boxes shall be used next to traffic signal controllers and in driveways only.

.4 Junction boxes in roadways should be avoided at all times. If absolutely required in a roadway, the junction box shall be a custom concrete box with an H20 dynamic rated riser and ductile iron manhole lid. Custom concrete junction boxes shall meet the approval of the City Engineer.

10.05 CONDUCTORS

.1 For the purpose of standardization and to accommodate future expansion, street lighting conductors shall be No. 4 AL RW90 and No. 6 AL RW90 bond. The use of alternate conductor sizes will require the approval of the City Engineer.

10.06 SERVICE EQUIPMENT

.1 The designer shall confirm service locations with BC Hydro.

.2 Street lighting systems are controlled with a lighting contactor and photocell. The photocell shall be located on the luminaire nearest the service panel.

.3 Service panels for street lighting systems shall have a 60A – 2P breaker, contactor and photocell bypass switch and shall be mounted in a service base as shown on Standard Drawing No. E-10.1 and wired as shown on Standard Drawing No. E-10.3.

.4 Where possible traffic signal and street lighting systems shall be fed from the same service panel. The combination street lighting and traffic signal service panel shall have a 100A – 2P main breaker, sub-breakers, contactor, photocell bypass switch and where required a flasher control unit. The service panel shall be mounted in a service base of on the side of the traffic controller. Refer to Standard Drawings No. E-10.1, E-10.3, E-10.4, and E-10.5 for details.

.5 All services shall be 120/240V single phase, 3 wire. Alternate service voltage must meet the approval of the City Engineer.

10.07 CONCRETE BASES

.1 The Civil Engineer shall assess the existing soil conditions at the proposed concrete base installations to determine if modifications to the standard drawings are required. The Civil Engineer shall report sub-standard soil conditions to the Electrical Engineer for integration into the electrical design.

.2 The Engineer shall submit for approval by the City Engineer, the design modifications to the standard drawings that are required to meet the existing soil conditions.

.3 Avoid running more than two conduits into a streetlight pole base. Where this situation cannot be avoided a junction box shall be used.

.4 When the selecting pole base locations search out proposed or existing utility locations to avoid conflicts.

10.20 SCOPE

.1 This specification refers to the materials for street lighting and traffic installations. Only those products approved by the City Engineer and listed on the City of Nanaimo Approved Product List will be accepted for installation. When the City of Nanaimo Approved Product List does not list a product, the Ministry of Transportation and Infrastructure's Recognized Product List shall be referenced. Only those products approved by the City Engineer will be accepted for an installation.

.2 All materials shall be new unless otherwise noted.

.3 All material shall meet or exceed the Canadian Electrical Code Requirements and Canadian Standards Association Standards, where applicable, and are subject to the approval of the Electrical Safety Branch Inspector prior to installation.

.4 All similar items of materials shall be of one type and from the same manufacturer.

.5 Unless otherwise noted, the following materials shall be supplied by the City of Nanaimo at the Developers expense:

(a) Traffic Controllers/Cabinets;
(b) Padlocks;
(c) Siren pre-emption systems; and
(d) Street light pole locking handhole covers.

10.21 CONDUIT

.1 Exposed Conduit:

(a) All exposed conduit shall be rigid steel unless otherwise noted on the Standard Drawings.
(b) Rigid steel conduit shall be hot-dipped galvanized and shall conform to CSA C22.2 No. 45.
(c) Rigid still conduit clamps and fitting shall be hot dip galvanized.
(d) All rigid conduit ends shall be reamed and all necessary bushings, locknuts, elbow and bends shall be provided.
(e) All joints shall be made with threaded couplers.

.2 Buried Conduit:

(a) Buried conduit couplings, adaptors, bends and fittings shall be rigid unplasticized PVC.
(b) Rigid PVC conduit shall conform to CSA C22.2 No. 211.2.
(c) Rigid PVC couplings, adaptors, bends and fittings shall conform to CSA C22.2 No. 85.
(d) Only factory conduit bends are acceptable.
(e) Conduit cement shall be CSA certified type.
(f) Each standard length of conduit, couplings, adaptors, bends and fittings shall bear a CSA certification label.

.3 Concrete for conduit encasement shall conform to Section 11.0 – Cast In Place Concrete Works. Concrete encasement will only be required where specifically noted on the Contract Drawings or where directed by the Engineer. ***(REVISED MAY 2020)***

.4 In locations with concrete encasement is not required, bedding sand shall be used in accordance with Section 4.0 – Trench Excavation, Bedding and Backfill.

10.22 TRENCH MARKER TAPE

.1 Trench marker tape shall be 150 mm wide yellow and shall be labelled "CAUTION – ELECTRICAL LINE BURIED BELOW".

.2 Tape shall be minimum 3.5 mils thick heavy duty polyethylene material.

10.23 JUNCTION BOXES

.1 Large round and rectangular plastic junction boxes and lids shall be manufactured in accordance with the Ministry of Transportation and Infrastructure Electrical and Traffic Engineering Manual.

.2 Concrete junction boxes shall be in accordance with Standard Drawing No. E-3.2 and Standard Drawing E-3.3.

.3 Custom concrete junction boxes for roadways shall be installed as per the Contract Drawings.

.4 All junction boxes shall have galvanized steel lids.

10.24 CONCRETE BASES

.1 Concrete bases shall be in accordance with the Standard Drawings.

.2 Concrete bases shall be pre-cast. Poured in place concrete bases shall meet the approval of the City Engineer.

.3 Concrete for cast in place concrete bases shall conform to Section 11.0 – Cast In Place Concrete Works. ***(REVISED MAY 2020)***

.4 Top of concrete bases shall be troweled smooth and level with beveled edges. Top surface shall not vary by more than 3mm in depth as measured across the widest surface.

.5 All concrete shall be fully vibrated.

.6 Anchor bolts shall be as shown on Standard Drawing No. E-1.9 to Standard Drawing No. E-1.11. Anchor bolts shall be manufactured in accordance with the Ministry of Transportation and Infrastructure Electrical and Traffic Engineering Manual.

10.25 POLES AND RELATED EQUIPMENT

.1 Poles, arms, extensions, brackets and clamps shall be as shown on Standard Drawing No. E-5.1 to Standard Drawing No. E-5.19 and Standard Drawing E-5.21. This material shall be manufactured in accordance with the Ministry of Transportation and Infrastructure Electrical and Traffic Engineering Manual. The nominal height of a pole on a service base shall be 0.9m shorter to allow for the height of the service base.

.2 Service bases shall be designed to meet or exceed the capacity of the pole. Service bases shall meet or exceed the Ministry of Transportation and Infrastructure material standards for the fabrication of poles as per the Electrical and Traffic Engineering Manual.

.3 Post top poles shall meet or exceed the Ministry of Transportation and Infrastructure Material standards for the fabrication of poles as per the Electrical and Traffic Engineering Manual.

.4 All poles, arms, extensions, brackets, clamps and service bases shall be hot dip galvanized.

10.26 CONDUCTORS

.1 All underground wiring that is rated for 40A and higher, shall be single conductor stranded aluminum with type RW90 XLPE insulation, unless otherwise noted on the Contract Drawings. ***(REVISED MAY 2020)***

.2 Grounding system and connections shall remain copper. Bonding conductors will be aluminum if current carrying conductors are aluminum.

.3 All aluminum terminations shall use anti oxidation compound as required by the Canadian Electrical Code.

.4 Contractor to use copper/aluminum rated splice hardware for all connections from aluminum to copper wire.

.5 All wiring that is rated for less than 40A shall be single conductor stranded copper with type RW90 XLPE insulation, unless otherwise noted on the Contract Drawings. ***(REVISED MAY 2020)***

.6 Multi-conductor traffic signal cable shall be 19 conductor IMSA specification 19-1 (stranded copper) unless otherwise noted on the Contract Drawings.

.7 Color coding and gauges (AWG) shall be as noted on the Contract Drawings.

.8 Shielded detector loop cable shall be 2 conductor No. 16 stranded copper and shall meet California Type B Lead in Cable specifications or IMSA specification 50-2 (1984).

10.27 LOOP SEALANTS AND BACKEROD

.1 Loop sealants shall be hot tar.

.2 Backerod shall be foam material. Backerod shall be sized to hold down conductor in loop slot and to resist melting during the pouring of hot tar.

10.28 TRAFFIC AND PEDESTRIAN SIGNAL HEADS AND LAMPS

.1 Traffic and pedestrian signal heads and lamps including backboards and visors shall be manufactured in accordance with the Ministry of Transportation and Infrastructure material standards as per the Electrical and Traffic Engineering Manual.

.2 Signal head layout, size and lamp requirements shall be as follows:

ITEM	LENS	REQUIRED DIAMETER	LAMP
Primary Heads (Overhead mount)	Red Yellow Green Left Turn (Gr, Yell)	300mm 300mm 300mm 300mm	LED LED LED LED
Secondary Heads (Side mount)	Red Yellow Green Left Turn (Gr, Yell)	200mm 200mm 200mm 300mm	LED LED LED LED
Pedestrian Heads	Combination Walk/Don't Walk Overlay Graphic	300mm square	LED
Pedestrian Countdown Display	Countdown Graphic	300mm square	LED
Notes: 1. All heads shall be mounted vertically. 2. All primary heads shall have backboards with fluorescent yellow reflective sheeting as per the Approved Product List.			

10.29 SIGNAL HEAD, SIGNAL DEVICE, AND SIGN MOUNTING HARDWARE

.1 Signal and sign mounting hardware shall be manufactured in accordance with the Ministry of Transportation and Infrastructure material standards as per the Electrical and Traffic Engineering Manual.

10.30 –NOT USED-

10.31 –NOT USED-

10.32 AUDIBLE SIGNALS

.1 Audible signals shall be manufactured in accordance with the Ministry of Transportation and Infrastructure material standards as per the Electrical and Traffic Engineering Manual.

10.33 CONNECTORS

.1 Aluminum conductor connections shall be split bolt connectors sized to suit conductor size. Aluminum to copper connections shall use anti-oxidation compound.

.2 Copper conductor connections shall be screw on type solderless connectors sized to suit conductor size with the exception of those used inside traffic controllers which shall be compression type spade connectors.

.3 Ground clamps shall be copper with bolt down compression connection.

10.34 CONDUCTOR TAGS

.1 Conductor tags in traffic controllers and pole handholes shall be sleeve type markers. Tags shall be designed so they can be snapped onto a conductor.

.2 Conductor tags in junction boxes shall be yellow and shall be a minimum of 60mm x 50mm x 0.5mm thick. Tags shall be rigid and waterproof. Tags shall be supplied with a ty-rap to connect to bundle of conductors. Tags shall be designed to be permanently labelled with a black indelible pen.

10.35 FUSES AND FUSE HOLDERS

.1 Fuses shall be a 10 amp ferrule type to suit fuse holder.

.2 Fuse holders to be inline type with 2 ‘L’ type rubber insulating boots.

10.36 GROUNDING ELECTRODES

.1 Grounding electrodes shall be ground rods or ground plates that conform to the Canadian Electrical Code.

.2 Grounding electrodes shall be fabricated from hot dipped galvanized steel.

.3 Ground rods shall have a hot forged point.

10.37 PEDESTRIAN PUSHBUTTONS

.1 Pedestrian pushbuttons shall have an integral sign with a raised walk symbol.

.2 Pushbutton unit shall be white with black tactile actuation hand walking symbol and directional arrow. Pushbutton symbols and arrows shall be available in both left and right hand directions.

.3 Pushbutton housing shall be designed to mount against a flat surface and shall be supplied with a rubber gasket for a watertight seal to the pole.

.4 Pushbutton shall be ***actuated*** via a magnetic proximity switch. A 2200mm length of purple No. 14 RW90 stranded copper conductor shall be supplied soldered to each switch terminal. Contacts shall be hermetically sealed.

.5 Extend sidewalk to pushbutton (wheelchair accessible).

10.38 RECEPTACLES

.1 Receptacles shall be 15A-120V GFI corrosion resistant spec grade duplex mounted in cast F.S. box.

.2 Covers shall be equipped with spec grade in use covers and be rated for wet location as per Canadian Electrical Code requirements.

10.39 LUMINAIRES

.1 Roadway and sign luminaires shall be manufactured in accordance with the Ministry of Transportation and Highways Material Standards.

.2 Post top luminaires shall be:

(a) IES type 2 or type 3 distribution;
(b) Cast aluminum with a glass or polycarbonate refractor;
(c) Vandal resistant;
(d) Equipped with a knockout for photocell where required; and
(e) Powder paint finish.

10.40 SERVICE PANELS

.1 Service panels should be as follows:

(a) 60A – 120/240V street lighting.
(b) 100A – 120/240V street lighting and traffic signal.

.2 Service wiring shall contain equipment show on Standard Drawing No. E-10.3 to Standard Drawing No. E-10.4.

.3 Service panel enclosures shall be stainless steel or powder coated aluminum and shall be waterproof with an EEMAC 3 rating.

.4 Service panels shall be designed for long lift and easy maintenance.

10.41 POST MOUNTED FLASHER LUMINAIRES

.1 Post mounted flasher luminaires shall be manufactured in accordance with the Ministry of Transportation and Infrastructure material standards as per the Electrical and Traffic Engineering Manual.

10.42 PHOTOCELL AND RECEPTACLE

.1 Photocells shall be manufactured in accordance with the Ministry of Transportation and Infrastructure material standards as per the Electrical and Traffic Engineering Manual.

10.43 –NOT USED-

10.44 NUTS, BOLTS AND WASHERS

.1 Nuts, bolts and washers 3/8” Ø or smaller shall be type 18-8 or 316 stainless steel hex head.

.2 Nuts, bolts and washers larger than 3/8” Ø shall be as follows:

(a) Nuts to be galvanized SAE grade 2 heavy hex.
(b) Bolts to be galvanized SAE grade 5.
(c) Washers to be galvanized.

.3 Screws shall be stainless steel Robertson No. 10.

10.45 COLD GALVANIZING COMPOUND

.1 Cold galvanizing compound shall be spray type and shall contain a minimum of 93% zinc in the finished film.

10.46 –NOT USED-

10.47 TRAFFIC CONTROLLERS

.1 Traffic controllers shall be designed to operate signalized intersections.

.2 Traffic Controller Unit (CU) and assembly shall be Type-1 as per *National Electrical Manufacturers Association (NEMA) Standards Publication No. TS-2.* CU and assembly shall be capable of a minimum 12 fully-actuated phases, and siren pre-emption in all directions.

.3 Malfunction Management Unit (MMU) shall be TS2-Type16 and shall be configured for the required signal phasing.

.4 The controller cabinet shall be base mount, size 6, made of sheet aluminum in accordance with *Section 7 of NEMA Standards Publication No. TS2-1992, “Traffic Controller Assemblies.”* The controller cabinet shall be supplied complete with all mounting hardware and shall be fully wired for the required signal phasing. Cabinets shall be equipped with a GFI receptacle, a heater, a fan, thermostat controls, a light and a 40A-1P breaker for the power supply feeders. Cabinets shall be primed and finished inside and out with a finish coat of a polyester back enamel paint, Munsel 70 in color. A durable waterproof document pouch shall be located on the cabinet door, containing as built cabinet wiring diagrams and user manuals for the controller and all auxiliary equipment. The cabinet shall be equipped with a police door with key lock access for the following switches:

- Signals on/off switch.
- Flash/automatic switch.
- Manual/automatic switch.
- Extendible police cord to 2 metres.

.5 All auxiliary devices such as Bus Interface Units (BIU's), Cabinet Power Supply, load switches, flash switches, shall be *NEMA TS-2 Standard.* Detector modules shall be rack mount type.

.6 All traffic signal controller assemblies shall be shop tested prior to delivery and come with a minimum two year warranty on all parts and labor.

.7 The traffic controller manufacturer shall enter all signal timings. In addition the manufacturer shall have technician on site to check all field wiring connections and put the controller into operation during the signal start-up.

.8 The controller cabinet shall include a UPS system to power the cabinet and all signals and be equipped with sufficient batteries for 6 hours of run time.

10.48 SIREN PRE-EMPTION SYSTEM

.1 Siren pre-emption systems shall be designed to provide exclusive right of way for police, fire, or ambulance vehicles in lieu of the regular sequence of phrases. Siren detectors mounted on the signal pole arms shall detect the sound of the siren send a signal to the traffic controller through a hard wire connection. Lights on digital detectors indicate direction of pre-emption to the drivers.

.2 A siren pre-emption system shall consist of sound-based detectors with indication lights, shielded cables and rack mount interface cards. Refer to Standard Drawing No. E-6.6.

.3 Sound-based detectors shall be supplied with suitable hardware to mount on signal pole arms.

.4 Rack mount interface cards shall be installed inside the traffic controller cabinet.

10.60 CONTRACTOR QUALIFICATIONS

.1 All electrical work to be performed by Registered Electrical and Inspection Contractor under provisions of *British Columbia Safety Standards Act.*

10.61 PERMITS

.1 The Contractor shall obtain and pay for all permits, arrange for electrical inspections covering all work, pay all other fees and charges, and make all deposits that are in any way connected with the installation. The Contractor shall give all necessary notices to authorities having jurisdiction and shall be responsible for complying with all applicable public ordinances.

10.62 CODES AND REGULATIONS

.1 Electrical work shall conform to the latest edition of Canadian Electrical Code. In addition, any bulletins published by the Ministry of Natural Gas Development, Building and Safety Standards Branch, shall also apply.

.2 All work shall conform to all applicable regulations of WorkSafeBC and if required, a Notice of Project Form 52E49 must be submitted prior to commencing construction. The Contractor shall ensure compliance with the following sections:

(a) WorkSafeBC form 30M33 must be completed prior to working in the vicinity of overhead power lines.
(b) Notice of construction projects, WorkSafeBC Industrial Health and Safety Regulations, Section 34.16(3).

10.63 CERTIFICATE OF INSPECTION

.1 Prior to requesting final inspection the Contractor shall submit to the Engineer the Certificate of Inspection signed by the local Safety Officer of the British Columbia Safety Authority.

10.64 ELECTRICAL POWER SUPPLY

.1 Power shall be supplied from the BC Hydro secondary distribution system at location(s) shown on the Drawings.

.2 Prior to construction the Contractor shall confirm the exact service location(s) with BC Hydro.

.3 The Contractor shall arrange with BC Hydro for connection and disconnection of service, through BC Hydro Street Light Information Management System (SLIM) online at https://app.bchydro.com/ex/streetlight/. For sample forms of SLIM, refer to Appendix J. All connections and disconnections to be made by BC Hydro.

10.65 TRENCH EXCAVATION, BEDDING AND BACKFILL

.1 Refer to Section 4.0 – Trench Excavating, Bedding and Backfill for installation requirements.

.2 Backfill in accordance with Section 4.19 – Backfill and Compaction.

.3 Where soil conditions and/or foundations are unstable, the Contractor shall notify the Engineer in order that a special pole base design change can be considered.

10.66 CONCRETE BASES

.1 Concrete bases shall be installed as shown on Standard Drawing No. E-1.1 to Standard Drawing No. E-1.14 and Standard Drawing No. E-2.1 to Standard Drawing E-2.3.

.2 Minimize disturbance to surrounding soil when excavating.

.3 Concrete base installation tolerances to be as follows:

(a) Horizontal location to be within 150mm of specified.
(b) Vertical elevation to be within 10mm or specified.
(c) Top surface variation from level shall not exceed 3mm.
(d) Top of base shall be a minimum of 25mm proud of surrounding grade. The standard dimensions from grade to the top of base are shown in the Standard Drawings.

.4 Where poured in place are proposed the Contractor shall provide details of how they plan to carry out the work. In all cases wooden formwork shall be removed prior to poured in place backfilling bases. Where form tube foundations have been utilized, round tube forms may be buried.

.5 Concrete bases shall have a compressive strength of 30MPa and all backfill shall be fully compacted prior to pole installation.

.6 No concrete base shall be installed closer than 3m from a fire hydrant.

10.67 JUNCTION BOXES

.1 Install junction boxes in accordance with the Standard Drawings No. E-3.1 through to Standard Drawing No. E-3.4.

.2 Only concrete junction boxes shall be installed in driveways or other surfaces with low speed vehicle traffic.

.3 Custom concrete junction boxes shall only be installed where indicated on the Contract Drawings.

10.68 CONDUITS

.1 Underground conduits shall be installed in an open trench as shown on Standard Drawing No. E-4.1 and Standard Drawing No. E-4.2 unless otherwise noted on the Contract Drawings.

.2 Minimum cover over conduits shall be 600mm, except that cover for street light conduits placed under concrete sidewalk may be reduced to 300mm.

.3 Where indicated on the Contract Drawings conduits to be installed through a hole drilled under the pavement. Drilling equipment to be fully directional.

.4 Empty conduits shall be provided with a nylon pull string and capped.

.5 Conduits laid near other underground infrastructure shall maintain the required minimum clearances.

.6 Crossing over of conduits shall be kept to a minimum.

.7 Where conduits are stubbed and capped for future connection, the contractor shall install an iron stake below grade to mark the location.

10.69 TRENCH MARKER TAPE

.1 Trench marker tape shall be installed above and directly over the conduit as shown on Standard Drawing No. E-4.1 and Standard Drawing No. E-4.2.

10.70 POLES

.1 Install poles and related equipment as shown on the Standard Drawings.

.2 Poles shall be erected plumb.

.3 Where minimum pole to powerline clearances as shown on Standard Drawing No. E-5.20 cannot be maintained, advise the Engineer and defer further work pending instruction.

.4 Take all precautions necessary to ensure adequate protection of existing works and personnel during installation of poles.

.5 Install davit pole arms at right angles to the street centerline unless otherwise noted on the Contract Drawings.

.6 Confirm pushbutton and signal head locations prior to drilling and assembling poles.

.7 Field drilling of holes larger than 33mm diameter is not allowed in type 1, 3, 6, 7, & L shafts, and all arms and extensions. Where larger holes are required, they shall be reinforced with a welded bushing prior to galvanizing.

.8 All poles and related hardware to be handled with care to prevent stress to components through bending or twisting. Use nylon slings to transport and erect components. Use of steel chains as slings are not permitted. The Contractor shall repair or replace any damage to the components through overstress, scratching or denting to the satisfaction of the Engineer.

.9 Tighten all nuts and bolts to 1/3 past snug tight. "Snug-tight" is tightness attained by a few impacts of an impact wrench or full effort of a person using a spud wrench.

.10 All scratches in poles and field drilled holes shall be coated with 2 coats of cold galvanizing compound.

.11 Prior to the installation of luminaires, submit authorization form to the City to coordinate the installation of locking handhole covers. Once the streetlighting installation is complete, provide the City with 72 hours notice for the City to install the locking handhole covers. Refer to detail on Standard Drawing E-5.19.

.12 Poles shall be cleaned after erection.

10.71 <u>TRAFFIC AND PEDESTRIAN SIGNAL HEADS</u>

.1 Install traffic and pedestrian signal heads as shown on Standard Drawing No. E-6.1 to Standard Drawing No. E-6.5.

.2 Securely attach traffic and pedestrian signal heads and mounting hardware to the pole.

.3 Confirm final traffic and pedestrian signal head aiming on site with Engineer.

.4 Completely cover all traffic and pedestrian signal heads with burlap sacking from the time they are installed until system startup.

10.72 <u>AUDIBLE SIGNALS</u>

.1 Install audible signals as shown on Standard Drawing No. E-7.1.

.2 Aim, tune and adjust audible signal as per manufacturer's instructions.

.3 Wire each audible pedestrian signal through the pole and connect into the pedestrian signal head which controls the audible signal.

.4 Audible tones and decibel levels should meet the recommended tones as outlined in the Canadian National Institute for the Blind – CNIB Position for Accessible Pedestrian Signals in Canada.

10.73 <u>PEDESTRIAN PUSHBUTTONS</u>

.1 Install pedestrian pushbuttons as shown on Standard Drawing No. E-8.1.

.2 Securely attach pedestrian pushbuttons and signs to the pole.

.3 Completely cover pushbutton signs with burlap sacking from time they are installed until system startup.

.4 Extend sidewalk to pushbutton (wheelchair accessible).

10.74 LUMINAIRES AND PHOTOCELLS

.1 Install luminaires and photocells in accordance with manufacturer's instructions.

.2 Luminaires shall be cleaned after pole erection and plumbing is complete.

.3 Securely attach the luminaire to the pole.

.4 Cobra head luminaires shall be installed such that the bottom face is parallel to the road surface. The head shall be rotated to match the roadway grade.

.5 Aim photocells north.

10.75 MEDIAN SIGNAGE AND POST MOUNTED FLASHERS

.1 Install median signage in accordance with the Ministry of Transportation and Infrastructure material standards as per the Electrical and Traffic Engineering Manual.

.2 Install post mounted flashers in accordance with the Ministry of Transportation and Infrastructure material standards as per the Electrical and Traffic Engineering Manual.

10.76 UNDERGROUND DIP SERVICE

.1 Install underground dip service as shown on Standard Drawing No. E-9.1.

10.77 SERVICE PANELS

.1 Service panels for street lighting shall be mounted in a service base Service panels for intersections may be mounted on the side of the cabinet.

.2 Wiring shall be in accordance with the Standard Drawing No. E-10.3 to Standard Drawing No. E-10. 5.

.3 Service panels and the electrical equipment inside shall be protected against the entrance of dust, dirt, moisture, and mechanical damage during construction.

.4 Unused opening in the sheet steel panels shall be plugged with suitable corrosion resistant plugs.

.5 Securely attach service panels inside the service base or on the side of the controller.

10.78 WIRING

.1 Before pulling conductors through the conduit, the conduit shall be blown out with compressed air from both ends and then swabbed out to remove all stones, dirt, water and other foreign material from the conduit.

.2 No conductor shall be drawn into any raceway until all work of any nature that may cause damage to the conductor or its insulation has been completed. During pulling, the conductors shall be fed carefully into the raceway to prevent stretching, twisting, kinking or looping. Only talc or other CSA approved lubricants shall be used to assist in the pulling operations. Grease type lubricants shall not be permitted.

.3 Wiring to conform to requirement of the Canadian Electrical Code.

.4 Wiring shall be installed in pole handholes as shown on Standard Drawing No. E-12.1 and Standard Drawing No. E-12.2.

.5 With exception of detector loop conductor to shielded cable splices, all conductor splices shall be made in pole handholes. Splices of detector loop conductor to shielded cable shall be made in junction boxes. See Standard Drawing No. E-14.4 for detector loop splice details.

.6 Signal cable colour coding shall be as shown on the Contract Drawings.

.7 Shielded cables shall run with no splices from controller to the respective loop or device.

.8 Single conductor sizes and colours shall be as shown on the Contract Drawings.

.9 With the exception of detector loop cables, bundle and label conductors in junction boxes with tags specified in Section 10.34 – Conductor Tags, *clause 10.34.2*. Labels shall be as follows:

(a) Street Lighting – STLTG.
(b) Photocell – PEC.
(c) Controller Power – CONT PWR.
(d) Signal Cable – SIGNAL CABLE No. 1, No. 2, ETC.
(e) Post Mounted Flasher – FLASH.
(f) Advance Warning Sign – AWS1, AWS2, ETC.

.10 Label individual conductors in controllers and pole handholes with sleeve type markers as specified in Section 10.34 – Conductor Tags, *clause 10.34.1.* Labels shall be as follows:

(a) Street Lighting – STLTG.
(b) Photocell – PEC.
(c) Controller Power – CONT PWR.
(d) Signal Phase – 2R, 2Y, 2G, 2N (where ‘2’ indicates the Signal Phase and ‘R’ indicates Red, ‘Y’ indicates Yellow, ‘G’ indicates Green and ‘N’ indicates Neutral).
(e) Pedestrian Phase – P2W, P2DW, P2N (where ‘P2’ indications the Pedestrian Phase, ‘W’ indicates Walk, ‘DW’ indicates Don’t Walk and ‘N’ indicates Neutral).

(f) Detector Loop – L1, L2, ETC.
(g) Post Mounted Flasher – FLASH
(h) Advance Warning Sign – AWS1, AWS2, ETC.

.11 Wire each traffic signal and pedestrian signal head separately from base to pole. Run a separate neutral and bonding conductor from base of pole to each signal head or luminaire.

.12 Neatly arrange, bundle and ty-rap wiring in the traffic controller, junction boxes, vaults, pole handholes and service panels to the satisfaction of the Engineer.

.13 Secure conductor splices with the exception of detector loop to shielded cable with solderless type connectors. Where the number and/or size of conductors exceeds the capacity of the solderless connector use the split bolt connectors.

.14 Sealing of connections, with exception of detector loop to shielded cable splices, shall be performed using one of the following methods:

(a) Double dipping the connection in an approved liquid product as referenced in the City of Nanaimo's Approved Products List. Dipping shall be performed strictly adhering to the Manufacturer's specification.
(b) Each conductor shall have a wrap of the self-holding tape conforming to products listed in the City of Nanaimo's Approved Products List, then the complete splice shall be wrapped. PVC Tape shall then be applied to cover the complete splice.

.15 Seal detector loop to shielded cable splices in accordance with Standard Drawing No. E-14.4.

.16 If conductor connections require use of split bolts of similar style devices due to wire size, completely cover splice with tape then Duct Seal to form a ball over connection. Duct Seal shall be thick enough to prevent the sharp ends of the conductors and/or point of the connector from protruding through the taped connection. Once the Duct Seal has been applied, the splice shall be taped with self-holding and PVC tape.

.17 Bond all luminaires, signal heads, steel junction box lids and vault lids with a No. 12 Cu RW90 conductor.

.18 Bundle ty-rapped conductors every 75mm and route neatly inside the controller. Tag the conductors at the terminal blocks. Wiring inside of controller shall generally consist of:

(a) Connection of the traffic controller power to the terminals supplied.
(b) Connection of all the traffic and pedestrian phases to the terminals supplied.
(c) Connection of the detector loops to the terminal supplied.
(d) Connection of the bond conductor.

.19 Make connections in traffic controller with insulated spade type crimp-on connectors.

.20 Flash-out and check all signal and pedestrian heads at the terminal block in controller cabinet prior to system start-up.

10.79 TRAFFIC CONTROLLER

.1 Install the traffic controller as shown on the Standard Drawings.

.2 The type of traffic controller shall be indicated on the Contract Drawings.

10.80 POLE MOUNTED RECEPTACLES

.1 Pole mounted receptacles shall be installed as shown on Standard Drawing No. E-13.1.

.2 Receptacles shall be installed to the elevation and orientation shown on the Contract Drawings.

10.81 DETECTOR LOOPS

.1 Detector loops shall be installed in accordance with Standard Drawing No. E-14.1 to Standard Drawing No. E-14.7.

10.82 GROUNDING

.1 All grounding shall conform to the Canadian Electrical Code and latest Electrical Safety Branch Amendments.

.2 Connect all ground rods, plates, conductors, and galvanized steel conduits together. Connect only one wire to any one ground bushing.

.3 Bond rigid steel conduits.

10.83 COLD GALVANIZING COMPOUND

.1 Repair damage to the galvanized surfaces with cold galvanizing compound. Application of cold galvanizing compound shall conform to manufacturer’s instructions and the following:

(a) Surface to be mechanically cleaned with a wire brush or grinder and chemically cleaned to remove all welding flux, paint, grease, oil, rust, scale or other detrimental foreign matter.
(b) Surface shall be absolutely dry and ambient temperature shall be over 10°C.
(c) Apply uniform coats as thick as possible without causing runs on the finished surface.

10.84 OVERHEAD SIGNS

.1 Overhead street name signs mounted on signal poles shall be bolted to the arms in accordance with Standard Drawing No. E-15.1.

.2 Overhead regulatory and warning signs 750 mm X 750 mm or smaller shall be mounted on signal poles in accordance with Standard Drawing No. E-15.2 to Standard Drawing No. E-15.4.

.3 Extruded aluminum signs 1220 mm(H) X 2440 mm(W) such as advance warning signs or guide signs shall be mounted on sign poles in accordance with Standard Drawing No. E-15.5 to Standard Drawing No. E-15.14.

.4 Signs shall be securely attached to the pole.

.5 Temporary signs shall be plywood, unless otherwise noted.

10.85 TESTING AND COMMISSIONING

.1 The Contractor shall carry out all adjustments and tests necessary to ensure that the entire electrical installation and all its equipment, material and components are in satisfactory physical condition and perform the intended function and operations. Any adjustments required to make the system operate in the manner intended by the Engineer shall be made by the Contractor.

.2 At the completion of the job, proper system operation shall be demonstrated to the Engineer and the City of Nanaimo.

.3 Traffic signal startup shall be carried out as follows:

(a) Upon completion of the installation, prior to start-up, the Contractor shall advise the Engineer and the City of Nanaimo to carry out their final inspection. After the final inspection is completed a written list of deficiencies will be sent to the contractor.
(b) All deficiencies noted during the final inspection shall be corrected to the satisfaction of the Engineer and the City of Nanaimo prior to signal start-up.
(c) After the deficiencies are corrected (prior to the signal start-up) the Contractor shall put the signal into flash for a period of seven (7) days.
(d) The Contractor shall provide the City with the proposed signal start-up date and time. Upon approval from the City, the Contractor shall advise the Engineer and the controller manufacturer a minimum of 72 hours in advance of the approved start-up date and time. Where a siren pre-emption system is installed, the Contractor shall arrange to have the manufacturer test the operation of their system prior to start-up. The fire chief shall all be present during the final testing of the siren pre-emption system.
(e) The controller manufacturer’s representative shall inspect all field wiring connections and controller operation on site prior to signal start-up.
(f) In the presence of the Engineer, the controller manufacturer and the City, the contractor shall put the signal into full operation.
(g) The Contractor shall supply all the necessary traffic control personnel required during the signal start-up. A minimum of 2 qualified flag persons are required.
(h) The signal start-up shall be done during non-peak traffic periods.

10.86 CLEANUP

.1 Any areas where work has been performed shall be restored to original condition, or better.

.2 Existing equipment designated as being removed shall be returned to the City of Nanaimo works yard or disposed off-site as noted on the Contract Drawings.

.3 The interior of enclosures, pole handholes and wiring areas shall be cleaned of dust, dirt and loose materials, vacuum-cleaned and all water and moisture removed.

.4 All fastening screw holes provided in enclosures shall have a fastening screw installed.

.5 Any spots where the galvanizing is damaged due to drilling, tapping, reaming, welding or surface damage during transportation and erection shall be refinished with cold galvanizing compound in accordance with Section 10.83 – Cold Galvanizing Compound.

BASE INDEX		
TYPE	DRAWING	POLE TYPES
A	E-1.2	TYPE 4 SIGNAL POST
B	E-1.2	TYPE 4A & 5 SIGNAL POST & 4.5m TO 7.5m POST TOP LUMINAIRE POLES
C	E-1.3 & E-1.4	7.5m, 9.0m & 11.0m DAVIT LUMINAIRE POLES
C1	E-1.3 & E-1.4	6.6m, 8.1m & 10.1m LUMINAIRE POLES & 3.1m, 5.1m & 6.6m POST TOP LUMINAIRE ON 0.9m HIGH SERVICE BASE
E2	E-1.5 & E-1.6	TYPE 1 AND 3 SIGNAL POLES
F2	E-1.7 & E-1.8	TYPE 6 AND 7 SIGNAL POLES
L2	E-1.7 & E-1.8	TYPE L SIGNAL POLE

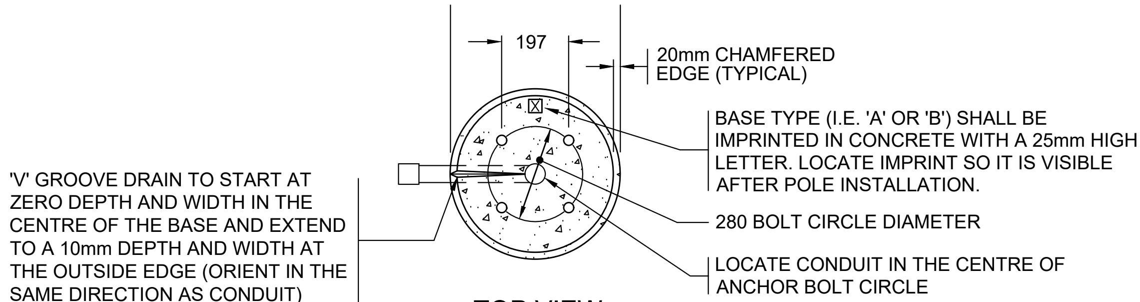
NOTES:

1. REFER TO SECTION 10 FOR SPECIFICATIONS

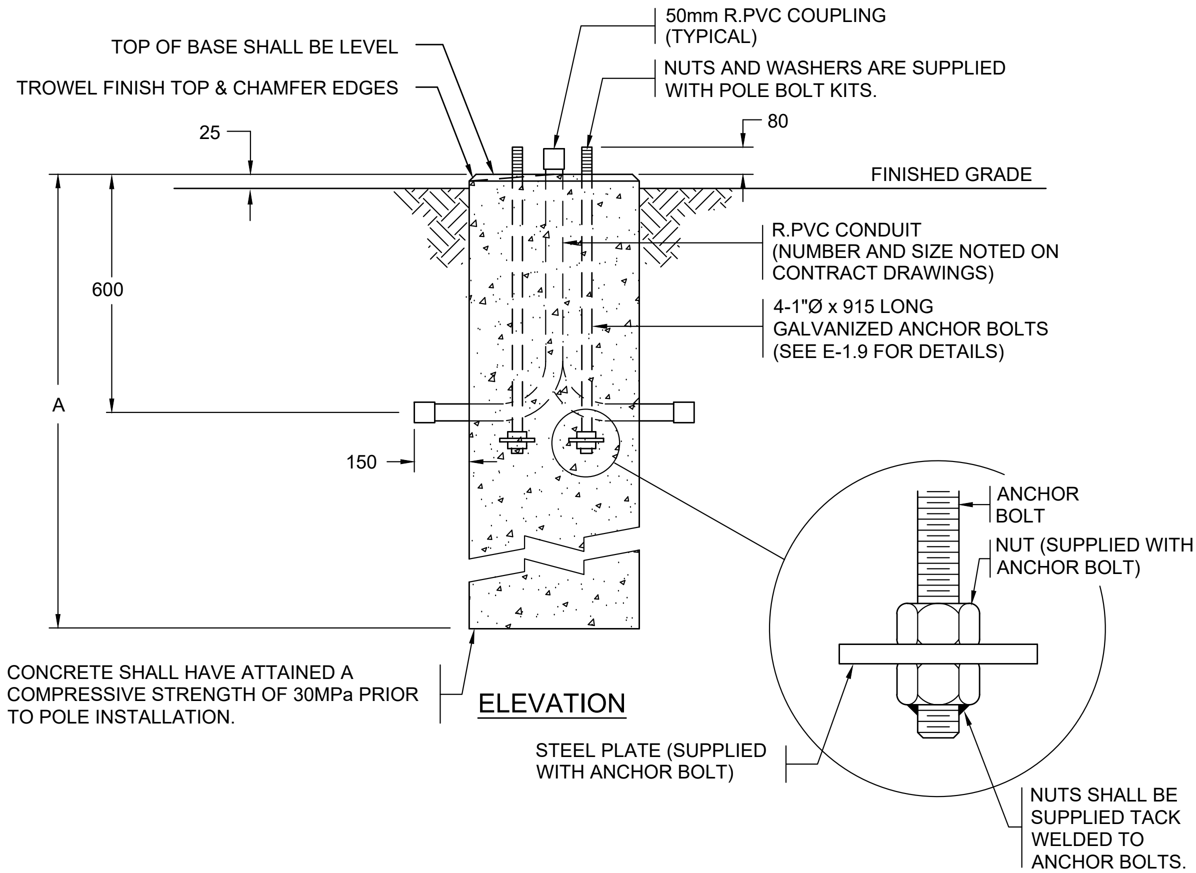
CITY OF NANAIMO
THE HARBOUR CITY

BASE INDEX

Scale: NTS
Created: MAY 2013
Rev Date: MAY 2020
Dwg No: E-1.1



TOP VIEW



ELEVATION

BASE TYPE	POLE TYPE	APPROXIMATE MASS	VOLUME OF CONCRETE	DIM A
A	TYPE 4 SIGNAL POST (2.5m)	600 kg	0.24 m3	1200
B	TYPE 4A SHAFTS & 4.5m TO 7.5m POST TOP LUMINAIRE POLES	760 kg	0.30 m3	1500

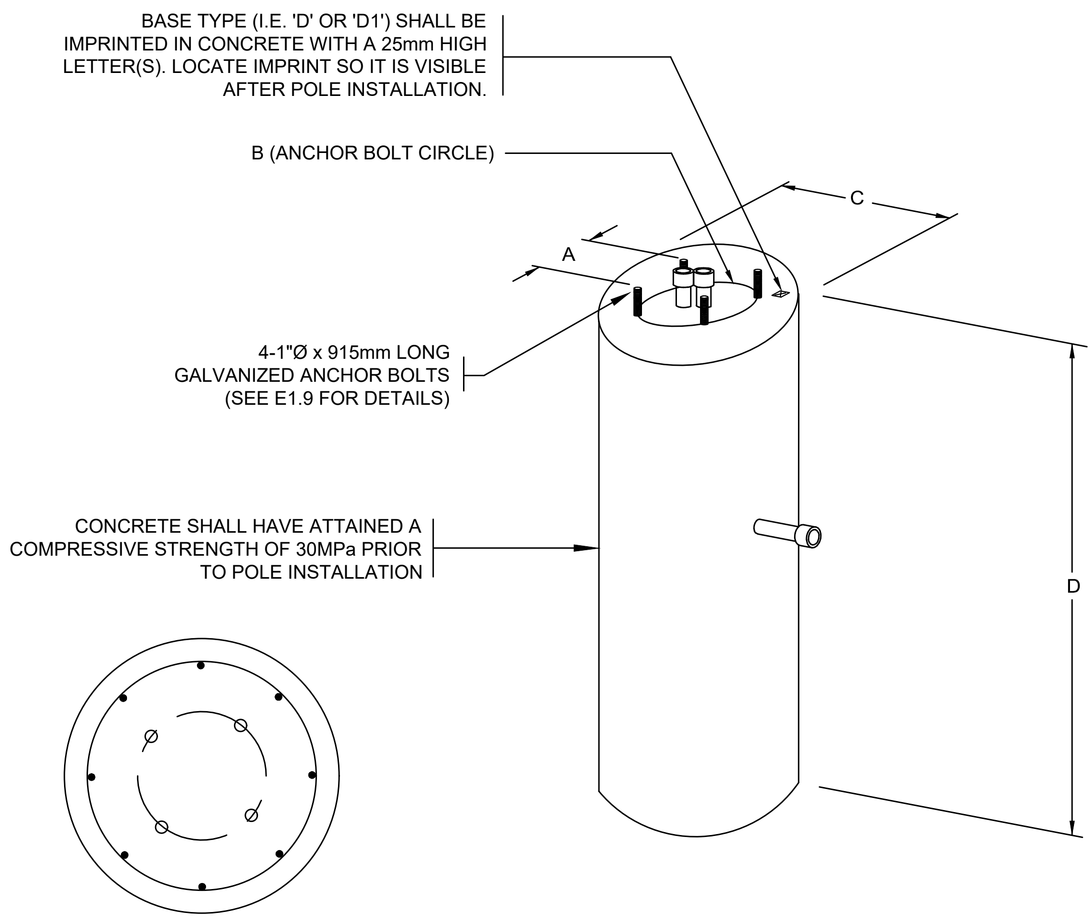
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. SEE DRAWINGS E-1.13 & E-1.14 FOR BACKFILL REQUIREMENTS.

CITY OF NANAIMO
THE HARBOUR CITY

TYPE A & B FORM TUBE CONCRETE BASES

Scale: NTS
Created: MAY 2006
Rev Date: MAY 2020
Dwg No: E-1.2



PRECAST OR CAST IN PLACE CONCRETE BASES

BASE TYPE	POLE TYPE	APPROXIMATE MASS	VOLUME OF CONCRETE	A	B	C	D	REINFORCING
D	7.5m, SINGLE LUMINAIRE	2000 kg	0.39m3	197	250	500	2200	6-15M VERTS 10M SPIRAL @ 150
D1	9.1m, DOUBLE LUMINAIRE	2000 kg	0.62m3	269	380	600	2200	8-15M VERTS 10M SPIRAL @ 150

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
3. SEE DRAWING E-1.4 FOR ADDITIONAL DETAILS.
4. SEE DRAWINGS E-1.13 & E-1.14 FOR BACKFILL REQUIREMENTS.
5. CLEAR COVER TO REINFORCING 50mm.

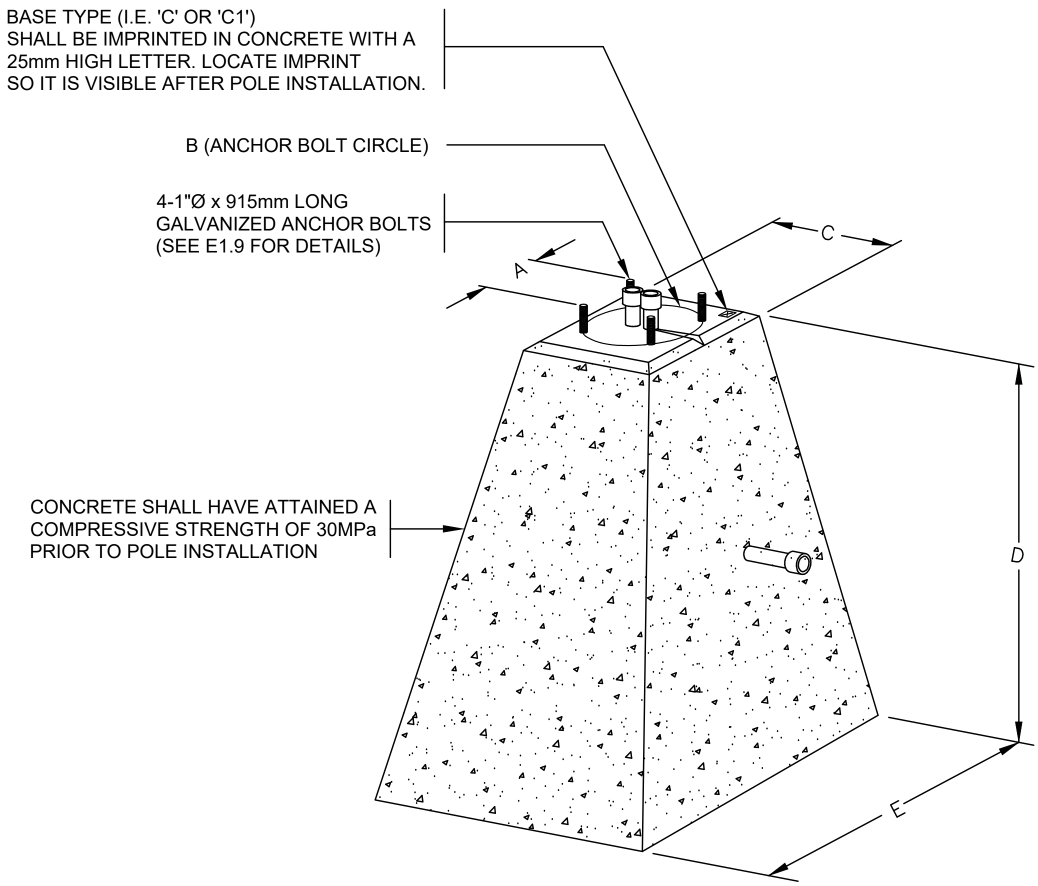
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 10 DWGS\E-1.2A

CITY OF NANAIMO
THE HARBOUR CITY

TYPE D & D1 FORM TUBE PRECAST OR CAST-IN-PLACE CONCRETE BASES

Scale:	NTS
Created:	NOV 2012
Rev Date:	MAY 2020
Dwg No:	E-1.2A

3.3.2020



PRECAST CONCRETE BASES

BASE TYPE	POLE TYPE	APPROXIMATE MASS	VOLUME OF CONCRETE	A	B	C	D	E
C	7.5m, 9.0m & 11.0m DAVIT LUMINAIRE POLES	2000 kg	0.83m3	197	280	450	1500	1000
C1	6.6m, 8.1m & 10.1m DAVIT LUMINAIRE & 3.1m, 5.1m & 6.6m POST TOP LUMINAIRE ON 0.9m HIGH SERVICE BASE	2000 kg	0.83m3	269	380	450	1500	1000

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. SEE DRAWING E-1.4 & E-1.4A FOR ADDITIONAL DETAILS.
4. SEE DRAWING E-1.4A & E-1.14 FOR BACKFILL REQUIREMENTS.

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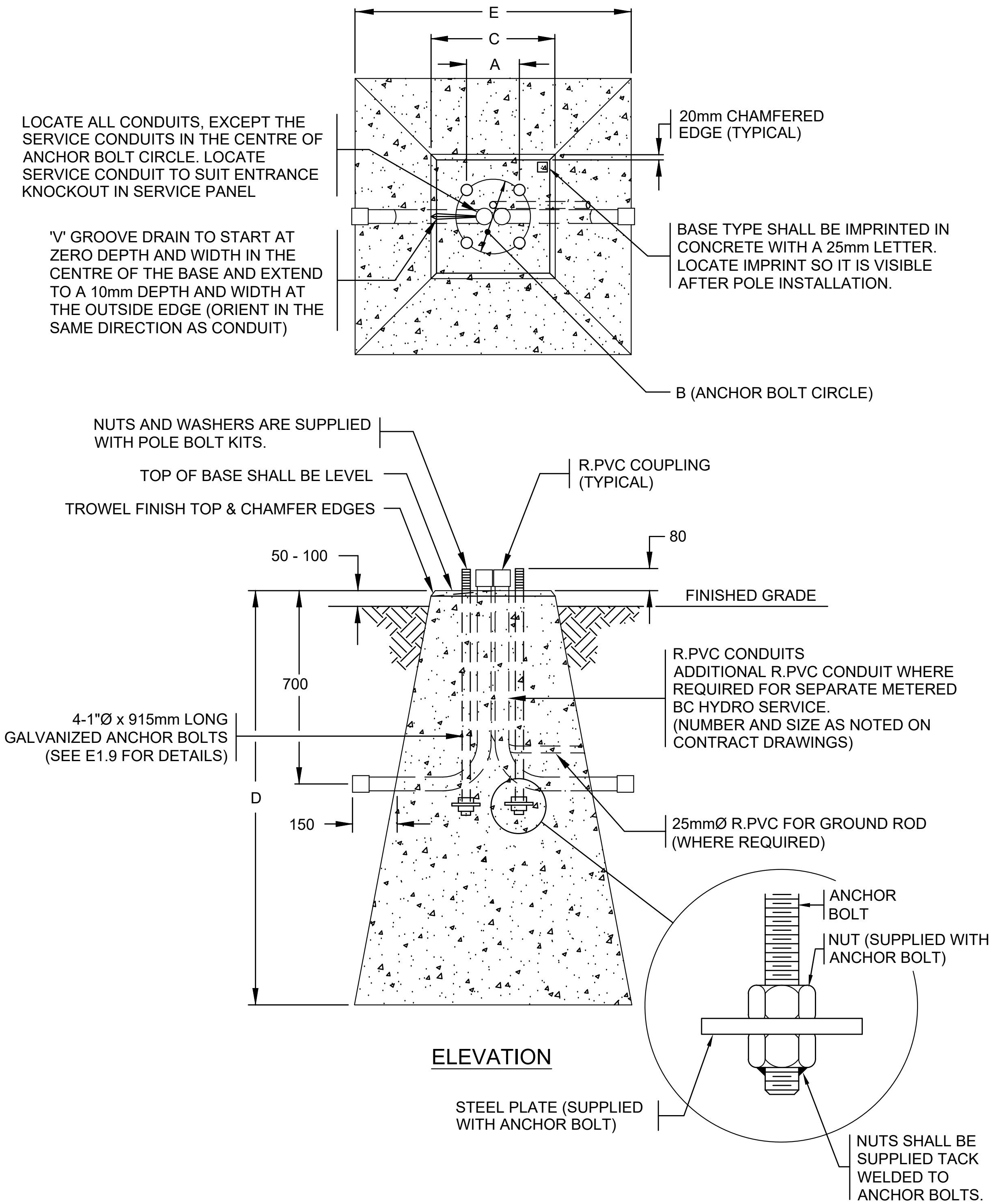
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

TYPE C & C1 TRAPEZOIDAL SHAPE CONCRETE BASES

Scale: NTS
Created: MAY 1999
Rev Date: NOV 2016
Dwg No: E-1.3

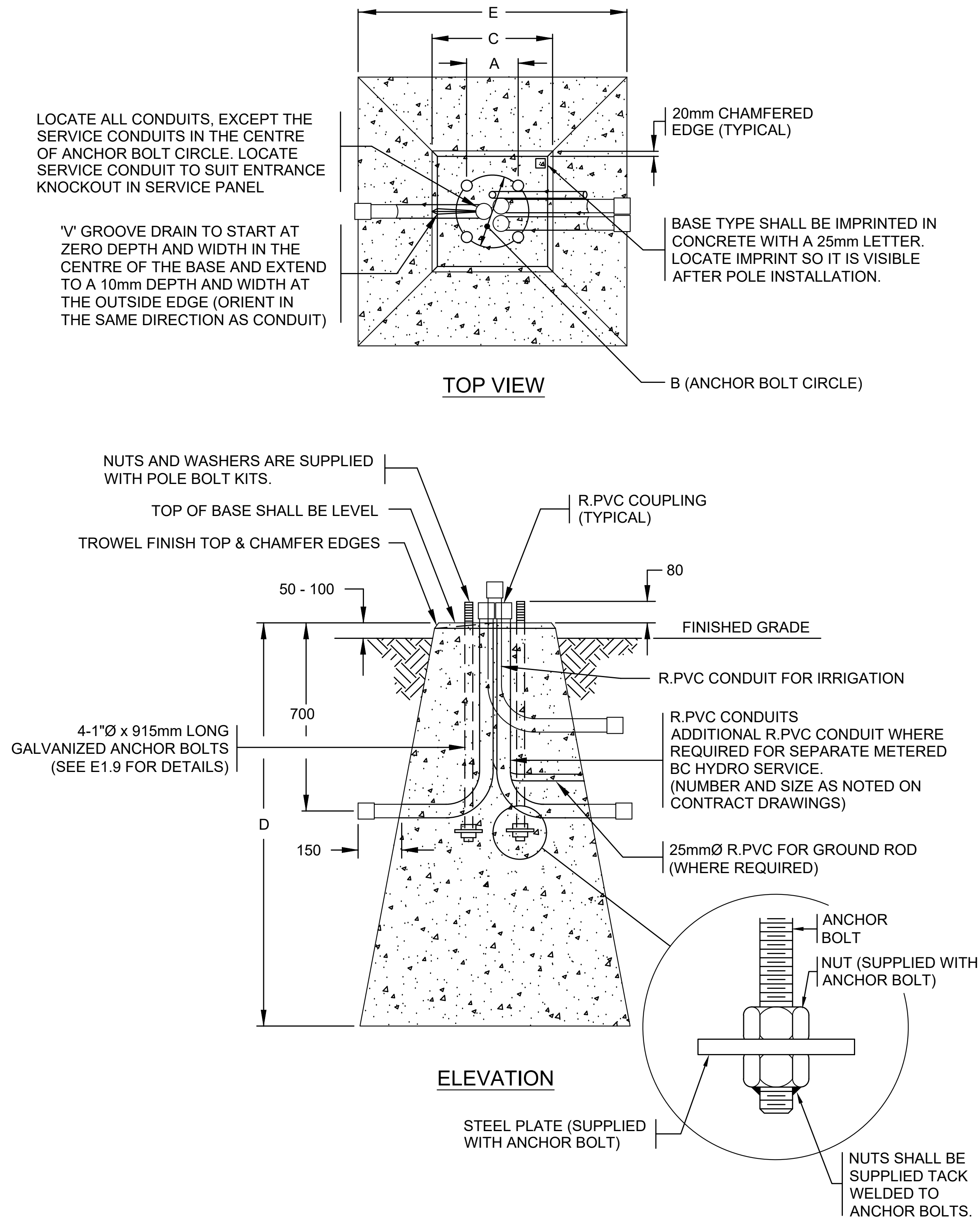


SEE DRAWING E-1.3 FOR NOTES AND ADDITIONAL DETAILS

CITY OF NANAIMO
THE HARBOUR CITY

TYPE C & C1 TRAPEZOIDAL SHAPE CONCRETE BASES

Scale:	NTS
Created:	JUN 2013
Rev Date:	NOV 2016
Dwg No:	E-1.4



SEE DRAWING E-1.3 FOR NOTES AND ADDITIONAL DETAILS

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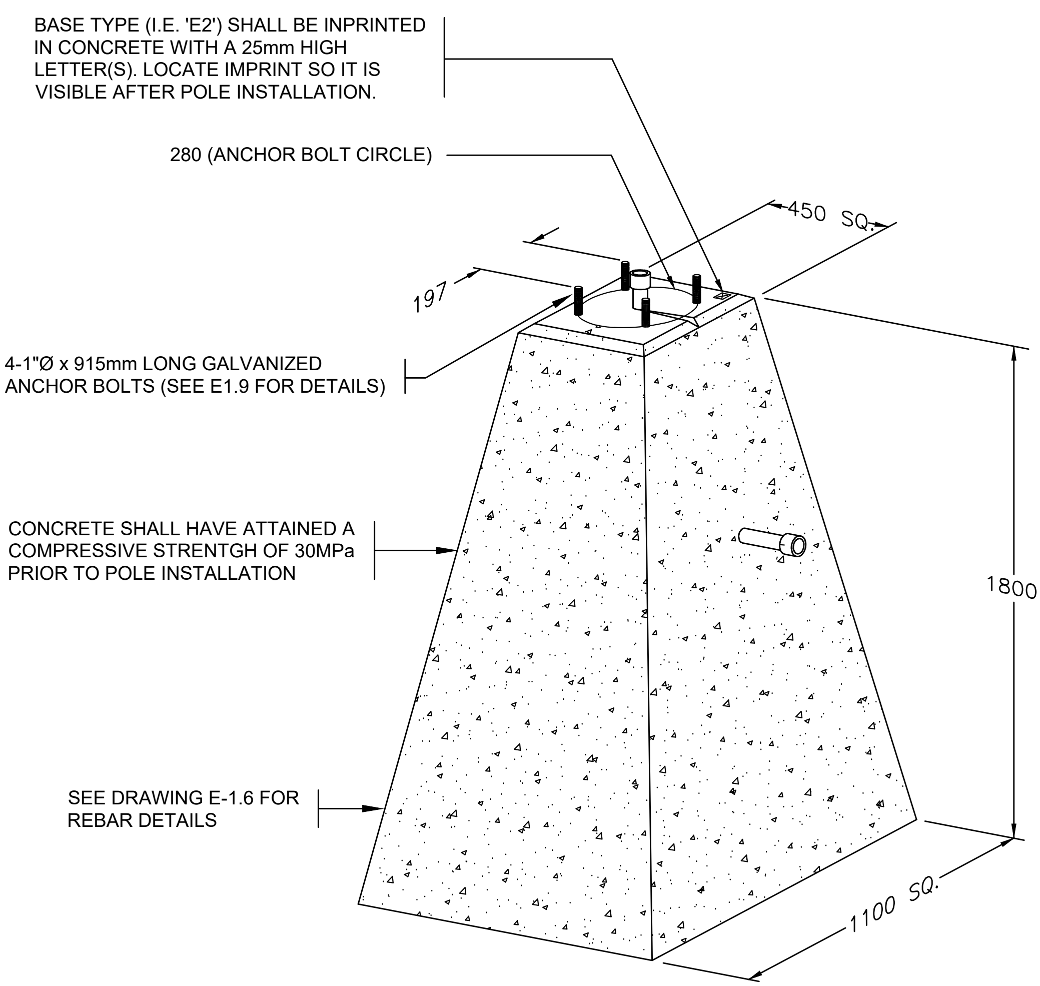
CITY OF NANAIMO
THE HARBOUR CITY

TYPE C & TYPE C1 TRAPEZOIDAL SHAPE CONCRETE BASES WITH IRRIGATION

Scale:	NTS
Created:	JUN 2013
Rev Date:	NOV 2019
Dwg No:	E-1.4A



PRECAST CONCRETE BASES

BASE TYPE	POLE TYPE	APPROXIMATE MASS	VOLUME OF CONCRETE
E2	TYPE 1 AND 3 SIGNAL POLES	2450 kg	1.0m^3

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. SEE DRAWING E-1.6 FOR ADDITIONAL DETAILS.
4. SEE DRAWINGS E-1.13 & E-1.14 FOR BACKFILL REQUIREMENTS.

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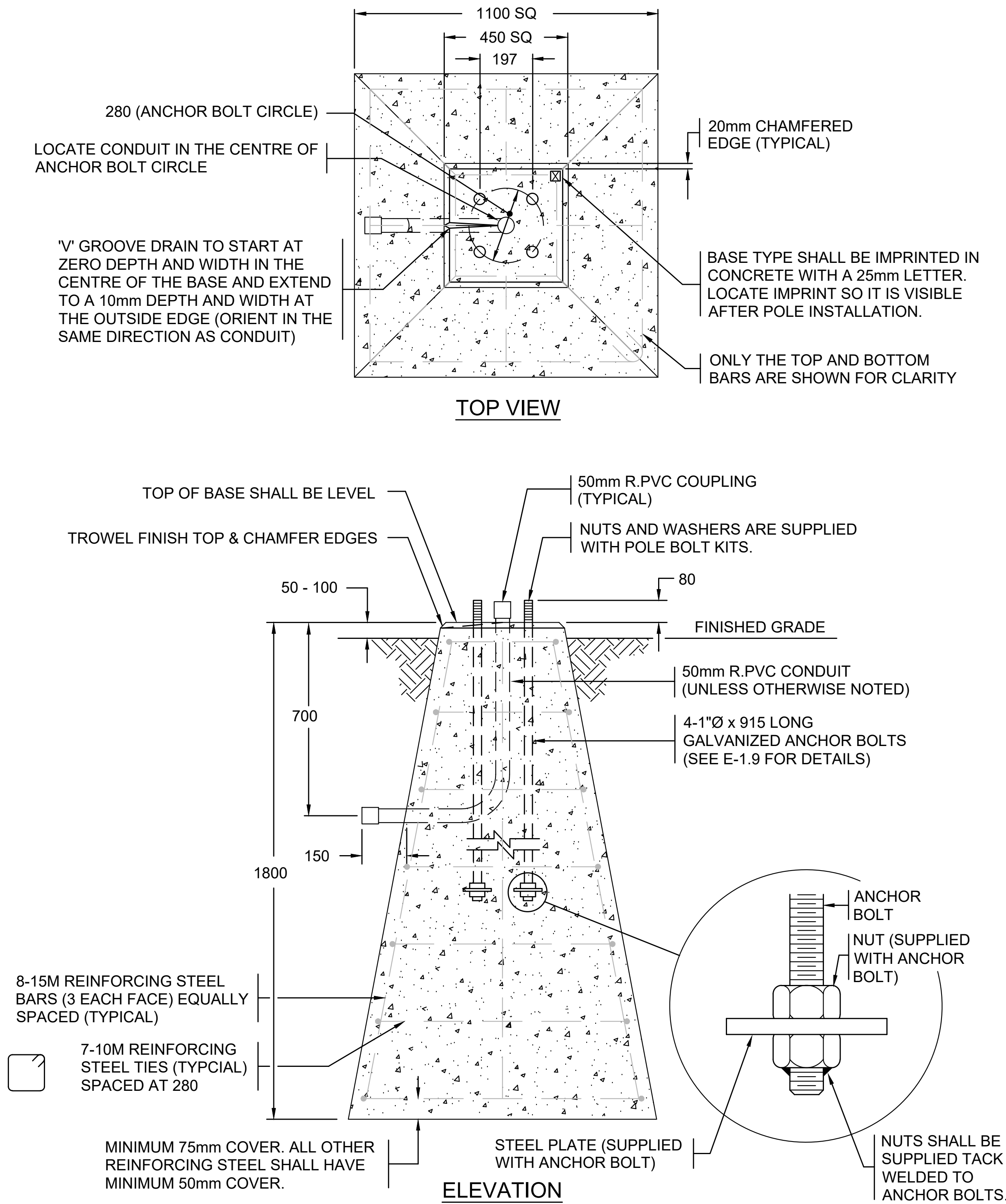
3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

TYPE E2 TRAPEZOIDAL SHAPE CONCRETE BASE

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-1.5



SEE DRAWING E-1.5 FOR NOTES AND ADDITIONAL DETAILS

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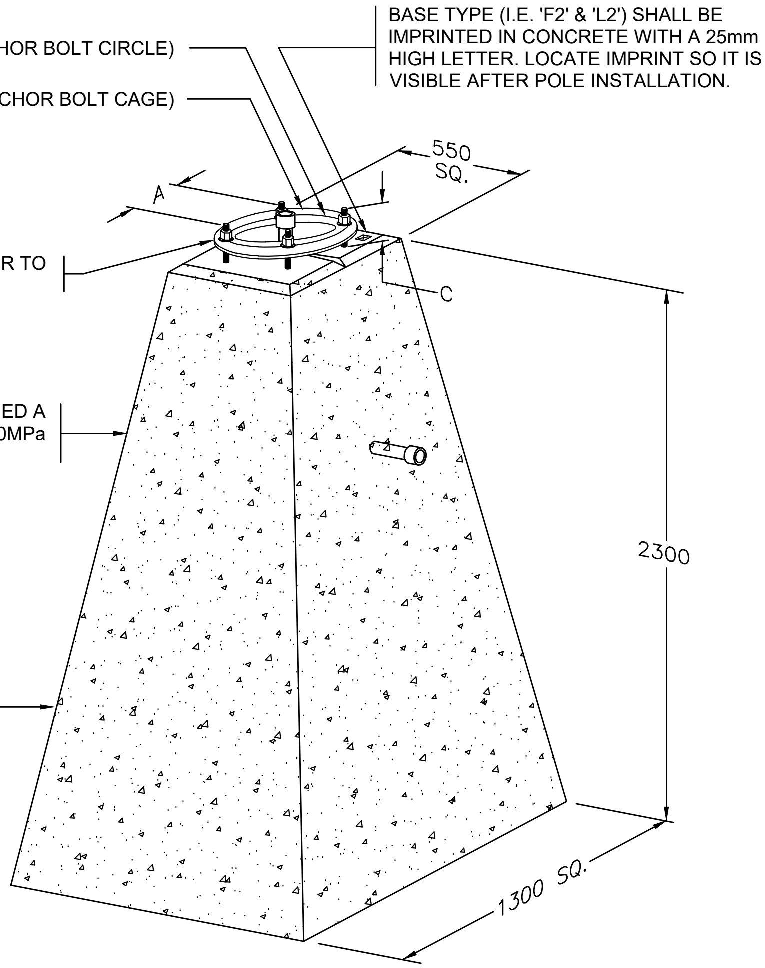
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

TYPE E2 TRAPEZOIDAL SHAPE CONCRETE BASE

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2016
Dwg No:	E-1.6



PRECAST CONCRETE BASES

BASE TYPE	POLE TYPE	APPROXIMATE MASS	VOLUME OF CONCRETE	A	B	C	D (ANCHOR BOLTS)
F2	TYPE 6 AND 7 SHAFTS	5000 kg	2.0 m3	243	343	160	4-1"Ø x 1220 GALVANIZED ANCHOR BOLTS PRE-ASSEMBLED IN A CAGE
L2	TYPE L POLES	5040 kg	2.0 m3	276	390	140	4-1 1/2"Ø x 1370 GALVANIZED ANCHOR BOLTS PRE-ASSEMBLED IN A CAGE

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. SEE DRAWING E-1.8 FOR ADDITIONAL DETAILS.
4. SEE DRAWINGS E-1.13 & E-1.14 FOR BACKFILL REQUIREMENTS.

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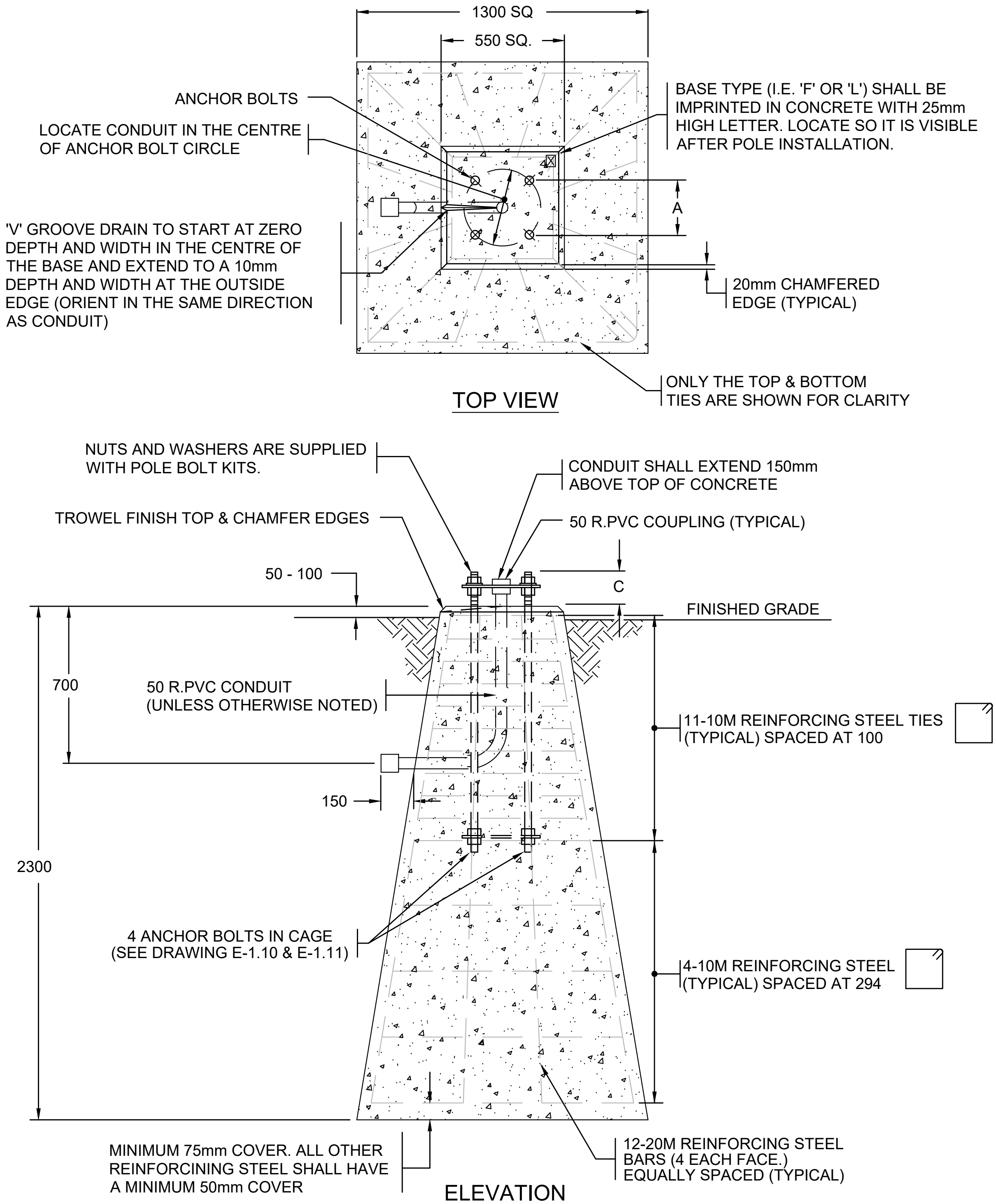
3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

TYPE F2 & L2 TRAPEZOIDAL SHAPE CONCRETE BASES

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-1.7



SEE DRAWING E-1.7 FOR NOTES AND ADDITIONAL DETAILS

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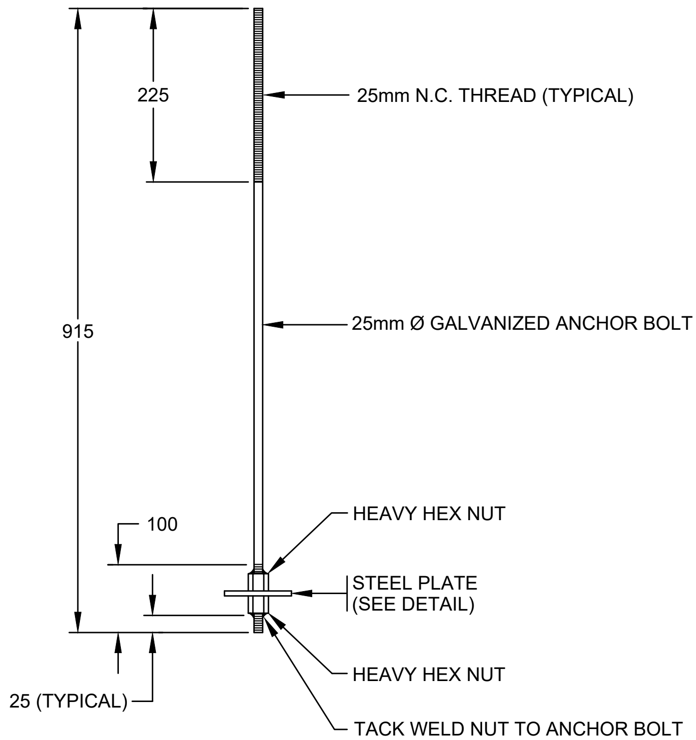
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

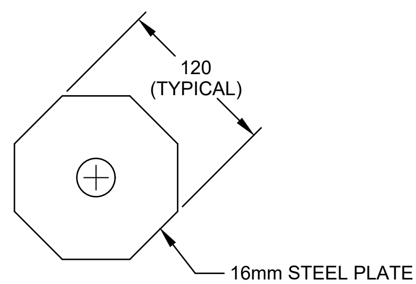
TYPE F2 & L2 TRAPEZOIDAL SHAPE CONCRETE BASES

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2016
Dwg No:	E-1.8



ANCHOR BOLT
4 PER SET

APPROXIMATE MASS (PER SET)
21 kg



STEEL PLATE

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

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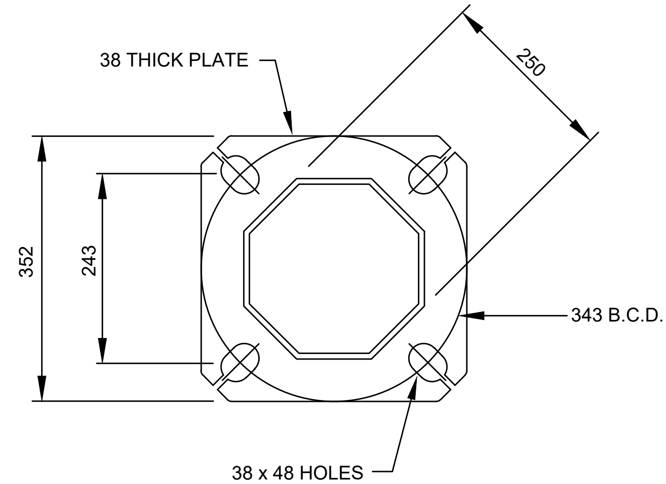
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

25mm DIAMETER ANCHOR BOLTS

Scale:	NTS
Created:	NOV 2009
Rev Date:	NOV 2009
Dwg No:	E-1.9



TYPE S POLE BASE PLATE

1:10

PARTS LIST FOR TYPE S SIGNAL POLE

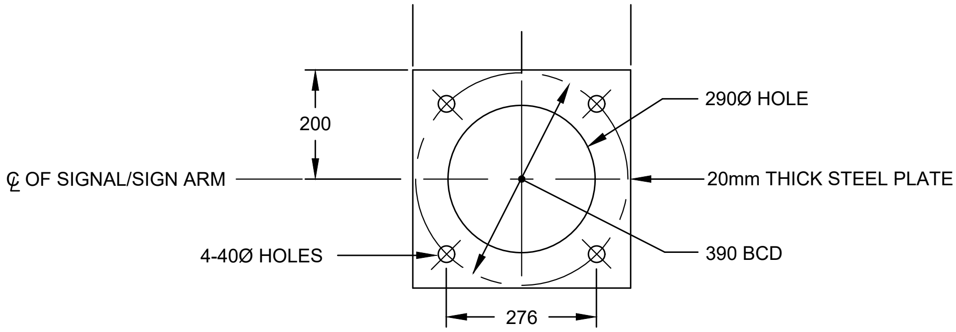
PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [S] POLE SHAFT	SN3152	385
TYPE [5S] SIGNAL ARM - 5.0m	SN3150	104
TYPE [5.5S] SIGNAL ARM - 5.5m	SN3155	111
TYPE [6S] SIGNAL ARM - 6.0m	SN3160	118
TYPE [6.5S] SIGNAL ARM - 6.5m	SN3165	125
TYPE [7S] SIGNAL ARM - 7.0m	SN3170	132
TYPE [7.5S] SIGNAL ARM - 7.5m	SN3175	192
TYPE [8S] SIGNAL ARM - 8.0m	SN3180	204
TYPE [8.5S] SIGNAL ARM - 8.5m	SN3185	214
TYPE [9S] SIGNAL ARM - 9.0m	SN3190	224
TYPE [9.5S] SIGNAL ARM - 9.5m	SN3195	292
TYPE [10S] SIGNAL ARM - 10.0m	SN3100	306
TYPE [10.5S] SIGNAL ARM - 10.5m	SN3105	320
TYPE [11S] SIGNAL ARM - 11.0m	SN3110	340
TYPE [1.75L] LUMINAIRE ARM EXTENSION - 1.75m	SN2063	29
TYPE [0.25L] LUMINAIRE ARM EXTENSION - 0.25m	SN2064	10
TYPE [2A] LUMINAIRE ARM	SN1832	35
TYPE 1 FLANGE COVER PLATE [1 FCP]	SN1367	1.5
TYPE S FLANGE COVER PLATE [S FCP]	SN1368	3
TYPE 3 FLANGE COVER PLATE [3 FCP]	SN2084	4
POST TOP TENON [PTT]	SN1831	5

* [ ] I.D. LABEL ON POLE

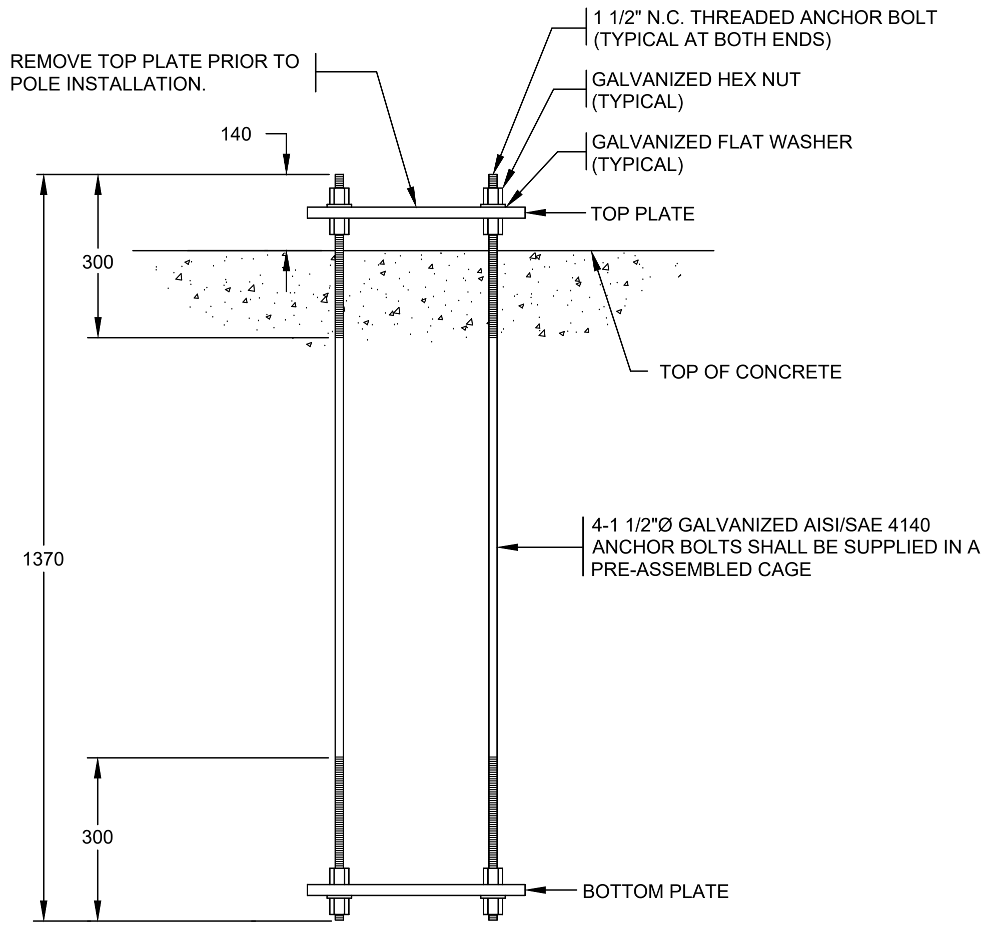
CITY OF NANAIMO
THE HARBOUR CITY

ANCHOR BOLT CAGE FOR TYPE S POLES

Scale: NTS
Created: JAN 1998
Rev Date: NOV 2016
Dwg No: E-1.10



TOP AND BOTTOM PLATES



ANCHOR BOLT CAGE

APPROXIMATE MASS
95 kg

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

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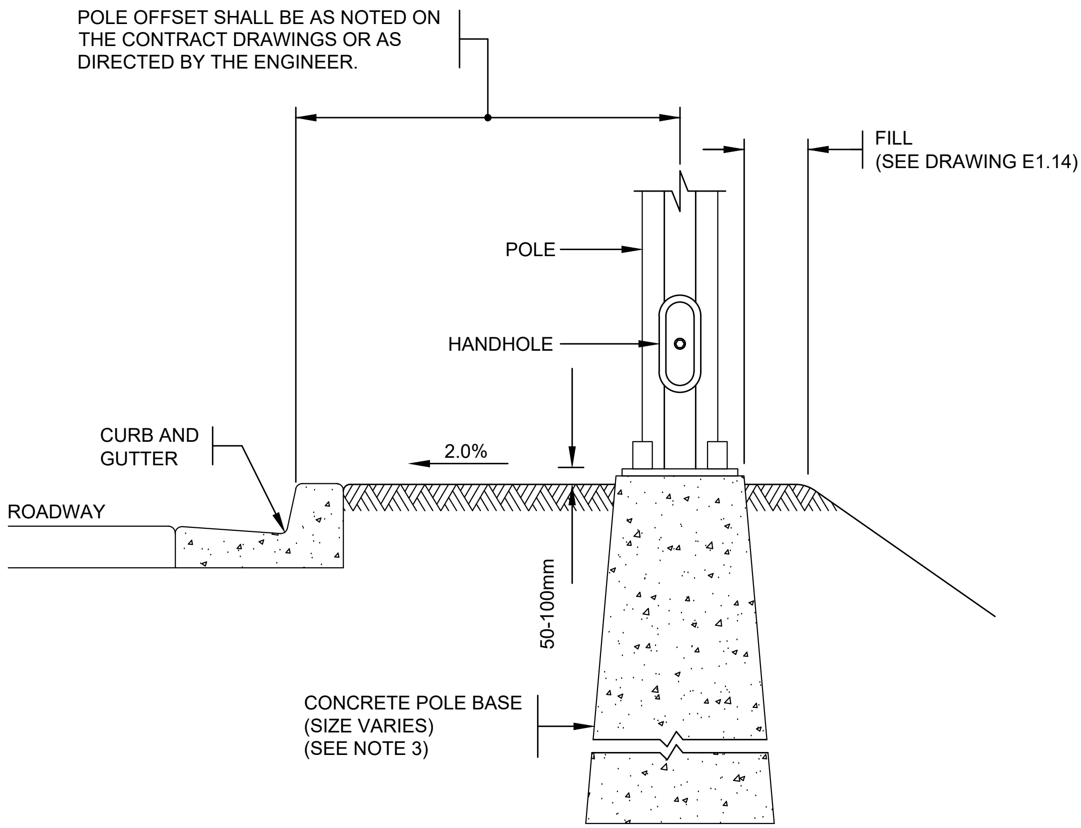
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

ANCHOR BOLT CAGE FOR TYPE L POLES

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-1.11



ELEVATION

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. CONCRETE BASE SHALL BE INSTALLED PARALLEL TO STREET CENTRELINE, NOT FACE OF CURB.

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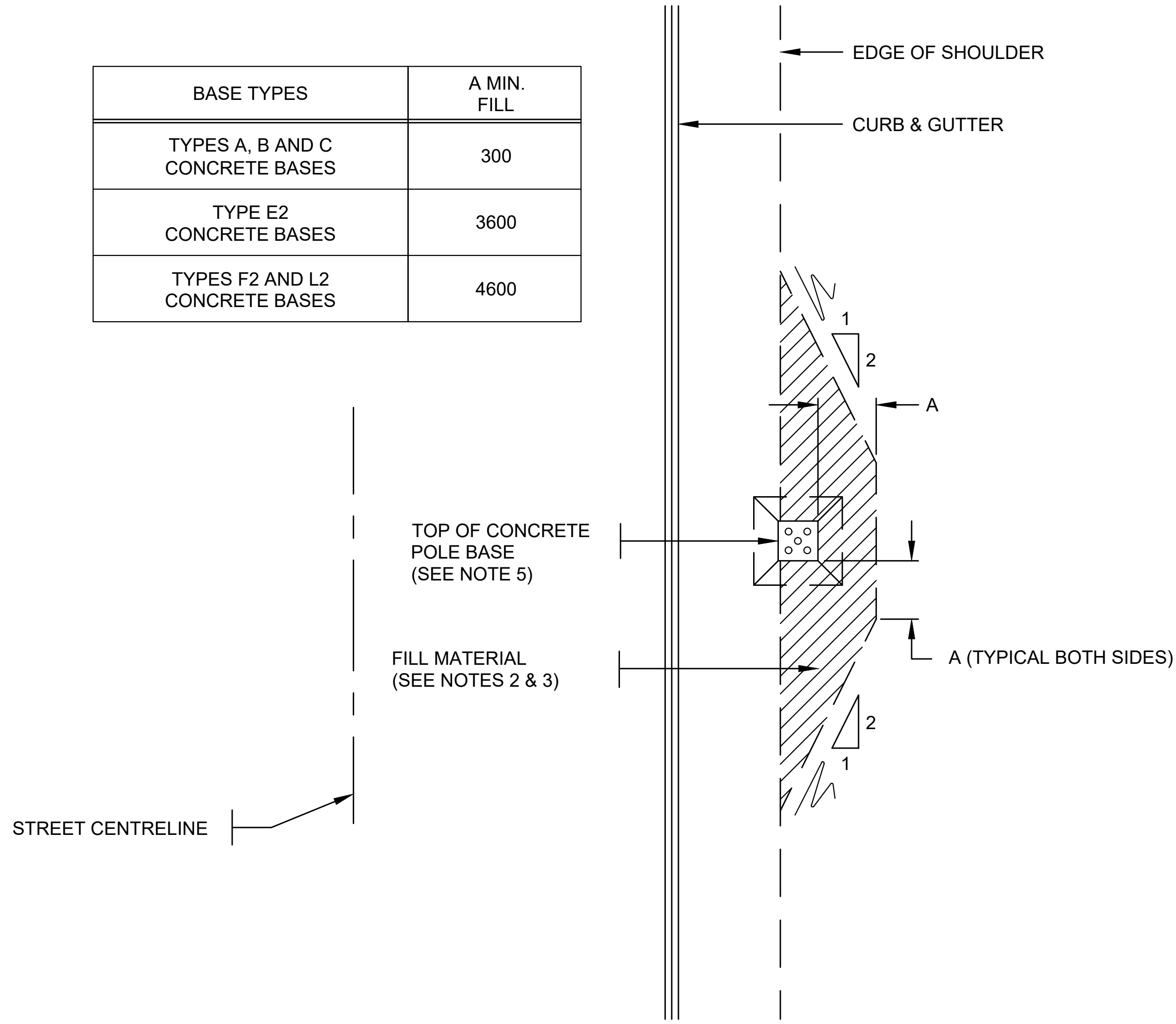
3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

POLE BASE INSTALLATION DETAILS

Scale:	NTS
Created:	MAY 2013
Rev Date:	NOV 2019
Dwg No:	E-1.13

BASE TYPES	A MIN. FILL
TYPES A, B AND C CONCRETE BASES	300
TYPE E2 CONCRETE BASES	3600
TYPES F2 AND L2 CONCRETE BASES	4600



PLAN

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. FILL MATERIAL SHALL CONSIST OF CLEAN WELL GRADED GRANULAR SOIL HAVING A MAXIMUM FINES CONTENT OF 8% (SILT AND CLAY SIZE PARTICLES) AND A MAXIMUM AGGREGATE SIZE OF 100mm.
3. FILL MATERIAL SHALL BE SUPPLIED, INSTALLED AND FULLY COMPACTED IN ACCORDANCE WITH SECTION 4 FOR THE MINIMUM AREA ALL AROUND THE BASE AS SHOWN ABOVE.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
5. CONCRETE BASE SHALL BE INSTALLED PARALLEL TO STREET CENTRELINE, NOT FACE OF CURB.

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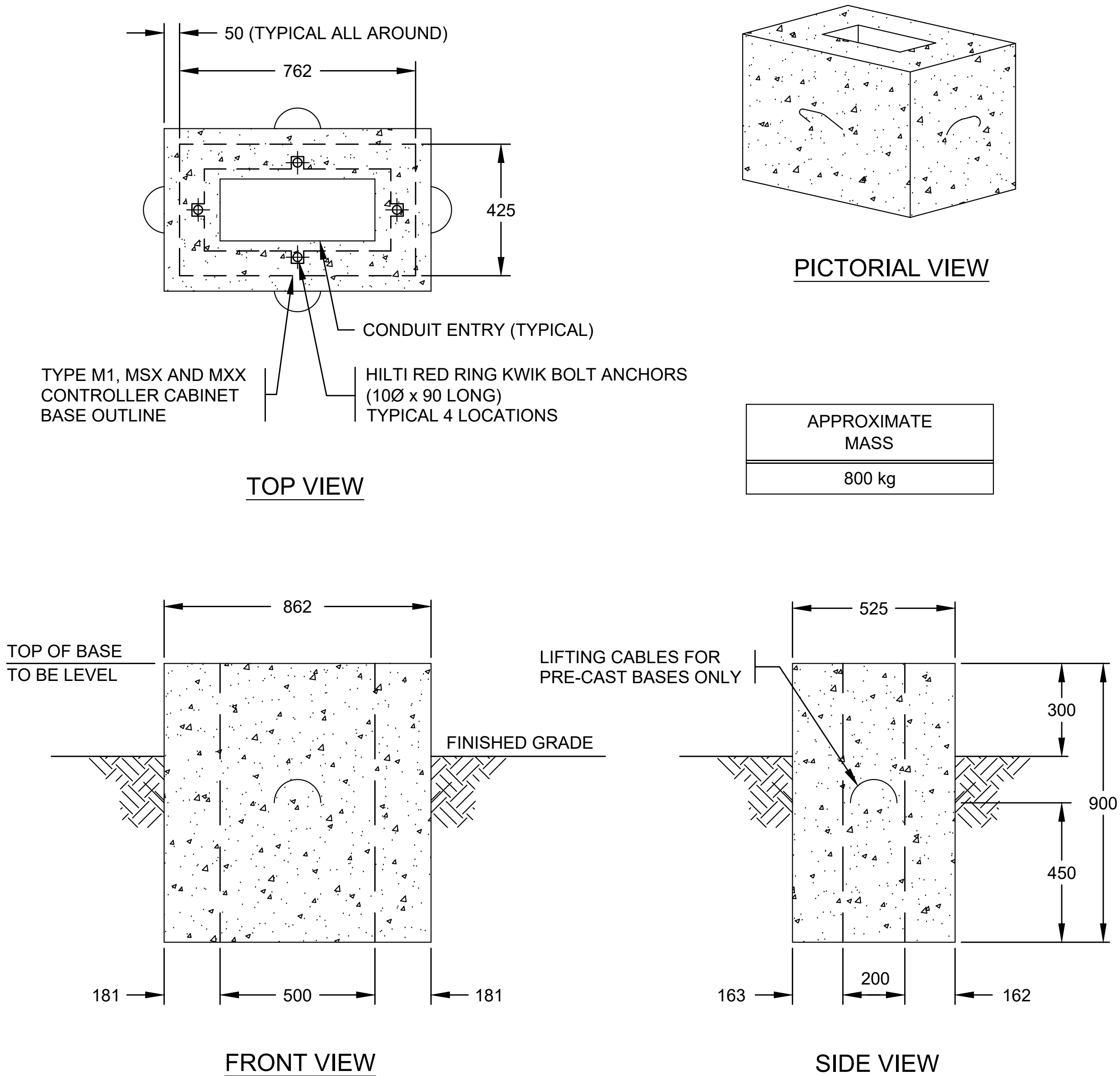
3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

POLE BASE INSTALLATION DETAILS

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2019
Dwg No:	E-1.14



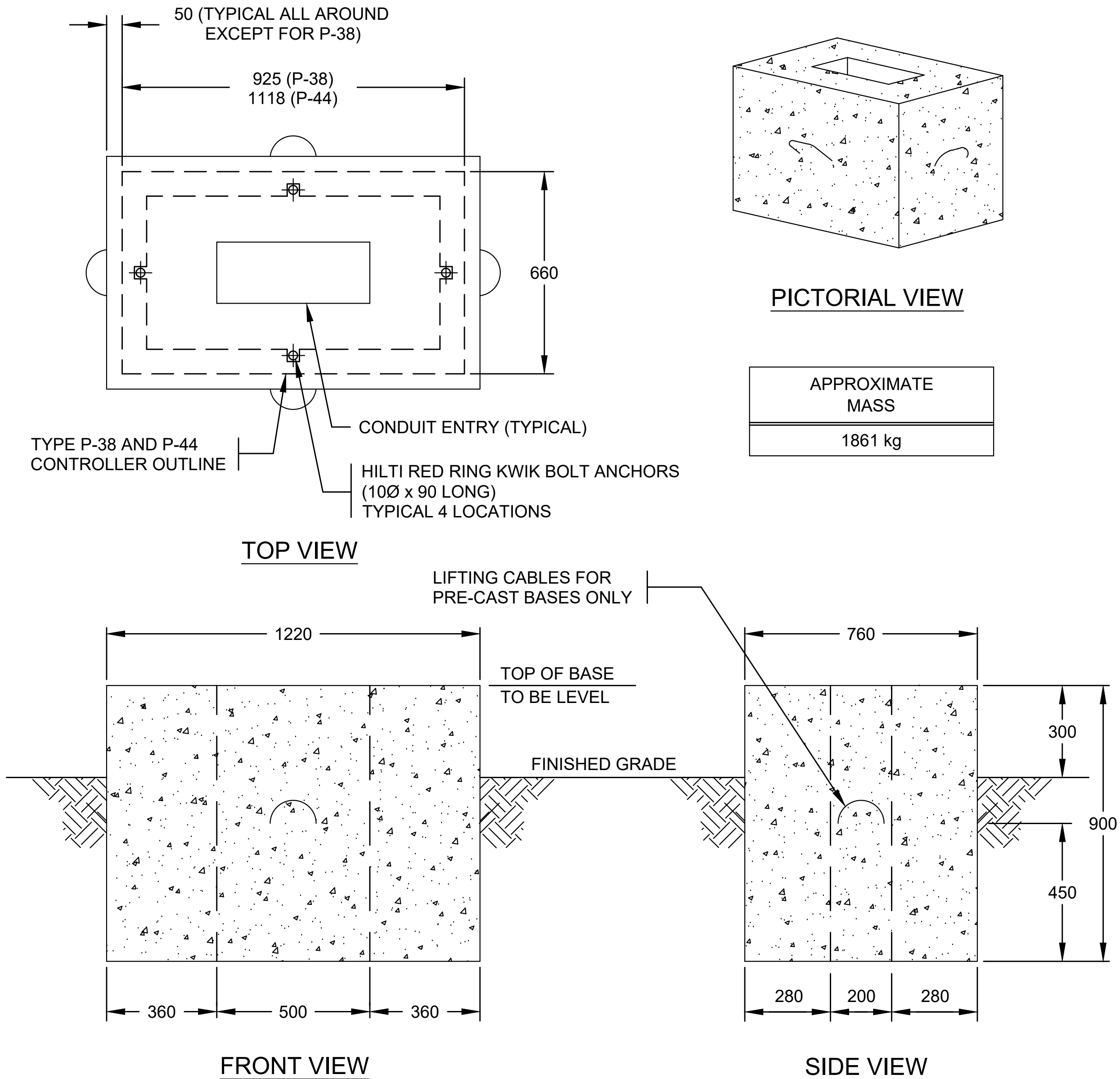
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.
3. BASES TO BE PRE-CAST OR CAST-IN-PLACE.

CITY OF NANAIMO
THE HARBOUR CITY

TYPE M (NEMA CABINET) CONCRETE CONTROLLER BASE

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-2.1



APPROXIMATE MASS
1861 kg

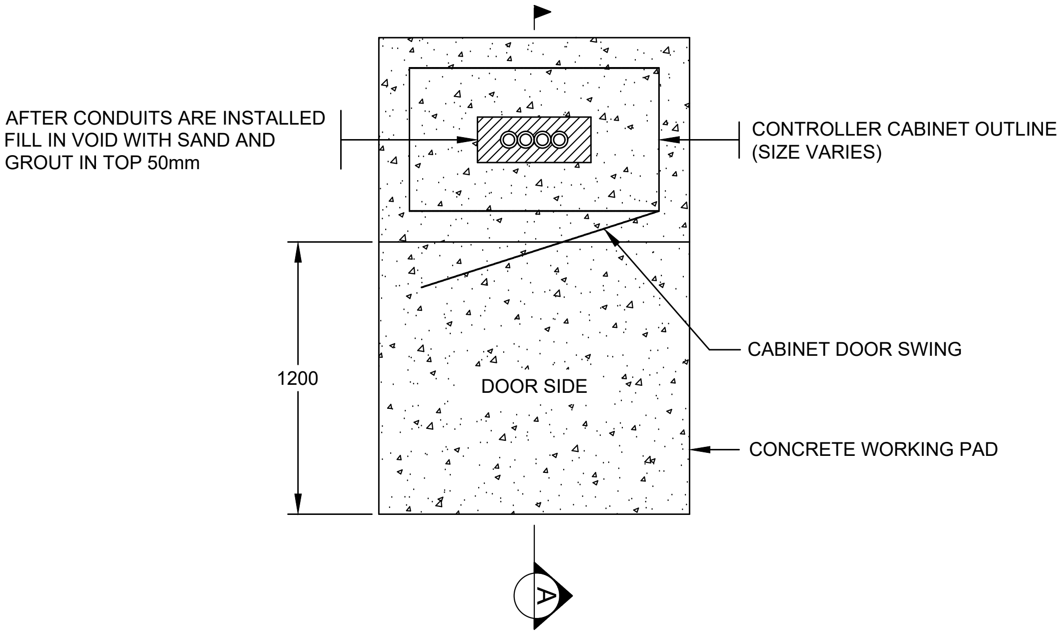
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.
3. BASES TO BE PRE-CAST OR CAST-IN-PLACE.

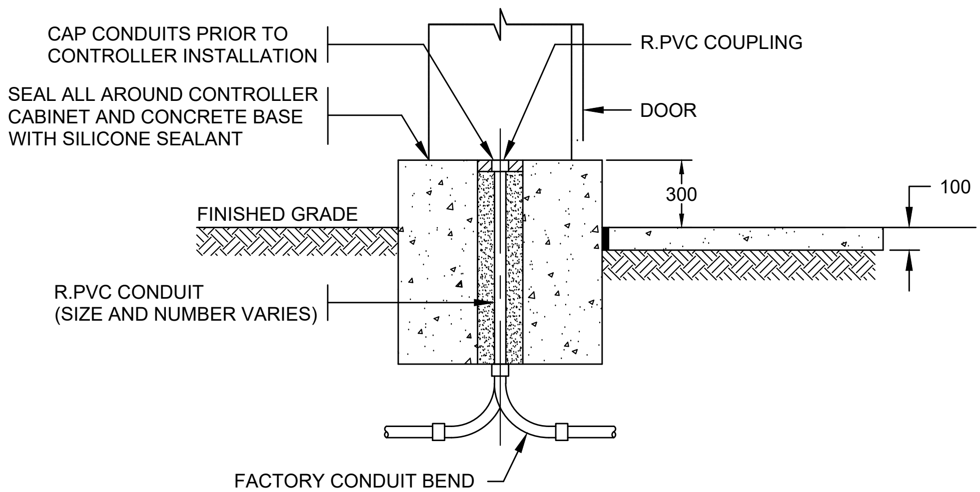
CITY OF NANAIMO
THE HARBOUR CITY

TYPE P (NEMA CABINET)
CONCRETE CONTROLLER BASE

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-2.2



TOP VIEW



SECTION A

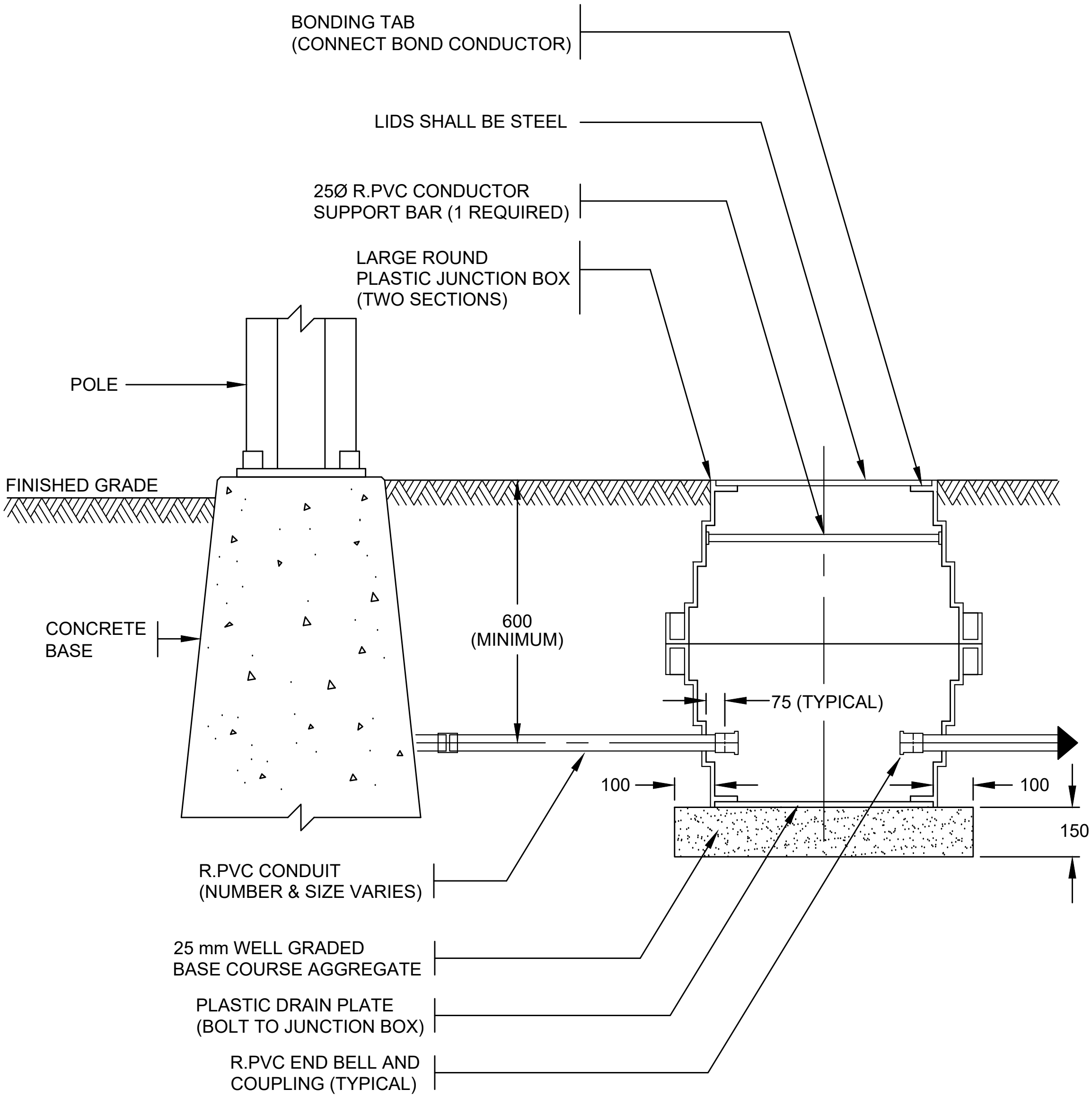
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

CITY OF NANAIMO
THE HARBOUR CITY

CONTROLLER INSTALLATION (FOR TYPE P CABINETS)

Scale:	NTS
Created:	MAY 2003
Rev Date:	MAY 2003
Dwg No:	E-2.3



NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. INSTALL LID ON PLASTIC JUNCTION BOX BEFORE BACKFILLING, TAMPING & PAVING OPERATIONS.
3. INSTALL TOP OF JUNCTION BOX FLUSH WITH FINISHED GRADE.
4. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.
5. CONCRETE JUNCTION BOX INSTALLATION SIMILAR.
6. NUMBER OF CONDUITS ENTERING JUNCTION BOX NOT TO EXCEED 10 (UNLESS OTHERWISE NOTED).

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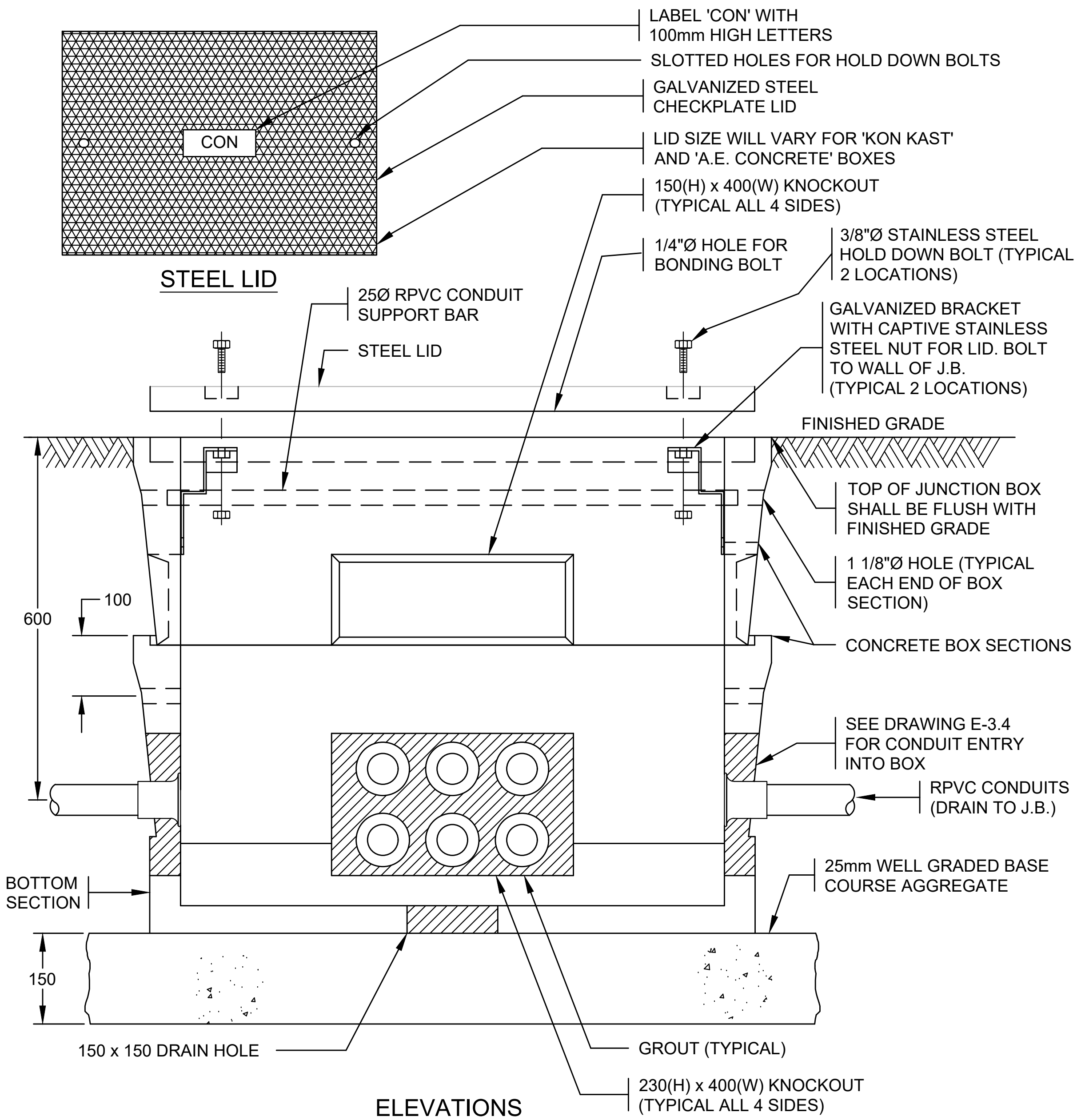
3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

JUNCTION BOXES

Scale:	NTS
Created:	MAY 2003
Rev Date:	MAY 2003
Dwg No:	E-3.1



NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS
2. ONLY PRODUCTS WITHIN THE CITY OF NANAIMO'S APPROVED PRODUCTS LIST, AND APPROVED BY THE CITY ENGINEER SHALL BE USED.
3. JUNCTION BOX SHALL BE DESIGNED FOR 5000kg STATIC LOADING.
4. VAULTS SHALL BE PRE-CAST CONCRETE WITH A MINIMUM COMPRESSIVE STRENGTH OF 35 MPa AT 28 DAYS.
5. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

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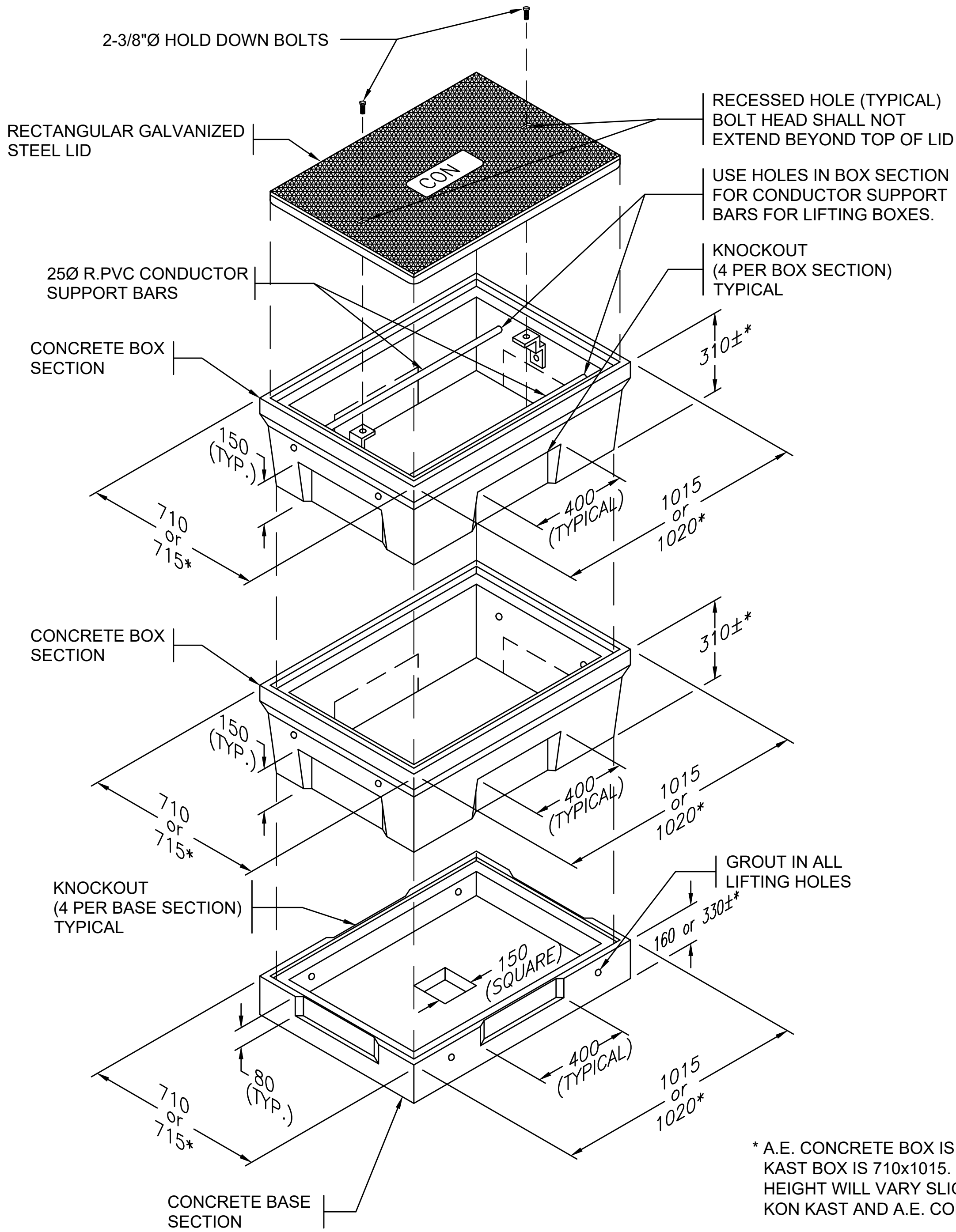
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

CONCRETE JUNCTION BOX DETAILS

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-3.2



* A.E. CONCRETE BOX IS 715x1020. KON KAST BOX IS 710x1015. BOX SECTION HEIGHT WILL VARY SLIGHTLY BETWEEN KON KAST AND A.E. CONCRETE BOXES.

NOTE: THESE BOXES ARE NOT INTERCHANGEABLE.

SEE DRAWING E-3.2 FOR NOTES

G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 10 DWGS\E-3.3

2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

CONCRETE JUNCTION BOX DETAILS

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-3.3

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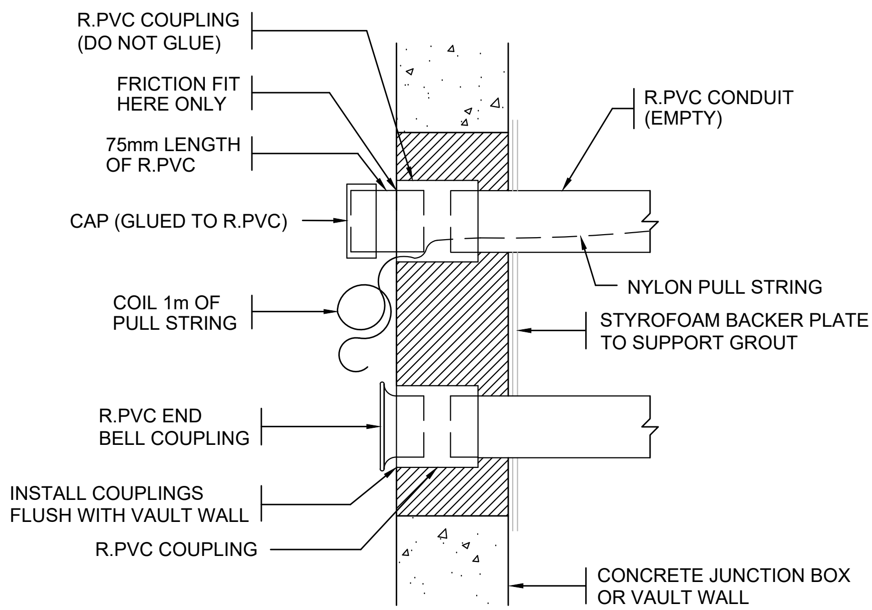

CONDUIT ENTRY TO VAULT OR CONCRETE JUNCTION BOX

SEE DRAWINGS E-3.2 & E-3.3
FOR NOTES AND ADDITIONAL DETAILS.

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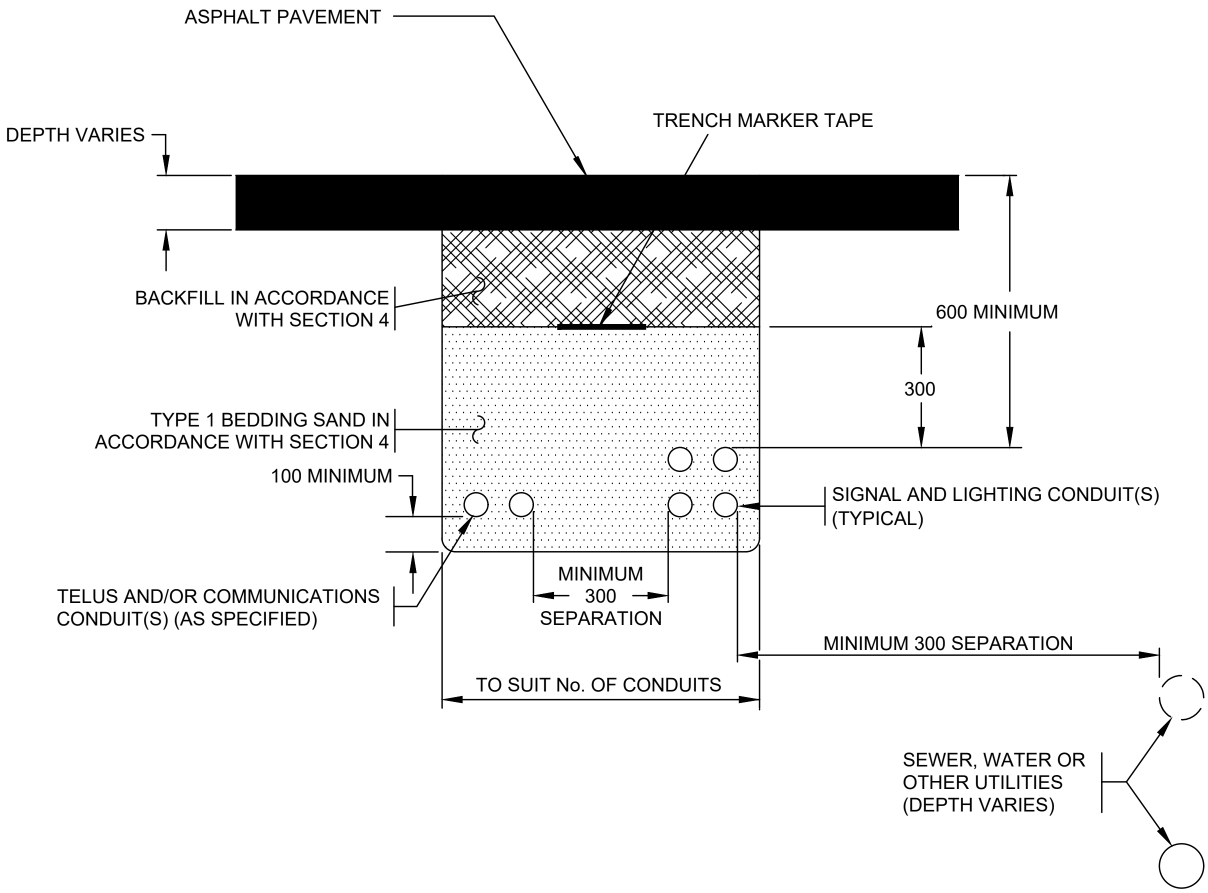
CITY OF NANAIMO
THE HARBOUR CITY

CONDUIT ENTRY INTO CONCRETE VAULT OR JUNCTION BOX

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-3.4



NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

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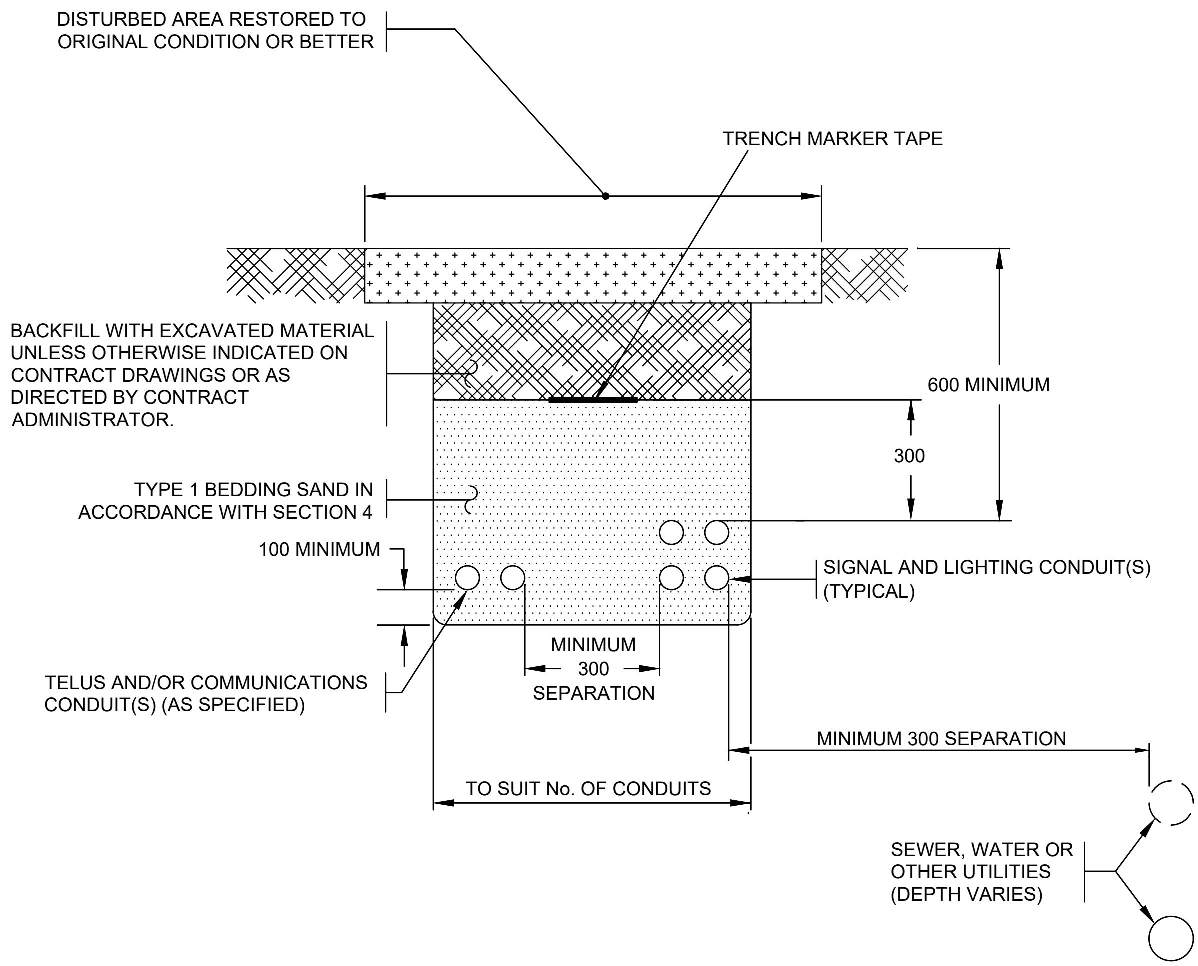
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

UNDERGROUND CONDUIT IN PAVED AREAS

Scale:	NTS
Created:	MAY 1999
Rev Date:	NOV 2019
Dwg No:	E-4.1



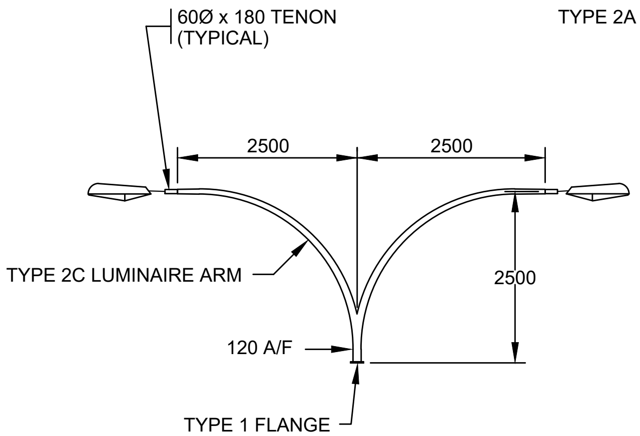
NOTES:

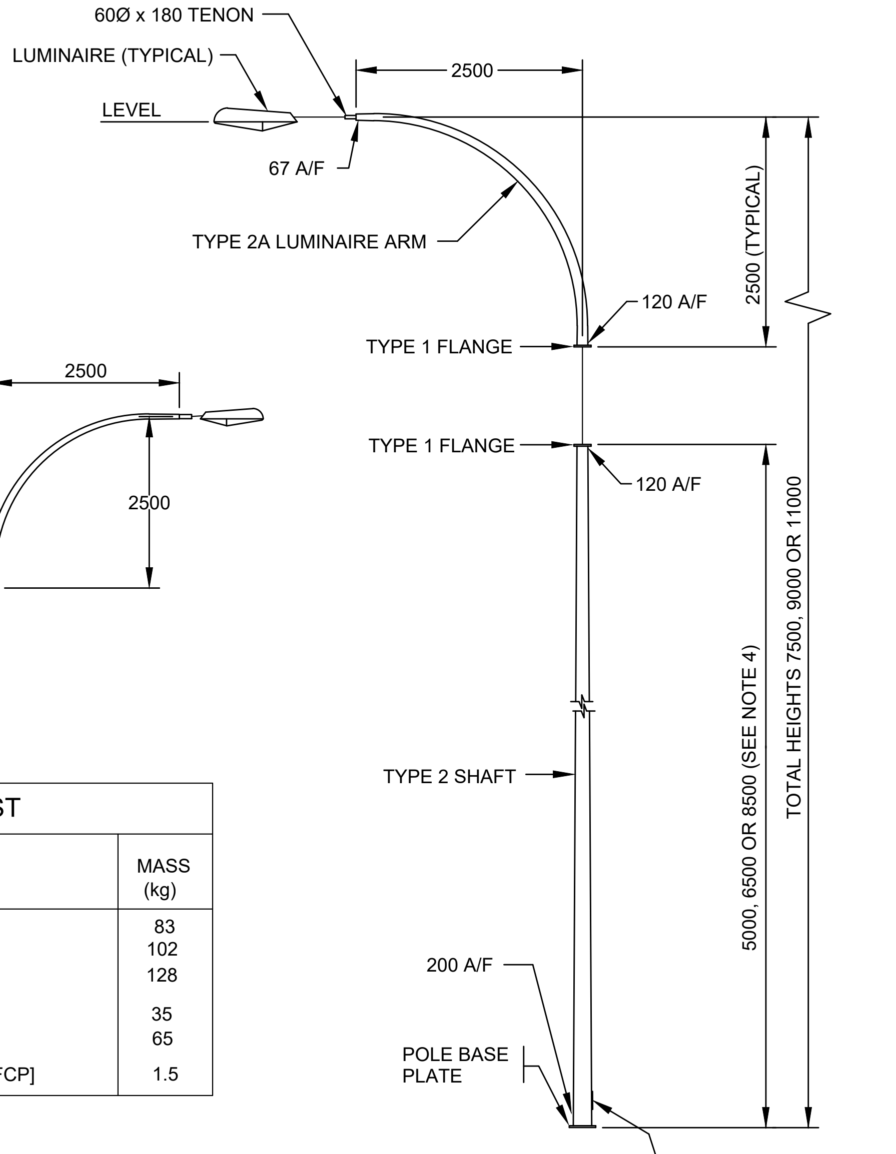
1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

CITY OF NANAIMO
THE HARBOUR CITY

UNDERGROUND CONDUIT IN NON-PAVED AREAS

Scale:	NTS
Created:	MAY 1999
Rev Date:	NOV 2019
Dwg No:	E-4.2

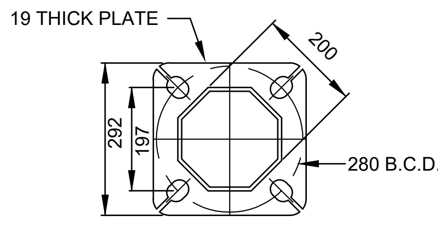




ELEVATION

PARTS LIST	
PART	MASS (kg)
TYPE [2(5)] SHAFT - 5.0m	83
TYPE [2(6.5)] SHAFT - 6.5m	102
TYPE [2(8.5)] SHAFT - 8.5m	128
TYPE [2A] LUMINAIRE ARM	35
TYPE [2C] LUMINAIRE ARM	65
TYPE 1 FLANGE COVER PLATE [1FCP]	1.5

* [ ] I.D. LABEL ON POLE



POLE BASE PLATE

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SEE DRAWING E-5.2 FOR TYPE 2 SHAFT, BOLT KITS AND POLE ASSEMBLY DETAILS.
3. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.
4. POLE SHAFTS TO BE SUPPLIED 0.9m SHORTER WHERE BEING INSTALLED ON SERVICE BASE.

2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

LUMINARE POLE (HIGHWAYS TYPE 2 SHAFT)

Scale:	NTS
Created:	JAN 1998
Rev Date:	MAY 2020
Dwg No:	E-5.1

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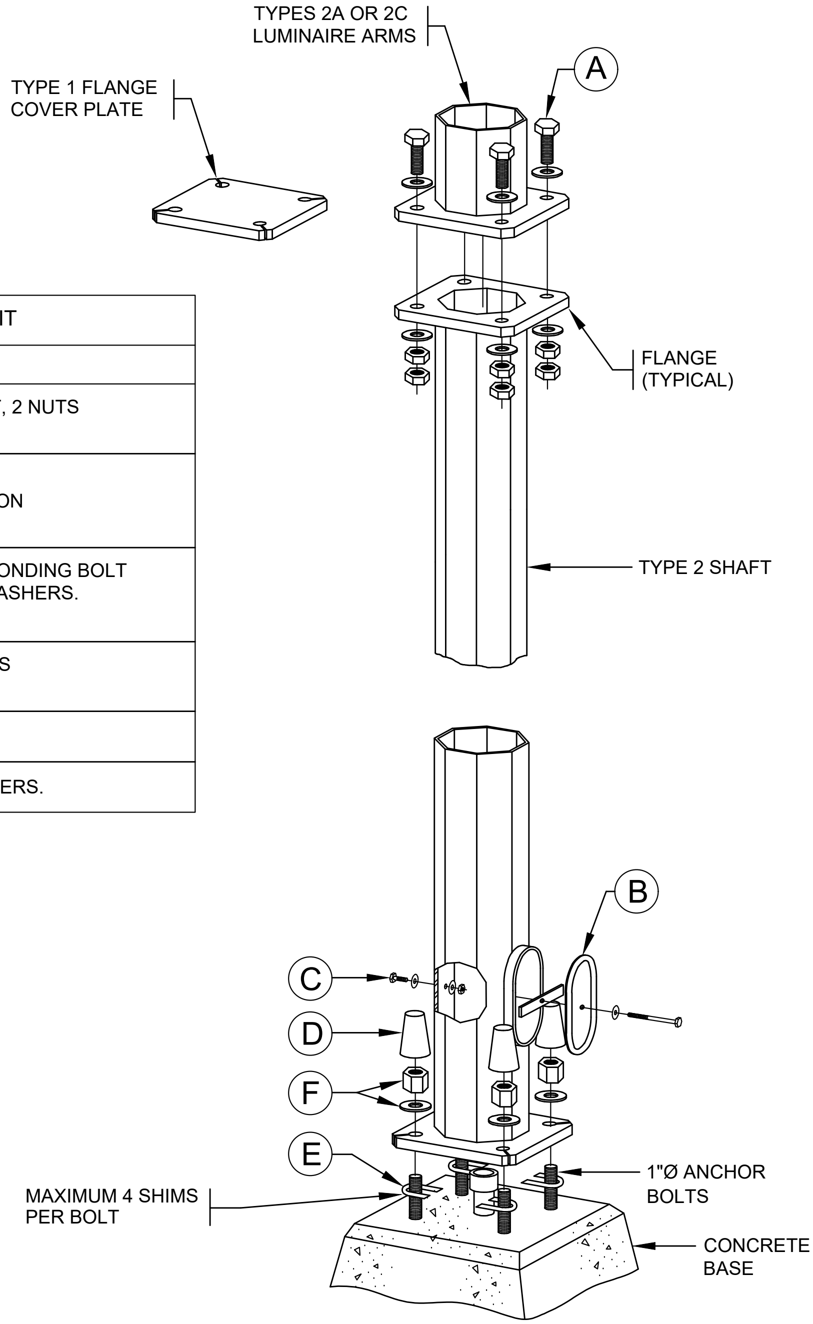
TYPE 2 SHAFT BOLT KIT		
ITEM	QUANTITY	DESCRIPTION
A	4	5/8"Ø x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	1	LOCKING HANDHOLE COVER. SEE DETAIL ON DRAWING E-5.19
C	1	3/8"Ø x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
D	4	PLASTIC NUT COVERS FOR 1" NUTS.
E	4	LEVELLING SHIMS.
F	4	1"Ø NUTS AND WASHERS.



POLE ASSEMBLY DETAIL

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SHAFTS TO BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS TO BE SUPPLIED WITH A GALVANIZED FINISH, UNLESS OTHERWISE NOTED.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

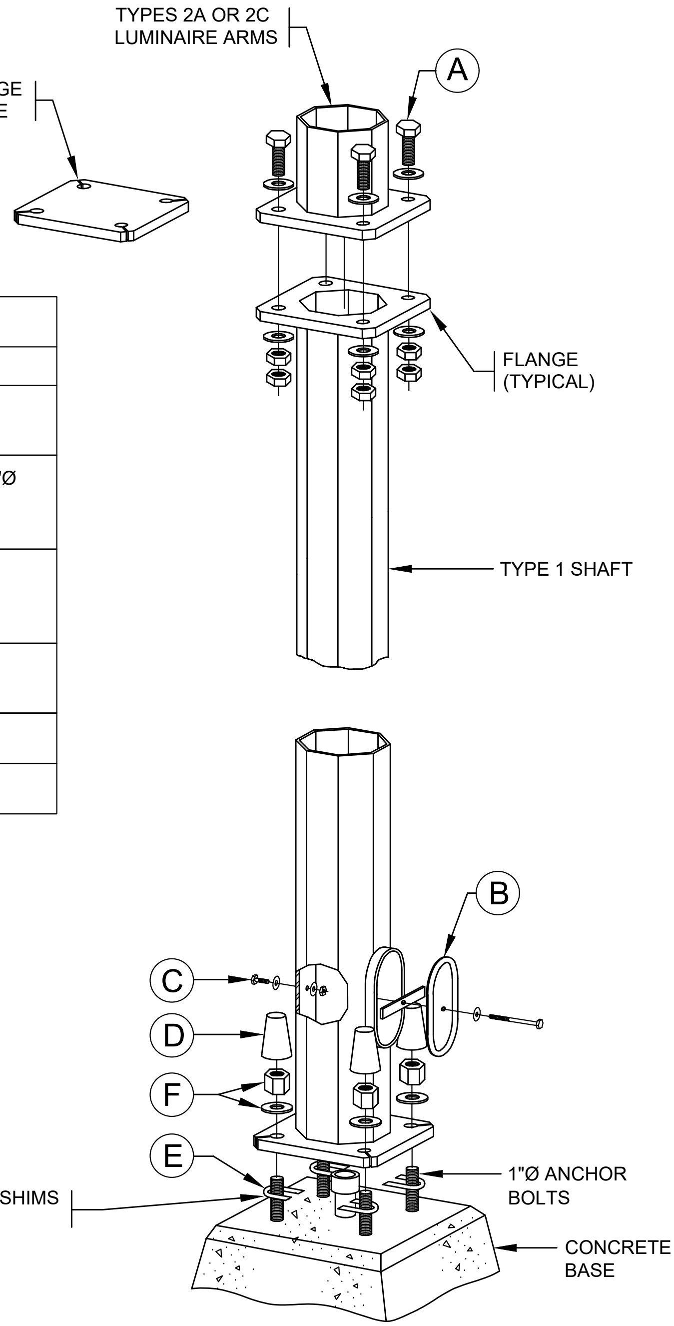
3.20.2020

CITY OF NANAIMO
THE HARBOUR CITY

LUMINARE POLE (HIGHWAYS TYPE 2 SHAFT)

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2019
Dwg No:	E-5.2

TYPE 2 SHAFT BOLT KIT		
ITEM	QUANTITY	DESCRIPTION
A	4	5/8"Ø x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	1	SMALL HANDHOLE COVER WITH 3/8"Ø x 2 1/2" LONG BOLT, WASHER & BACKER BAR.
C	1	3/8"Ø x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
D	4	PLASTIC NUT COVERS FOR 1" NUTS.
E	4	LEVELLING SHIMS.
F	4	1"Ø NUTS AND WASHERS.



POLE ASSEMBLY DETAIL

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SHAFTS TO BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS TO BE SUPPLIED WITH A GALVANIZED FINISH, UNLESS OTHERWISE NOTED.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

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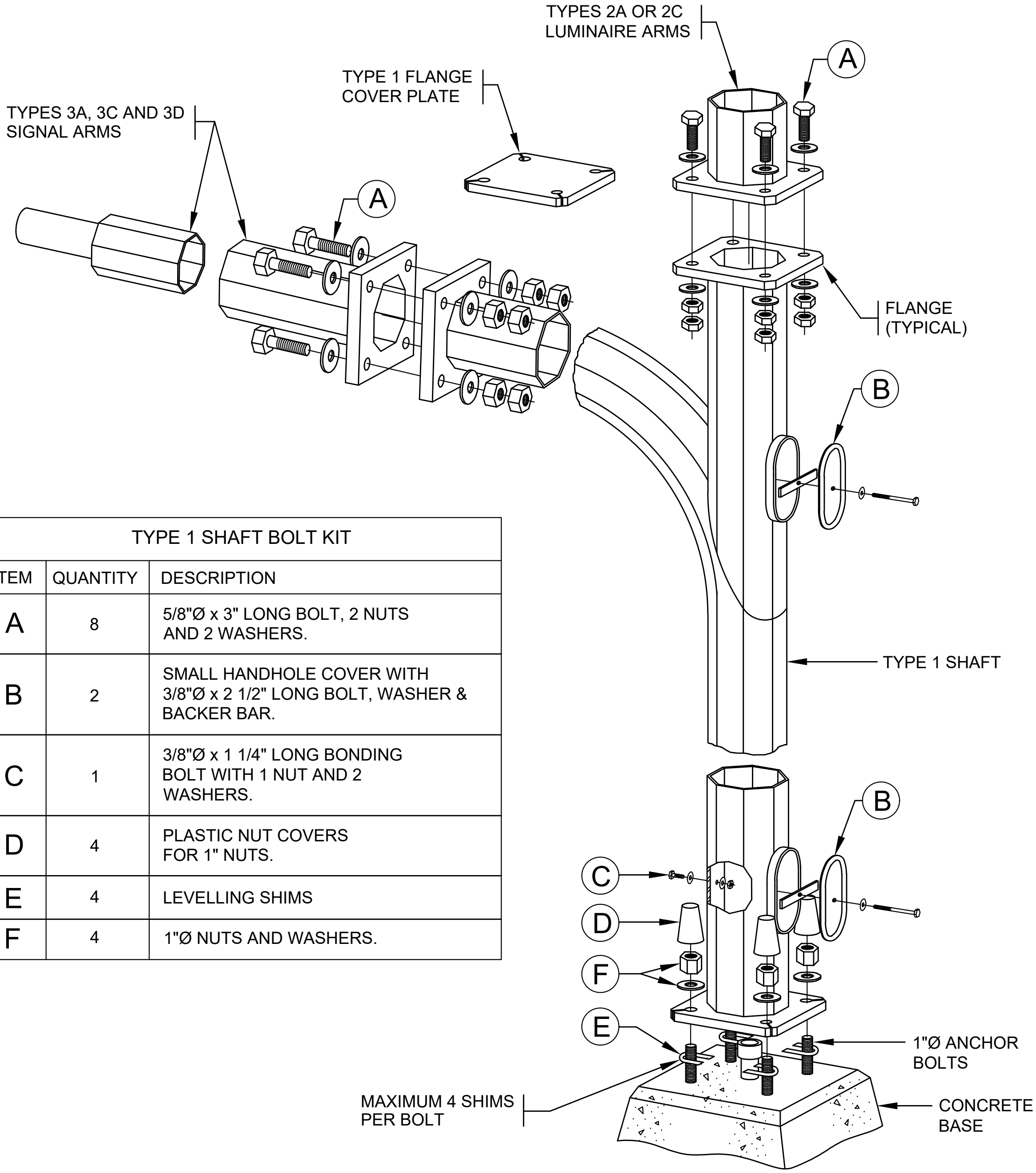
3.20.2020

CITY OF NANAIMO
THE HARBOUR CITY

SIGNAL POLE (HIGHWAYS TYPE 1 SHAFT)

Scale: NTS
Created: JAN 1998
Rev Date: NOV 2019
Dwg No: E-5.3



TYPE 1 SHAFT BOLT KIT		
ITEM	QUANTITY	DESCRIPTION
A	8	5/8"Ø x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	2	SMALL HANDHOLE COVER WITH 3/8"Ø x 2 1/2" LONG BOLT, WASHER & BACKER BAR.
C	1	3/8"Ø x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
D	4	PLASTIC NUT COVERS FOR 1" NUTS.
E	4	LEVELLING SHIMS
F	4	1"Ø NUTS AND WASHERS.

POLE ASSEMBLY DETAIL

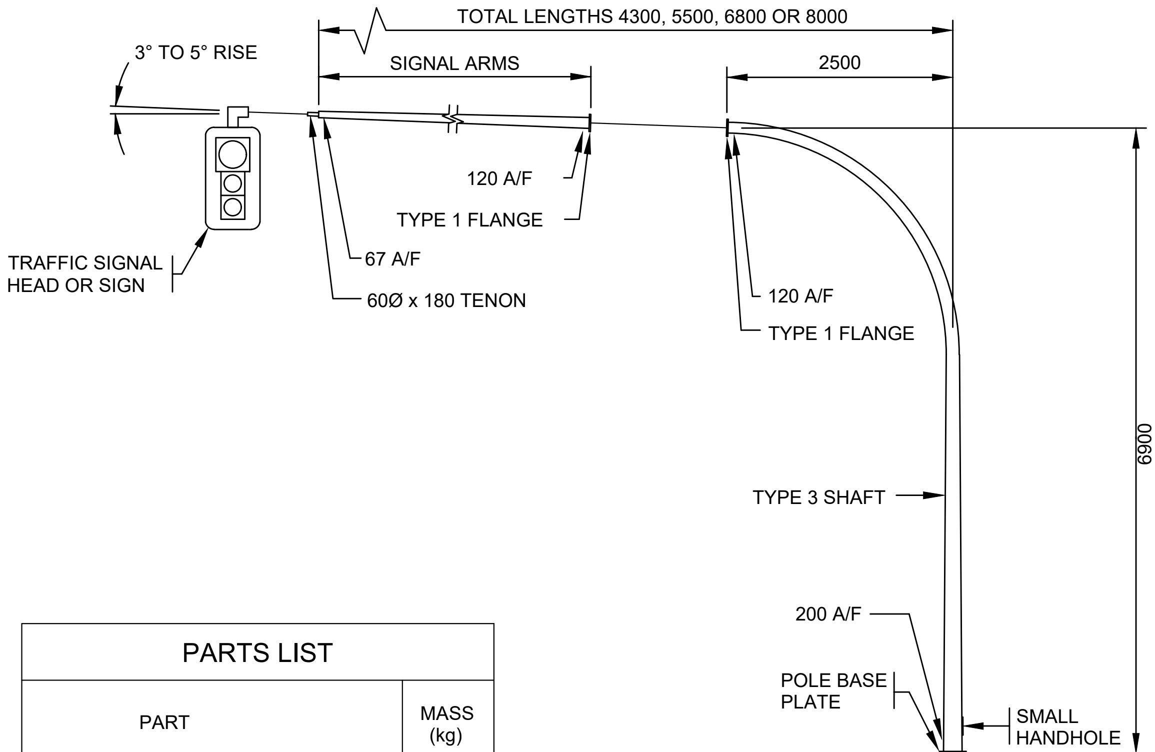
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SHAFTS TO BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS TO BE SUPPLIED WITH A GALVANIZED FINISH, UNLESS OTHERWISE NOTED.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

CITY OF NANAIMO
THE HARBOUR CITY

SIGNAL POLE (HIGHWAYS TYPE 1 SHAFT)

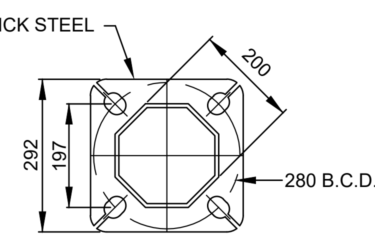
Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-5.4



ELEVATION

PARTS LIST	
PART	MASS (kg)
TYPE [3] SHAFT	186
TYPE [3C] SIGNAL ARM - 1.8m	18
TYPE [3A] SIGNAL ARM - 3.0m	27
TYPE [3D] SIGNAL ARM - 4.3m	54
TYPE [3E] SIGNAL ARM - 5.5m	68

* [ ] I.D. LABEL ON POLE



POLE BASE PLATE

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SEE DRAWING E-5.6 FOR TYPE 3 SHAFT, BOLT KITS AND POLE ASSEMBLY DETAILS.
3. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

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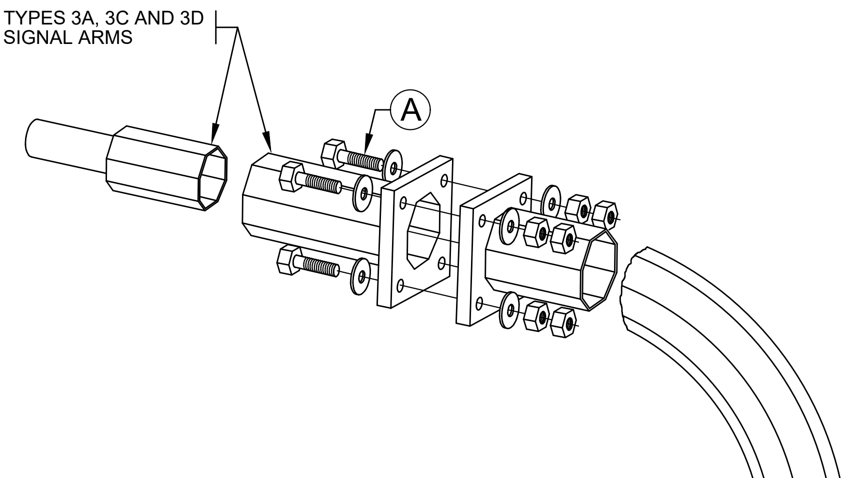
3.3.2020

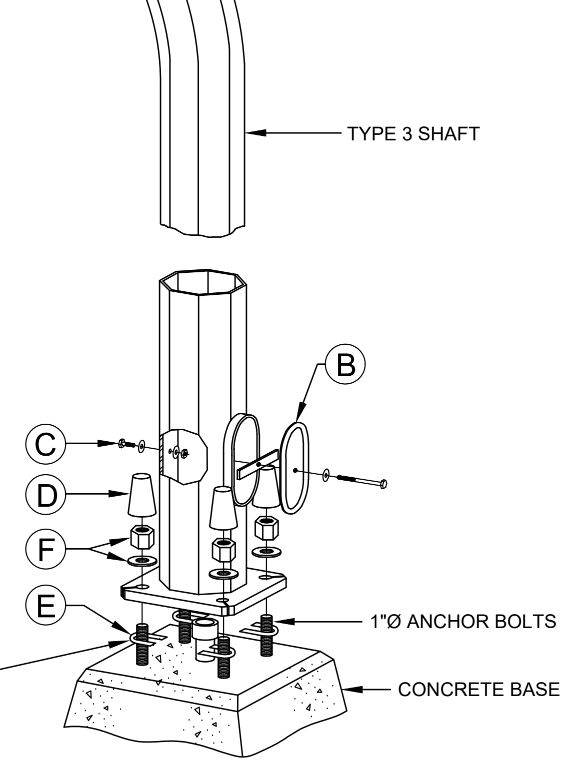
CITY OF NANAIMO
THE HARBOUR CITY

SIGNAL POLE (HIGHWAYS TYPE 3 SHAFT)

Scale: NTS
Created: JAN 1998
Rev Date: JAN 1998
Dwg No: E-5.5



TYPE 3 SHAFT BOLT KIT		
ITEM	QUANTITY	DESCRIPTION
A	4	5/8"Ø x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	1	SMALL HANDHOLE COVER WITH 3/8"Ø x 2 1/2" LONG BOLT, WASHER & BACKER BAR.
C	1	3/8"Ø x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
D	4	PLASTIC NUT COVERS FOR 1"Ø NUTS.
E	4	LEVELLING SHIMS.
F	4	1"Ø NUTS AND WASHERS.



POLE ASSEMBLY DETAIL

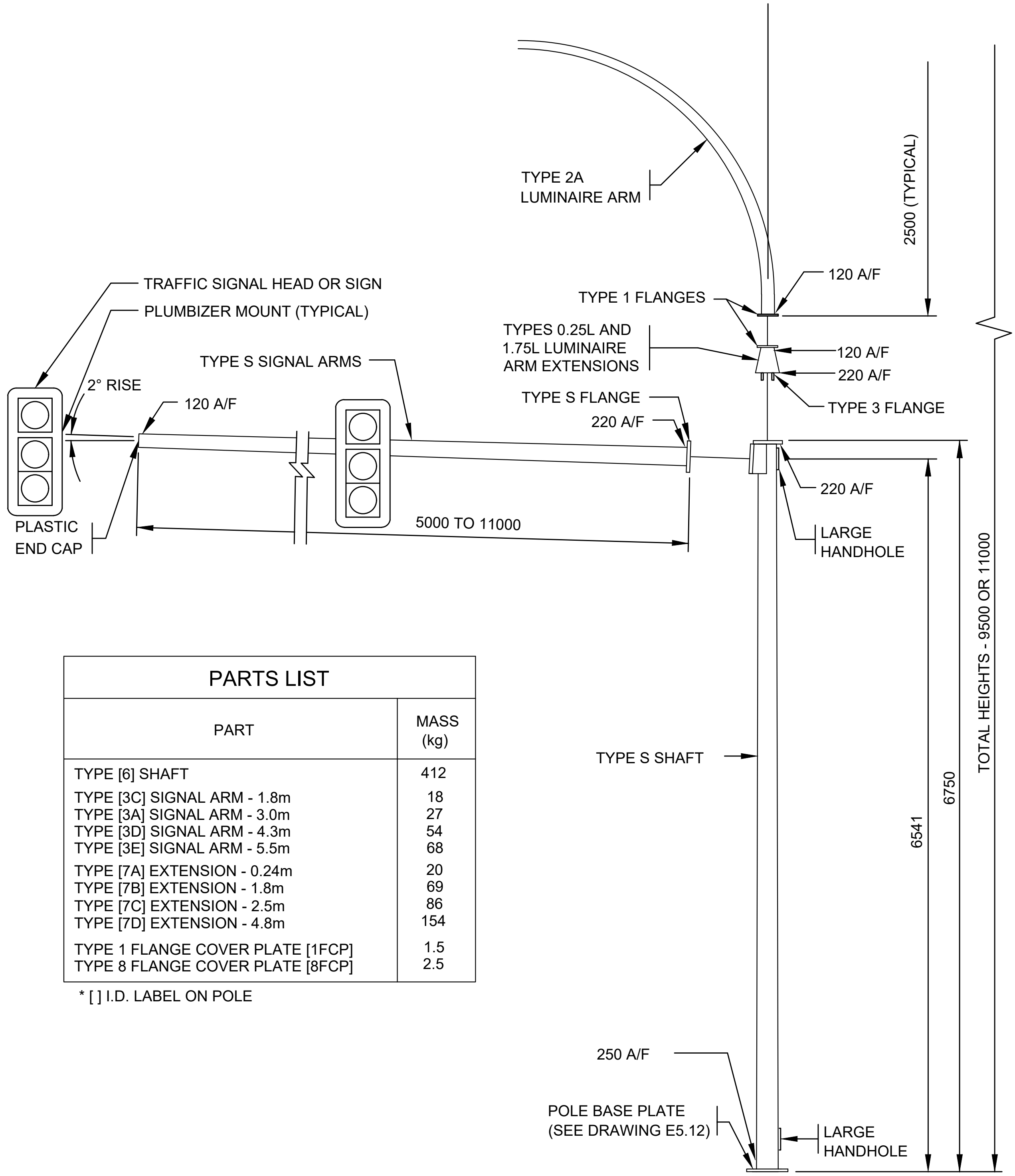
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SHAFTS TO BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS TO BE SUPPLIED WITH A GALVANIZED FINISH, UNLESS OTHERWISE NOTED.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

CITY OF NANAIMO
THE HARBOUR CITY

SIGNAL POLE (HIGHWAYS TYPE 3 SHAFT)

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-5.6



PARTS LIST

PART	MASS (kg)
TYPE [6] SHAFT	412
TYPE [3C] SIGNAL ARM - 1.8m	18
TYPE [3A] SIGNAL ARM - 3.0m	27
TYPE [3D] SIGNAL ARM - 4.3m	54
TYPE [3E] SIGNAL ARM - 5.5m	68
TYPE [7A] EXTENSION - 0.24m	20
TYPE [7B] EXTENSION - 1.8m	69
TYPE [7C] EXTENSION - 2.5m	86
TYPE [7D] EXTENSION - 4.8m	154
TYPE 1 FLANGE COVER PLATE [1FCP]	1.5
TYPE 8 FLANGE COVER PLATE [8FCP]	2.5

* [ ] I.D. LABEL ON POLE

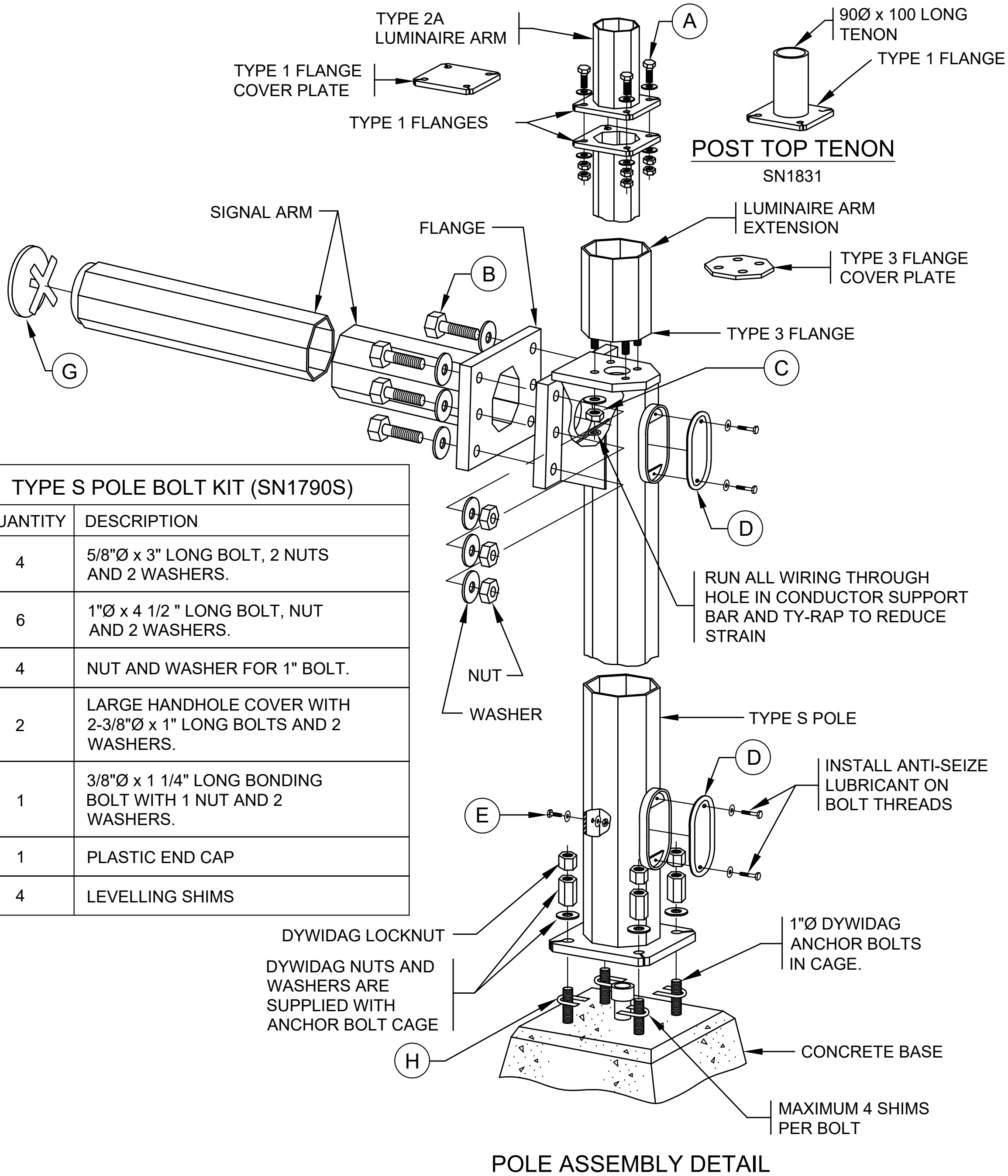
NOTES:

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

CITY OF NANAIMO
THE HARBOUR CITY

SIGNAL POLE (TYPE S SHAFT)
INSTALLATION DETAILS

Scale:	NTS
Created:	MAY 2013
Rev Date:	NOV 2016
Dwg No:	E-5.7



TYPE S POLE BOLT KIT (SN1790S)		
ITEM	QUANTITY	DESCRIPTION
A	4	5/8"Ø x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	6	1"Ø x 4 1/2 " LONG BOLT, NUT AND 2 WASHERS.
C	4	NUT AND WASHER FOR 1" BOLT.
D	2	LARGE HANDHOLE COVER WITH 2-3/8"Ø x 1" LONG BOLTS AND 2 WASHERS.
E	1	3/8"Ø x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
G	1	PLASTIC END CAP
H	4	LEVELLING SHIMS

POLE ASSEMBLY DETAIL

NOTES:

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. SHAFTS TO BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS TO BE SUPPLIED WITH A GALVANIZED FINISH.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

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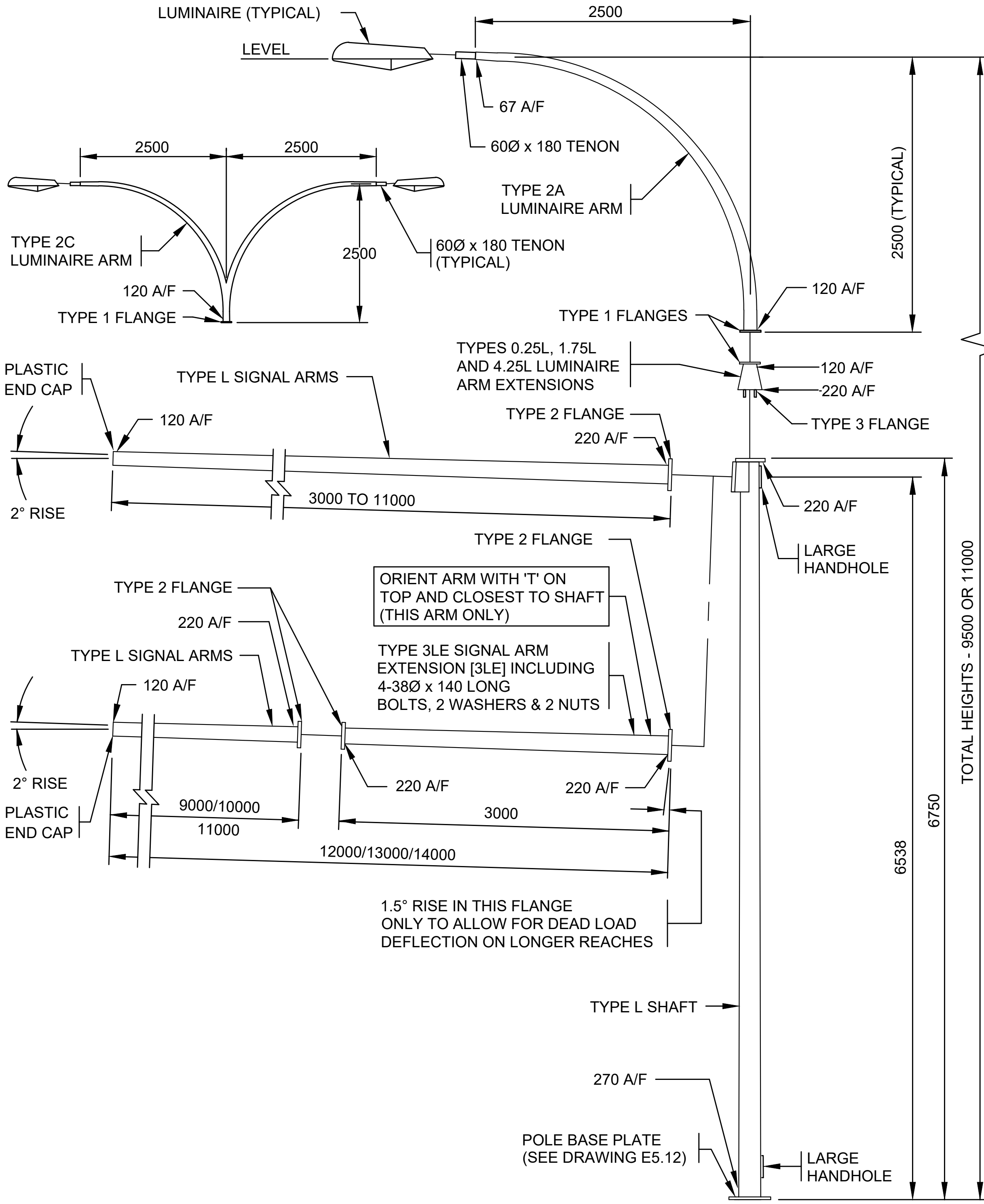
3.20.2020

CITY OF NANAIMO
THE HARBOUR CITY

SIGNAL POLE (TYPE S SHAFT)
INSTALLATION DETAILS

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-5.8



NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SEE DRAWING E-5.13 FOR BOLT KITS AND POLE ASSEMBLY DETAILS.
3. SEE DRAWING E-5.12 FOR BASE PLATE AND PARTS LIST.
4. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

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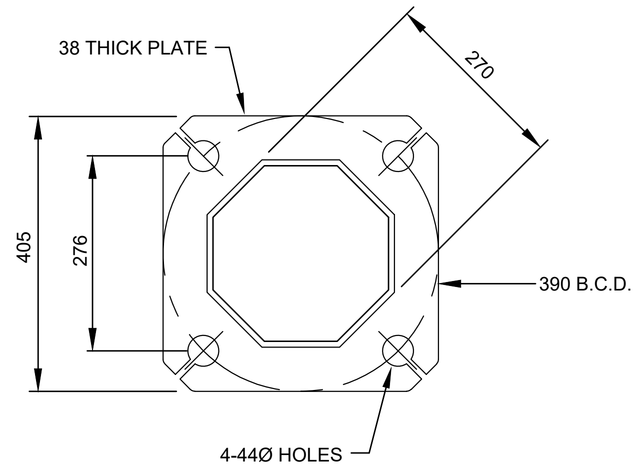
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

SIGNAL POLE (HIGHWAYS TYPE L SHAFT)

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	E-5.11



TYPE L POLE BASE PLATE

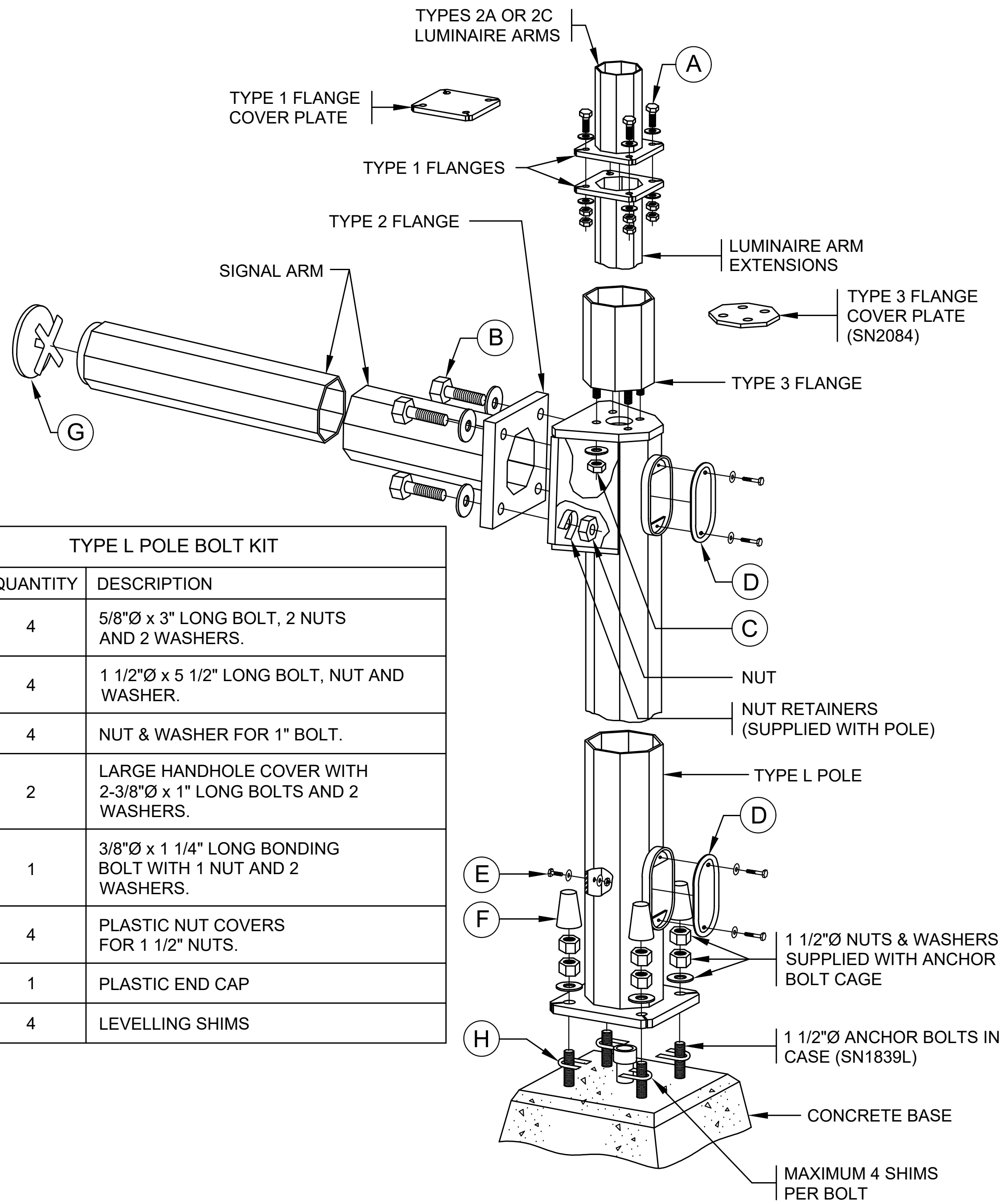
PARTS LIST FOR TYPE L SIGNAL POLE	
PART	MASS (kg)
TYPE [L] POLE SHAFT	442
TYPE [3L] SIGNAL ARM - 3.0m	97
TYPE [4L] SIGNAL ARM - 4.0m	118
TYPE [5L] SIGNAL ARM - 5.0m	173
TYPE [6L] SIGNAL ARM - 6.0m	201
TYPE [7L] SIGNAL ARM - 7.0m	229
TYPE [8L] SIGNAL ARM - 8.0m	259
TYPE [9L] SIGNAL ARM - 9.0m	284
TYPE [10L] SIGNAL ARM - 10.0m	377
TYPE [11L] SIGNAL ARM - 11.0m	410
TYPE [3LE] SIGNAL ARM EXTENSION - 3.0m	114
TYPE [4.25L] LUMINAIRE ARM EXTENSION - 4.25m	82
TYPE [1.75L] LUMINAIRE ARM EXTENSION - 1.75m	29
TYPE [0.25L] LUMINAIRE ARM EXTENSION - 0.25m	10
TYPE [2A] LUMINAIRE ARM	35
TYPE [2C] LUMINAIRE ARM	65
TYPE 1 FLANGE COVER PLATE [1 FCP]	1.5
TYPE 2 FLANGE COVER PLATE [2 FCP]	4
TYPE 3 FLANGE COVER PLATE [3 FCP]	4

* [ ] I.D. LABEL ON POLE

CITY OF NANAIMO
THE HARBOUR CITY

SIGNAL POLE (HIGHWAYS TYPE L SHAFT)

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2013
Dwg No:	E-5.12



TYPE L POLE BOLT KIT		
ITEM	QUANTITY	DESCRIPTION
A	4	5/8"Ø x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	4	1 1/2"Ø x 5 1/2" LONG BOLT, NUT AND WASHER.
C	4	NUT & WASHER FOR 1" BOLT.
D	2	LARGE HANDHOLE COVER WITH 2-3/8"Ø x 1" LONG BOLTS AND 2 WASHERS.
E	1	3/8"Ø x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
F	4	PLASTIC NUT COVERS FOR 1 1/2" NUTS.
G	1	PLASTIC END CAP
H	4	LEVELLING SHIMS

POLE ASSEMBLY DETAIL

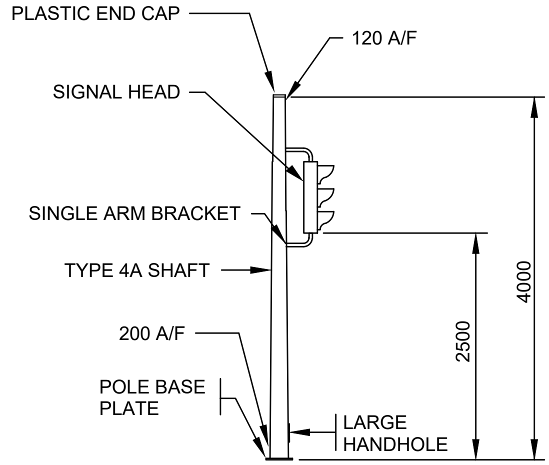
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SHAFTS TO BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS TO BE SUPPLIED WITH A GALVANIZED FINISH, UNLESS OTHERWISE NOTED.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

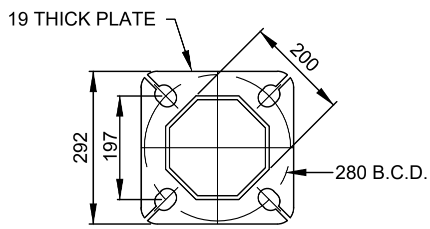
CITY OF NANAIMO
THE HARBOUR CITY

SIGNAL POLE (HIGHWAYS TYPE L SHAFT)

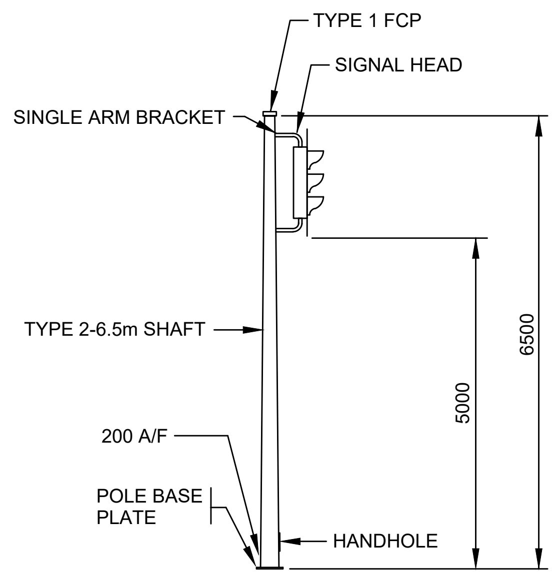
Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-5.13



TYPE 4A SHAFT



POLE BASE PLATE



TYPE 2-6.5m SHAFT

PARTS LIST

PART	MASS (kg)
TYPE [2] SHAFT	102
TYPE [4A] SHAFT	66

* [ ] I.D. LABEL ON POLE

NOTES:

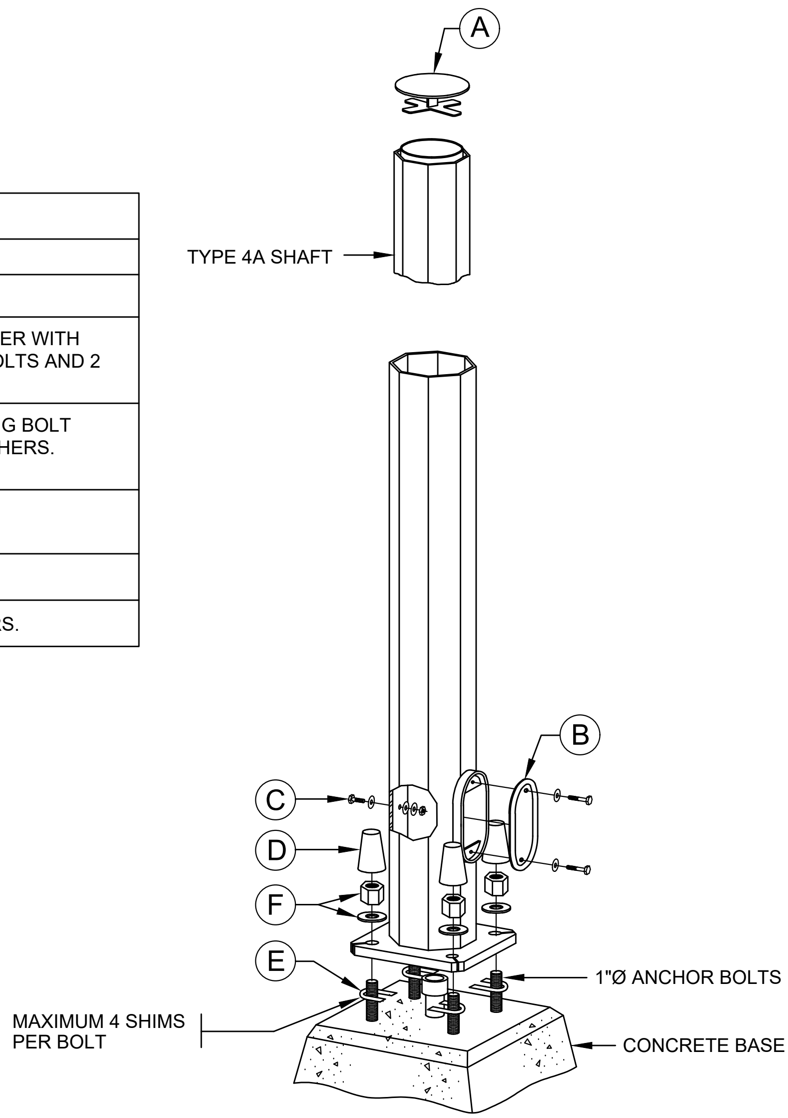
1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SEE DRAWING E-5.15 FOR TYPE 4A SHAFT, BOLT KITS AND POLE ASSEMBLY DETAILS.
3. ALL DIMENSION IN MILLIMETERS UNLESS OTHERWISE NOTED.
4. POLE SHAFTS TO BE SUPPLIED 0.9m SHORTER WHERE BEING INSTALLED ON SERVICE BASE.

CITY OF NANAIMO
THE HARBOUR CITY

SIGNAL POSTS
(HIGHWAYS TYPE
4A & 2-6.5m SHAFTS)

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-5.14

TYPE 4A SHAFT BOLT KIT		
ITEM	QUANTITY	DESCRIPTION
A	1	PLASTIC END CAP
B	1	LARGE HANDHOLE COVER WITH 2-3/8"Ø x 1 1/4" LONG BOLTS AND 2 WASHERS.
C	1	3/8"Ø x 1" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
D	4	PLASTIC NUT COVERS FOR 1"Ø NUTS.
E	4	LEVELING SHIMS.
F	4	1"Ø NUTS AND WASHERS.



POLE ASSEMBLY DETAIL

NOTES:

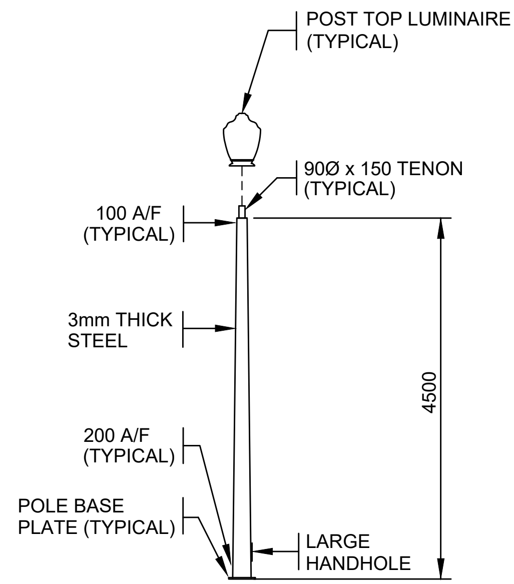
1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SHAFTS TO BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS TO BE SUPPLIED WITH A GALVANIZED FINISH, UNLESS OTHERWISE NOTED.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

CITY OF NANAIMO
THE HARBOUR CITY

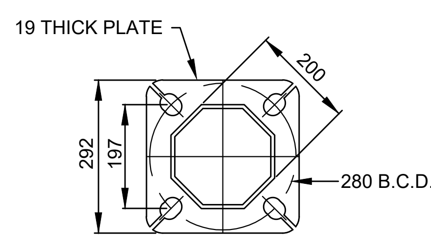
SIGNAL POSTS
(HIGHWAYS TYPE 4A &
2-6.5m SHAFTS)

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-5.15

PARTS LIST	
PART	MASS (kg)
4.5m - POST TOP LUMINAIRE POLE	55



4.5m POLE



POLE BASE PLATE

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SEE DRAWING E-5.17 FOR BOLT KIT AND POLE ASSEMBLY DETAILS.
3. ALL DIMENSION IN MILLIMETERS UNLESS OTHERWISE NOTED.
4. POST TOP POLES TO BE SUPPLIED 0.9m SHORTER WHEN INSTALLED ON A SERVICE BASE.

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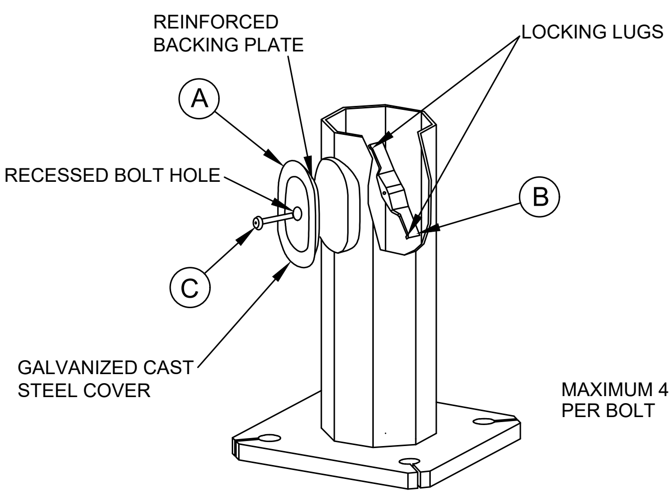
3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

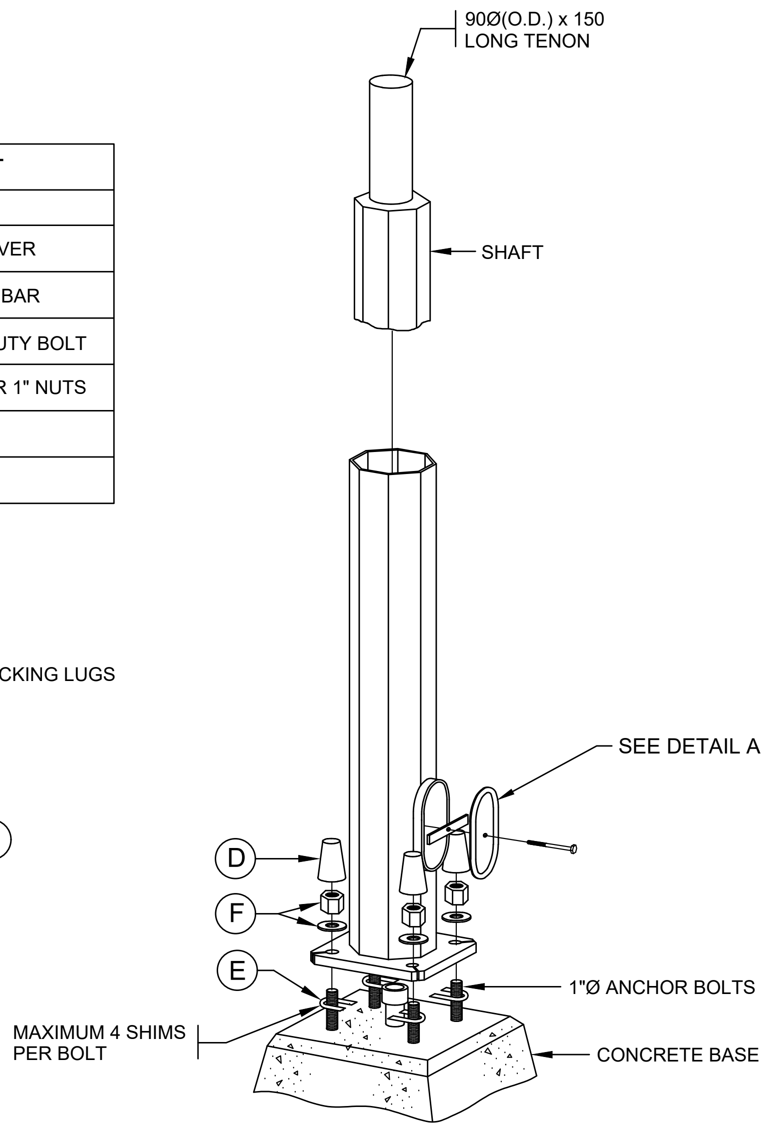
POST TOP LUMINAIRE POLES

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2019
Dwg No:	E-5.16

POST TOP POLE BOLT KIT		
ITEM	QUANTITY	DESCRIPTION
A	1	LOCKABLE HANDHOLE COVER
B	1	TAMPER PROOF BACKING BAR
C	1	TAMPER PROOF HEAVY DUTY BOLT
D	4	PLASTIC NUT COVERS FOR 1" NUTS
E	4	LEVELLING SHIMS
F	4	1"Ø NUTS AND WASHERS



DETAIL A



POLE ASSEMBLY DETAIL

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SHAFTS TO BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS TO BE SUPPLIED WITH A GALVANIZED FINISH, UNLESS OTHERWISE NOTED.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

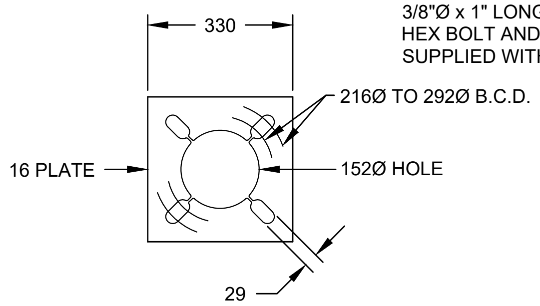
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 10 DWGS\E-5.17

3.20.2020

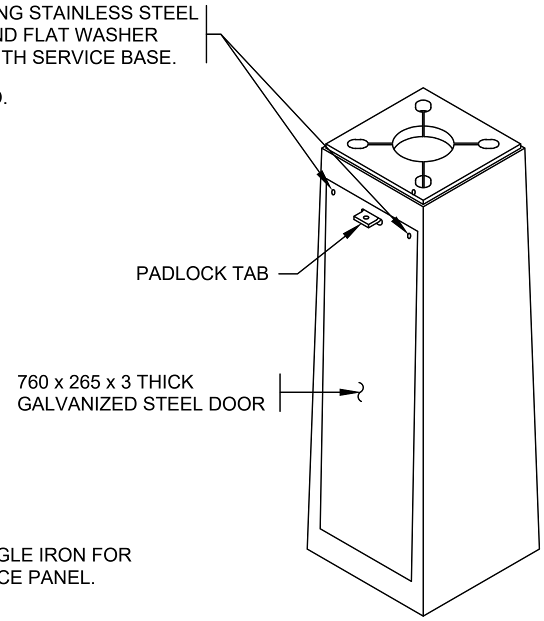
CITY OF NANAIMO
THE HARBOUR CITY

POST TOP LUMINAIRE POLES

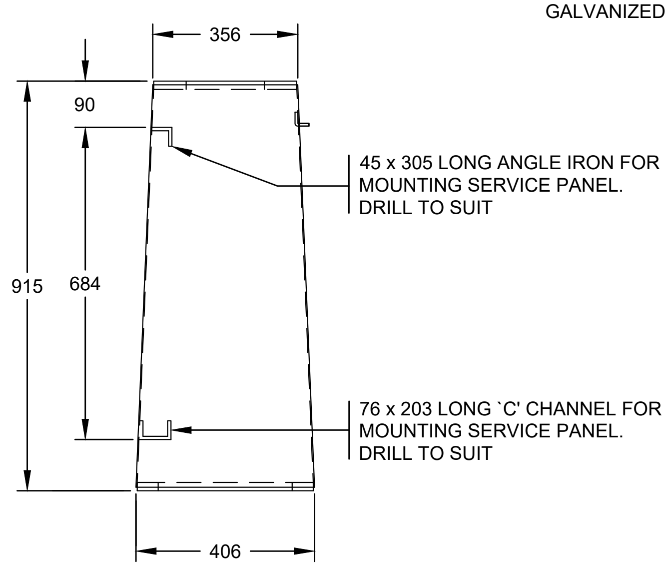
Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	E-5.17



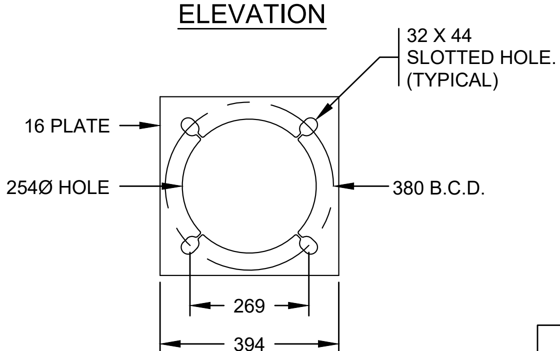
TOP VIEW



PICTORIAL VIEW



ELEVATION



BOTTOM VIEW

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SERVICE BASE TO BE USED WITH TYPE 2 SHAFTS AND POST TOP POLES ONLY.
3. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

SERVICE BASE BOLT KIT		
ITEM	QUANTITY	DESCRIPTION
POLE CONNECTION BOLTS	4	1"Ø x 3" LONG SAE GRADE 5 BOLT, NUT AND GALVANIZED 2 WASHERS.

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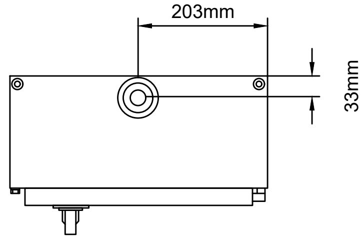
2.28.2020

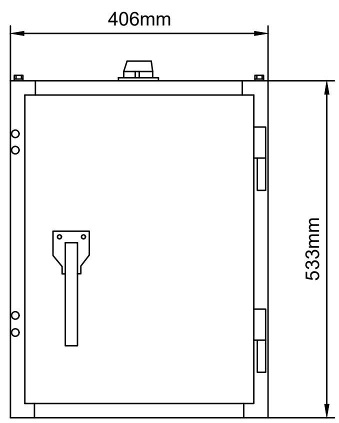
CITY OF NANAIMO
THE HARBOUR CITY

SERVICE BASE

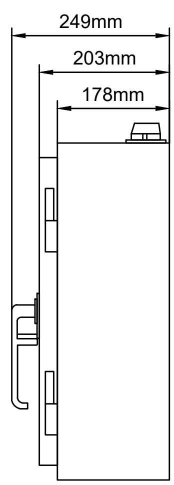
Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-5.18



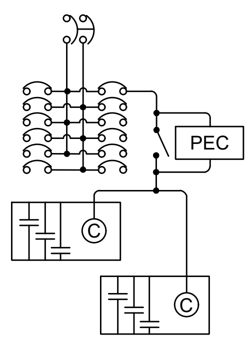
TOP VIEW



FRONT VIEW



SIDE VIEW



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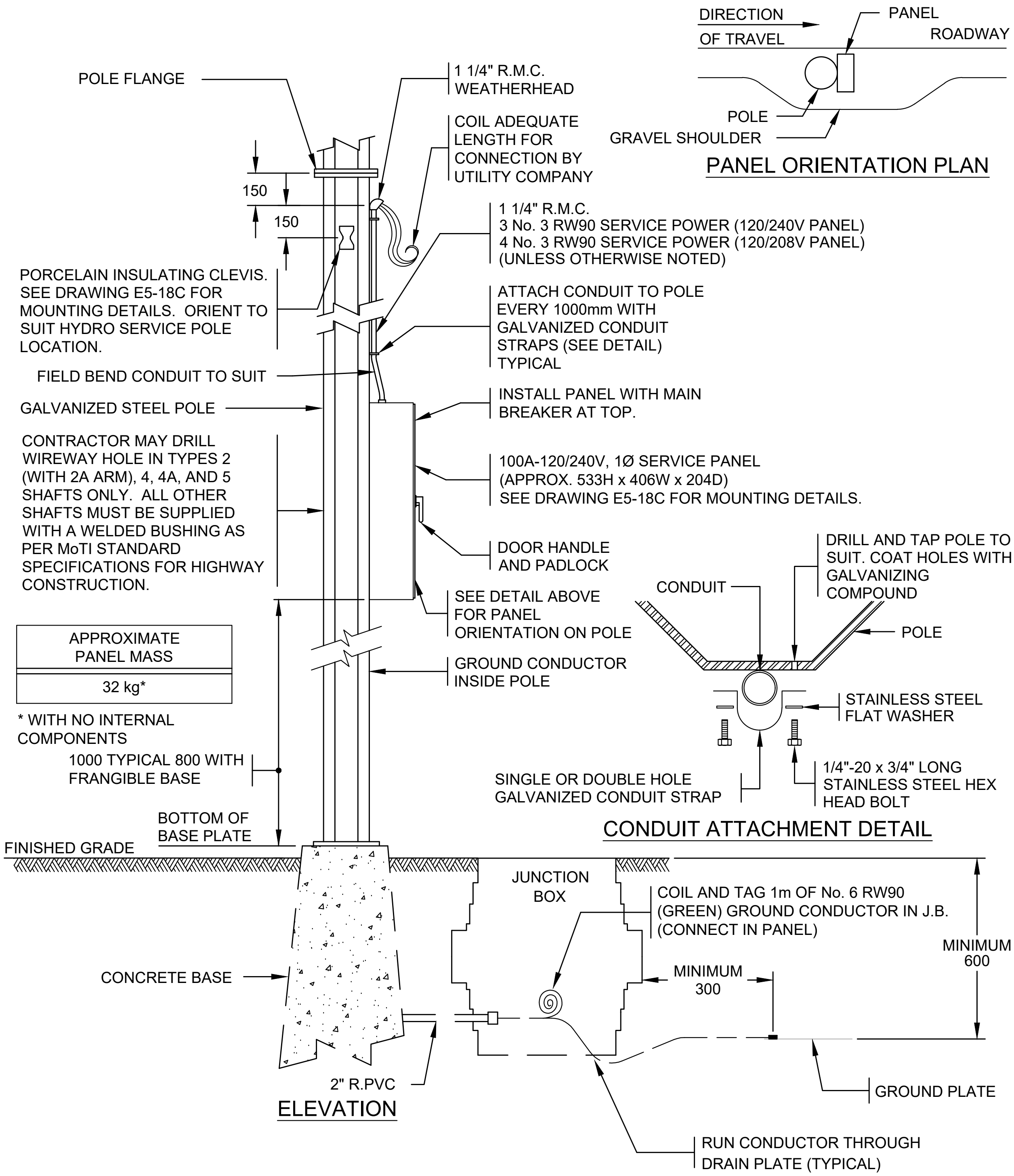
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

POLE MOUNTED SERVICE PANEL

Scale:	NTS
Created:	NOV 2012
Rev Date:	NOV 2012
Dwg No:	E-5.18A



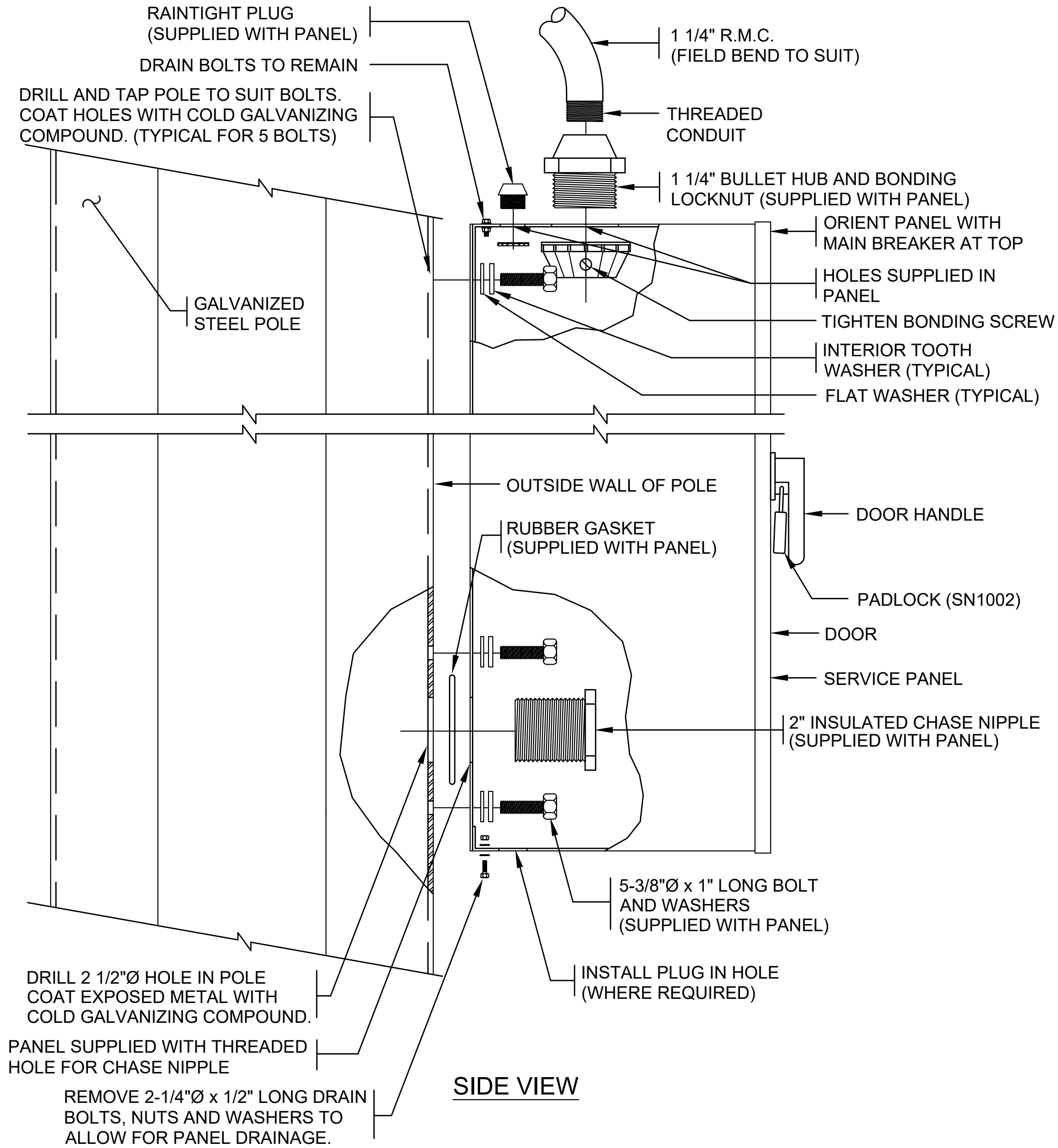
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

CITY OF NANAIMO
THE HARBOUR CITY

100A - OVERHEAD DROP SERVICE
(INSTALLATION DETAILS)

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-5.18B



SIDE VIEW

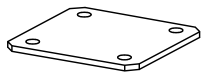
NOTES:

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
3. PANEL ASSEMBLY AND INSTALLATION INSTRUCTIONS SUPPLIED WITH PANEL.

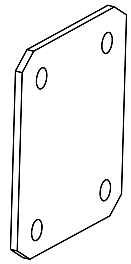
CITY OF NANAIMO
THE HARBOUR CITY

100A - OVERHEAD DROP SERVICE
(INSTALLATION DETAILS)

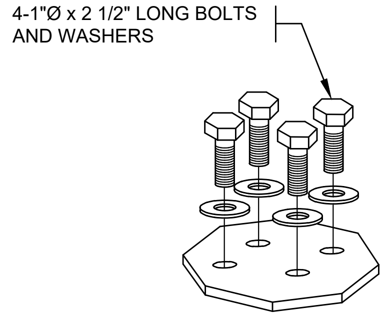
Scale:	NTS
Created:	NOV 2012
Rev Date:	NOV 2012
Dwg No:	E-5.18C



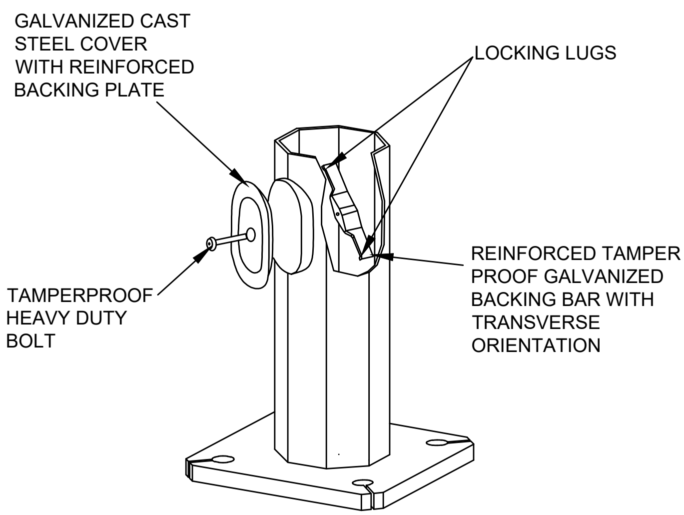
TYPE 1 FLANGE
COVER PLATE



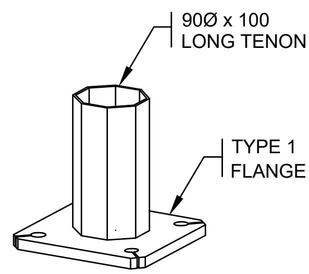
TYPE 2 FLANGE
COVER PLATE



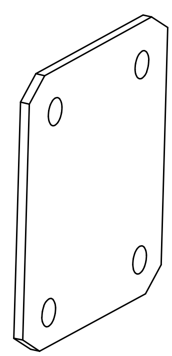
TYPE 3 FLANGE
COVER PLATE



SECURITY 4 X 7 HANDHOLE
COVER KIT



POST TOP
TENON



TYPE 8 FLANGE
COVER PLATE

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.

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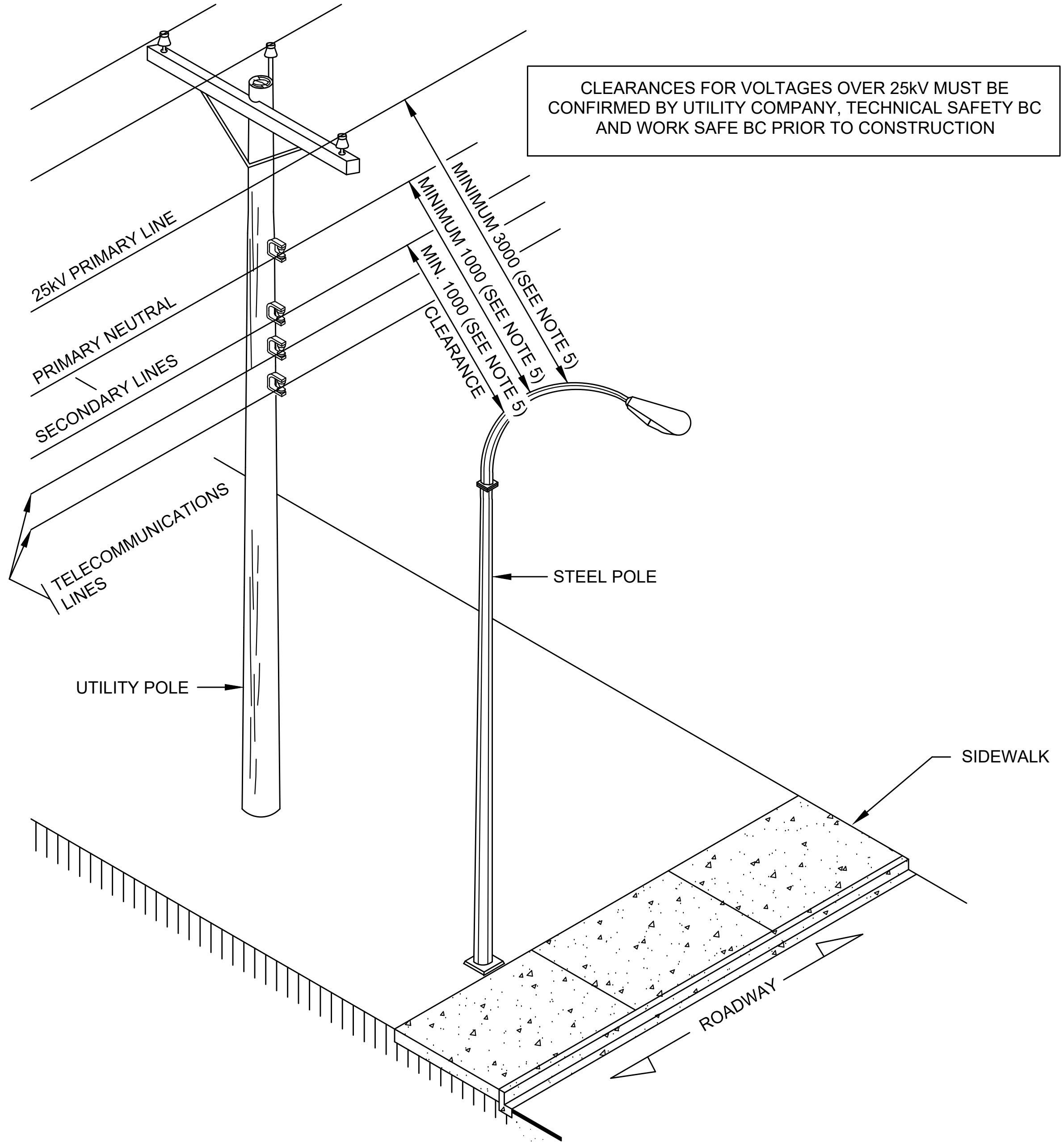
2.28.2020

CITY OF NANAIMO
THE HARBOUR CITY

POLE ACCESSORIES (HIGHWAYS TYPE)

Scale:	NTS
Created:	NOV 2012
Rev Date:	NOV 2019
Dwg No:	E-5.19



NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. CLEARANCES LISTED ABOVE ARE TO BE USED AS A GUIDELINE ONLY. EXACT REQUIRED CLEARANCES MAY VARY AND MUST BE CONFIRMED BY CONTRACTOR PRIOR TO CONSTRUCTION. AS PER THE REQUIREMENTS OF THE UTILITY COMPANY.
3. FOR CLEARANCES LESS THAN SHOWN, CONTRACTOR TO OBTAIN APPROVAL FROM UTILITY COMPANY AND WORKERS COMPENSATION BOARD PRIOR TO INSTALLATION.
4. CONTRACTOR SHALL COORDINATE WITH TELECOMMUNICATIONS UTILITIES TO INSTALL PLASTIC WEAR SHIELDS ON LINES THAT COME INTO CONTACT WITH POLES.
5. MINIMUM DISTANCE TO INCLUDE MAXIMUM SAG AND SWING.

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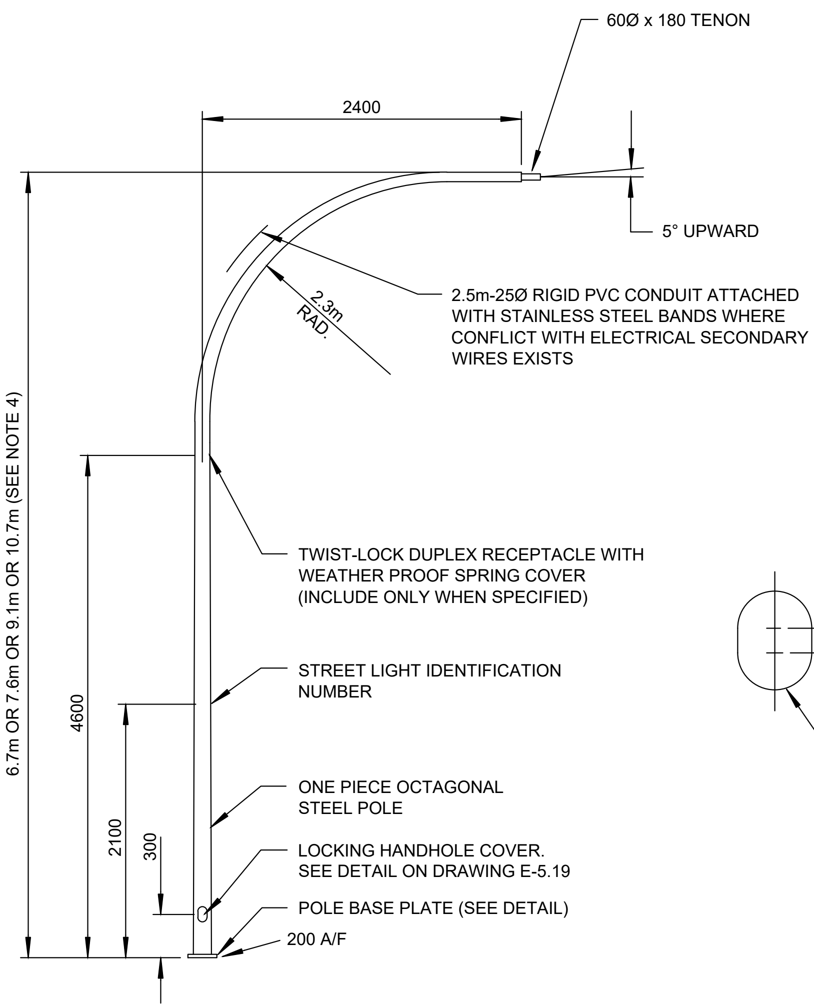
2.28.2020

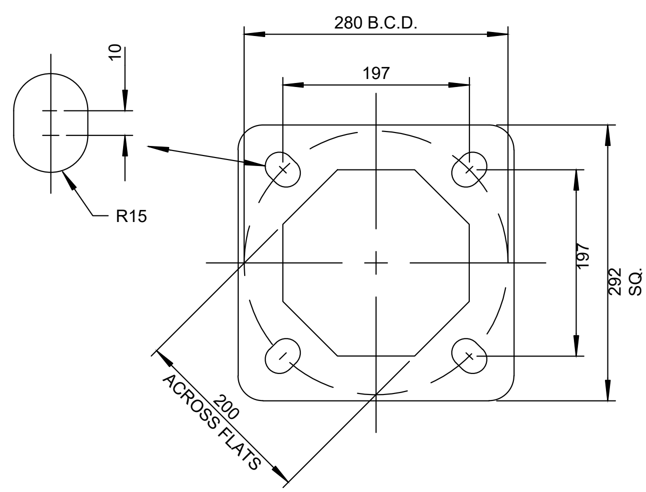
CITY OF NANAIMO
THE HARBOUR CITY

MINIMUM CLEARANCES TO OVERHEAD POWERLINES

Scale:	NTS
Created:	JAN 1998
Rev Date:	MAY 2020
Dwg No:	E-5.20



ELEVATION



POLE BASE PLATE

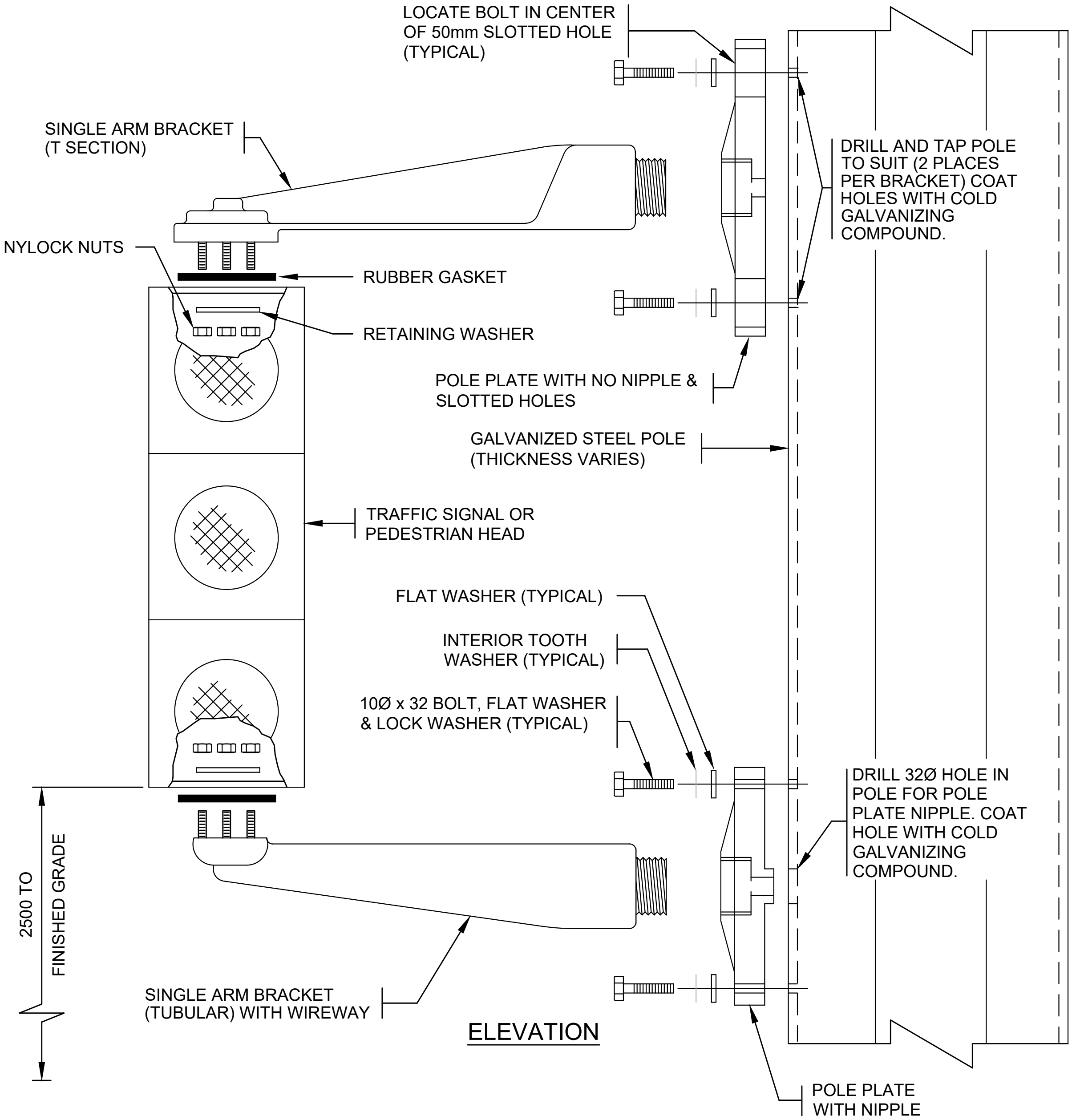
NOTES:

1. STRICT ADHERENCE TO CLEARANCES FROM HIGH VOLTAGE POWER AS SPECIFIED IN THE CANADIAN ELECTRICAL CODE IS REQUIRED
2. ALL DIMENSIONS IN MILLIMETERS UNLESS SHOWN OTHERWISE
3. POLE TO BE SUPPLIED 0.9m SHORTER WHERE BEING INSTALLED ON SERVICE BASE.
4. 6.7m AND 7.6m POLES REQUIRE APPROVAL FROM THE CITY ENGINEER.

CITY OF NANAIMO
THE HARBOUR CITY

ONE PIECE LUMINAIRE POLE FOR SINGLE FAMILY RESIDENTIAL ZONE

Scale:	NTS
Created:	JUL 1999
Rev Date:	NOV 2019
Dwg No:	E-5.21



ELEVATION

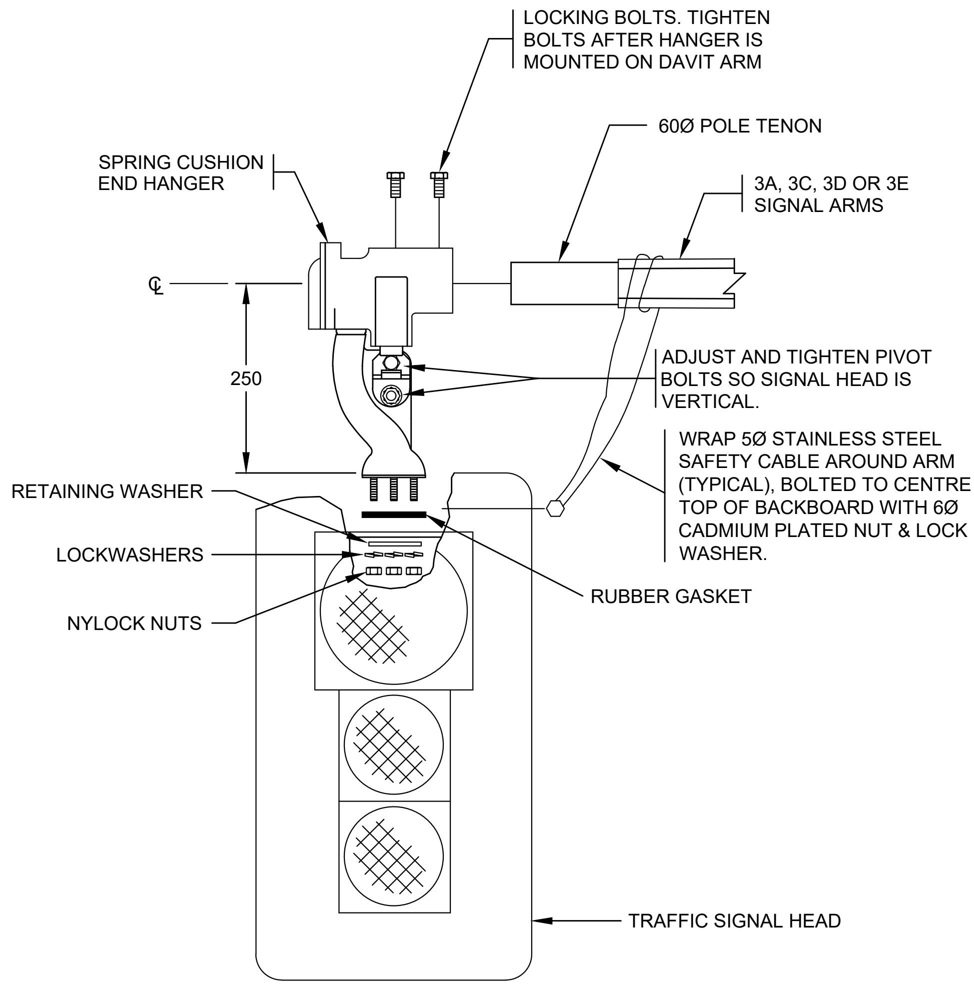
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. AIM SIGNAL HEADS AS DIRECTED BY THE CITY ENGINEER.
3. WHERE 3 OR MORE SIDE MOUNT SIGNAL HEADS ARE REQUIRED ON POLE, LOCATE 3rd & 4th PEDESTRIAN HEAD ARM BRACKETS WITH WIREWAY & POLE PLATE WITH NIPPLE TO TOP OF HEAD TO AVOID EXCESSIVE DRILLING OF POLE IN ONE AREA.
4. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

CITY OF NANAIMO
THE HARBOUR CITY

SIDE OF POLE SIGNAL HEAD MOUNTING

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-6.1



ELEVATION

NOTES:

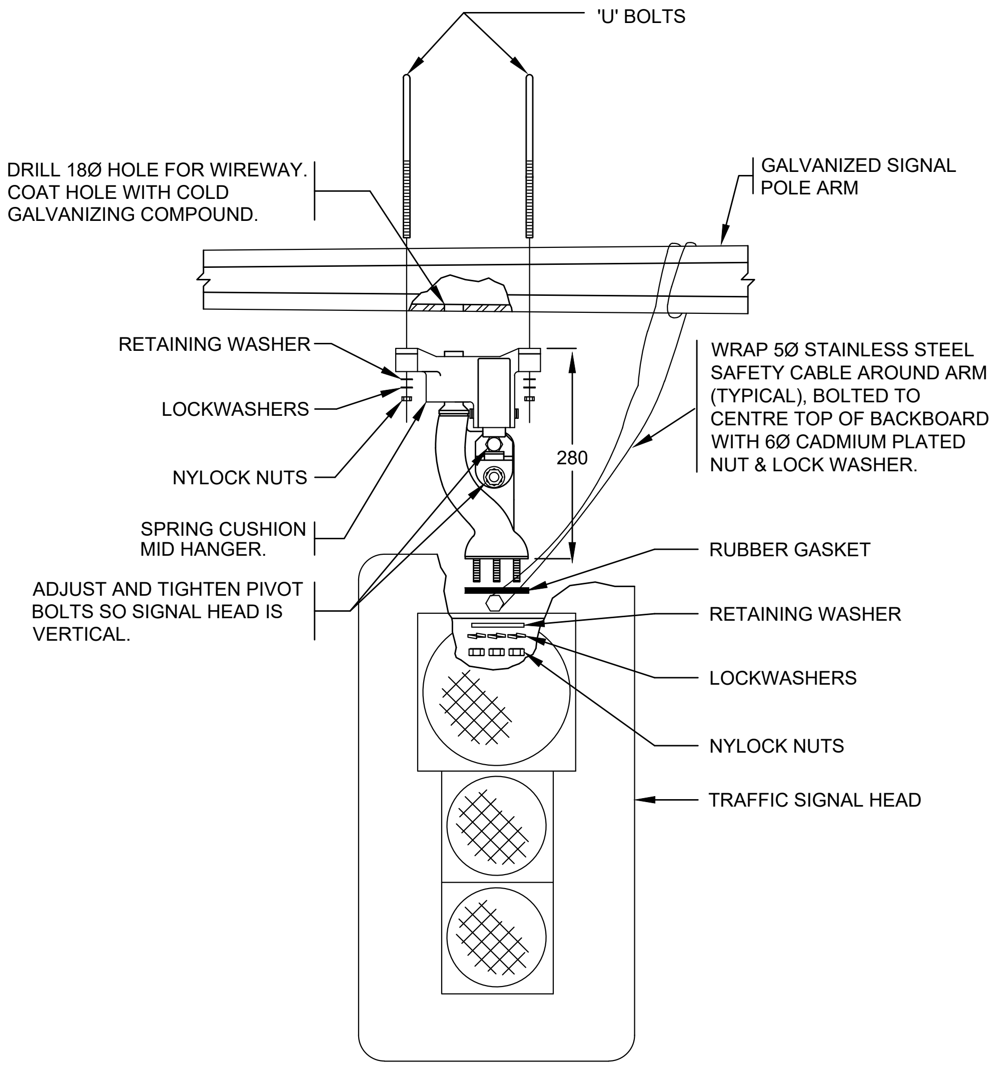
1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. AIM SIGNAL HEADS AS DIRECTED BY THE CITY ENGINEER.
3. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

CITY OF NANAIMO
THE HARBOUR CITY

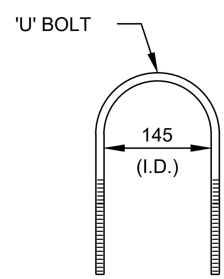
3.2.2020

OVERHEAD SIGNAL HEAD MOUNTING WITH SPRING CUSHION END HANGER

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-6.2



ELEVATION



SIDE VIEW

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. AIM SIGNAL HEADS AS DIRECTED BY THE CITY ENGINEER.
3. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

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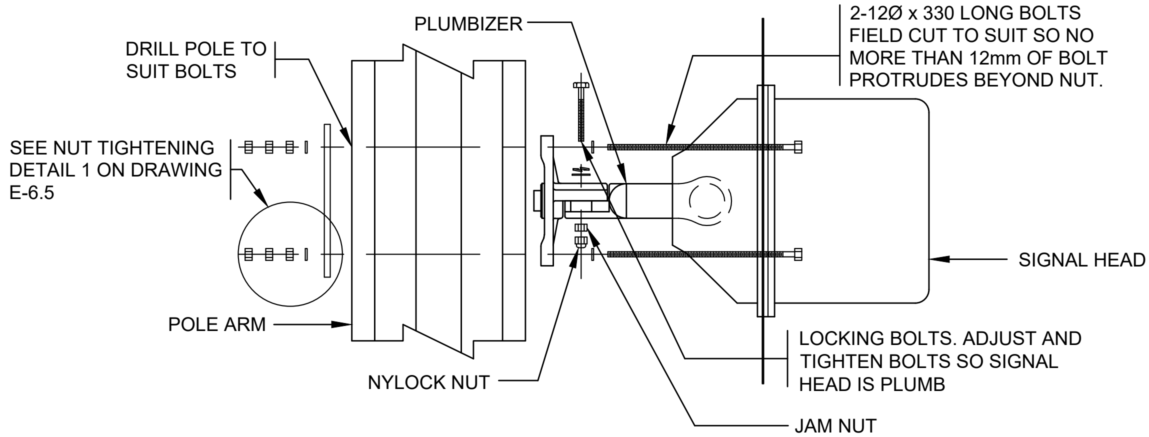
3.2.2020

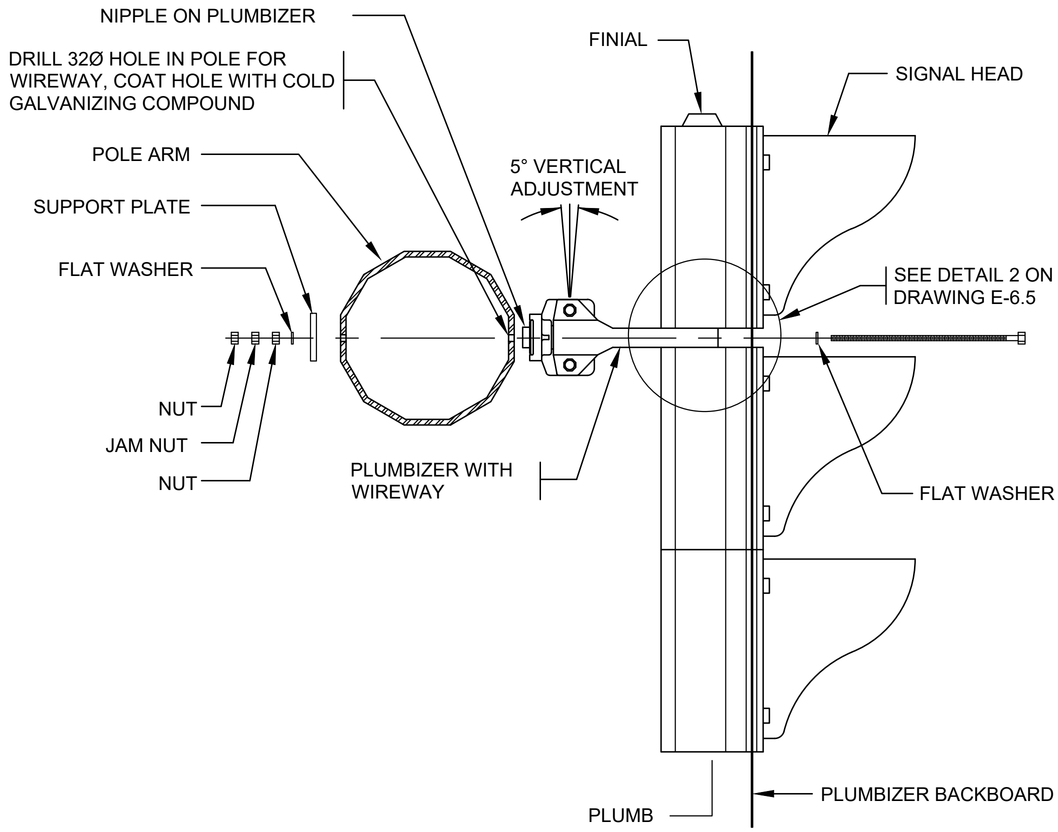
CITY OF NANAIMO
THE HARBOUR CITY

OVERHEAD SIGNAL HEAD MOUNTING WITH SPRING CUSHION MID HANGER

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-6.3



TOP VIEW



ELEVATION

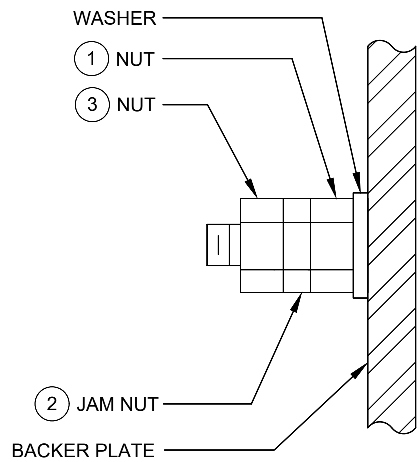
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. AIM SIGNAL HEADS AS DIRECTED BY THE CITY ENGINEER.

CITY OF NANAIMO
THE HARBOUR CITY

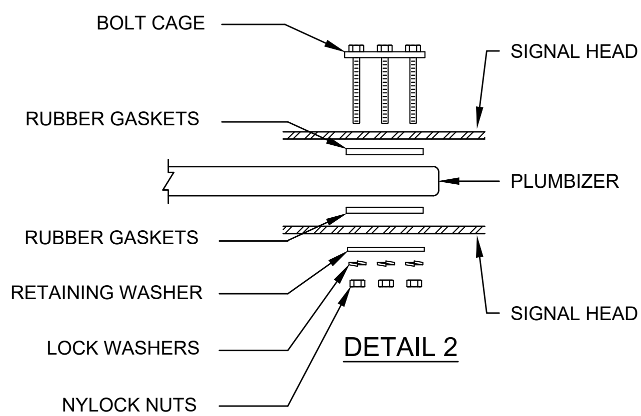
OVERHEAD SIGNAL HEAD MOUNTING WITH PLUMBIZER

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2016
Dwg No:	E-6.4



- TIGHTEN NUT (1) AGAINST WASHER,
- TIGHTEN JAM NUT (2) AGAINST NUT,
- SNUG NUT (3) AGAINST JAM NUT (2) AND THEN TIGHTEN NUT (3) AND JAM NUT (2) INTO EACH OTHER.

DETAIL 1



DETAIL 2

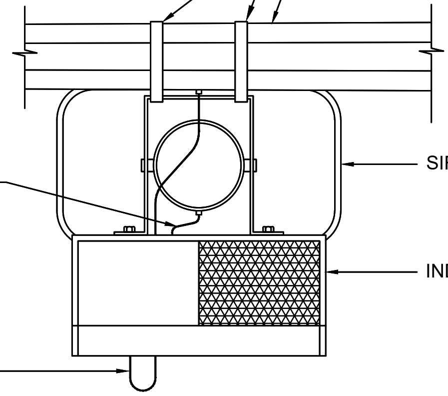
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. AIM SIGNAL HEADS AS DIRECTED BY THE CITY ENGINEER.

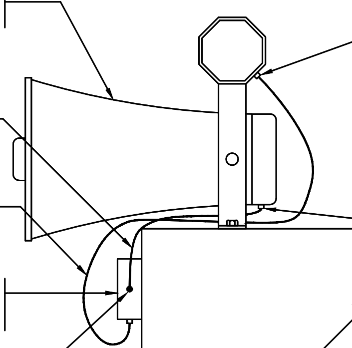
CITY OF NANAIMO
THE HARBOUR CITY

OVERHEAD SIGNAL HEAD MOUNTING WITH PLUMBIZER

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2016
Dwg No:	E-6.5



FRONT VIEW



SIDE VIEW

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. PRE-EMPTION UNIT IS TO BE SUPPLIED BY THE CITY OF NANAIMO AND INSTALLED BY THIS CONTRACTOR.
3. AIM, ADJUST SIREN PRE-EMPTION UNIT AS DIRECTED BY THE CITY ENGINEER.

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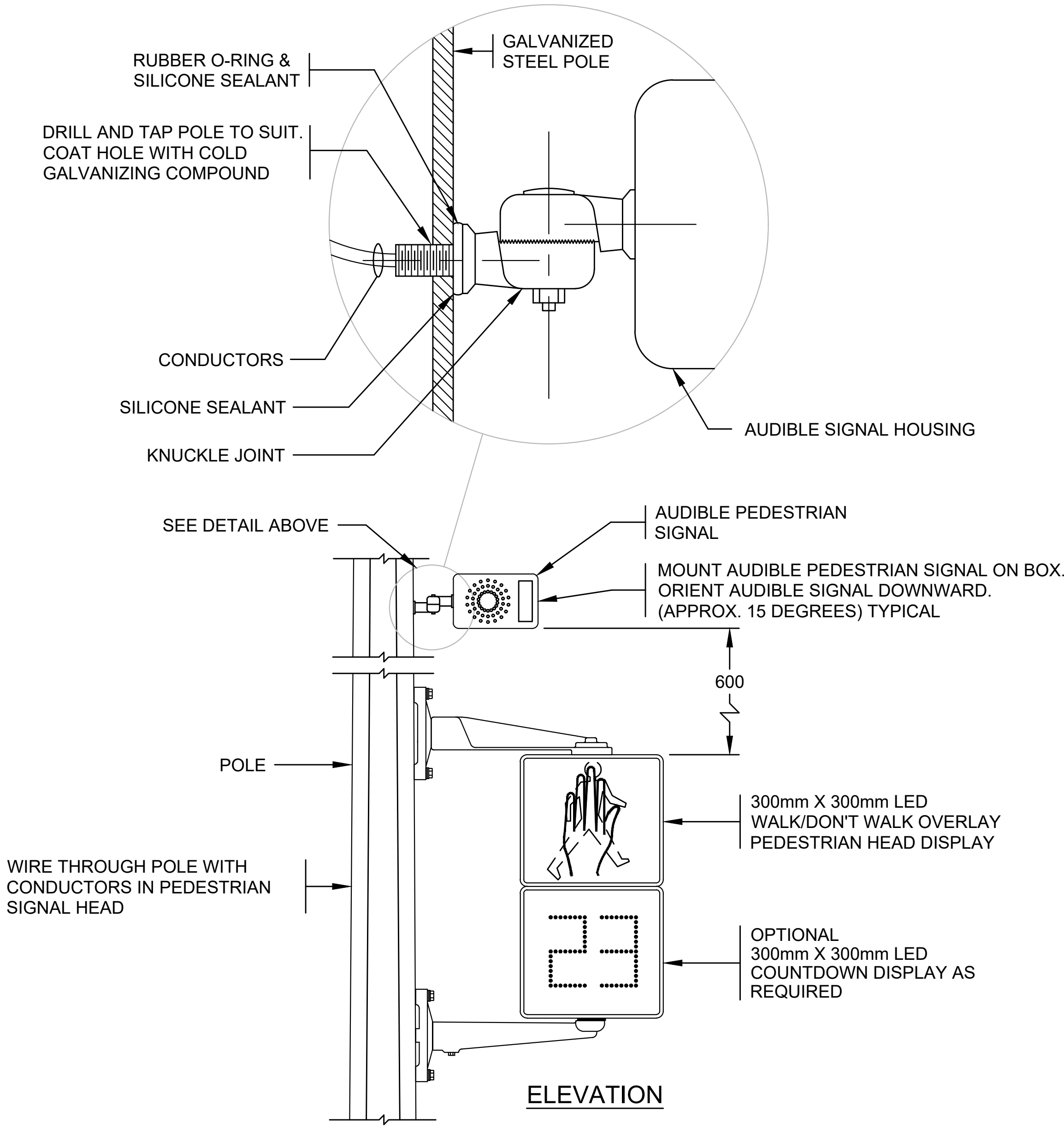
3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

EMERGENCY VEHICLE SIREN-ACTIVATED
PRE-EMPTION UNIT

Scale:	NTS
Created:	MAY 2001
Rev Date:	NOV 2019
Dwg No:	E-6.6



ELEVATION

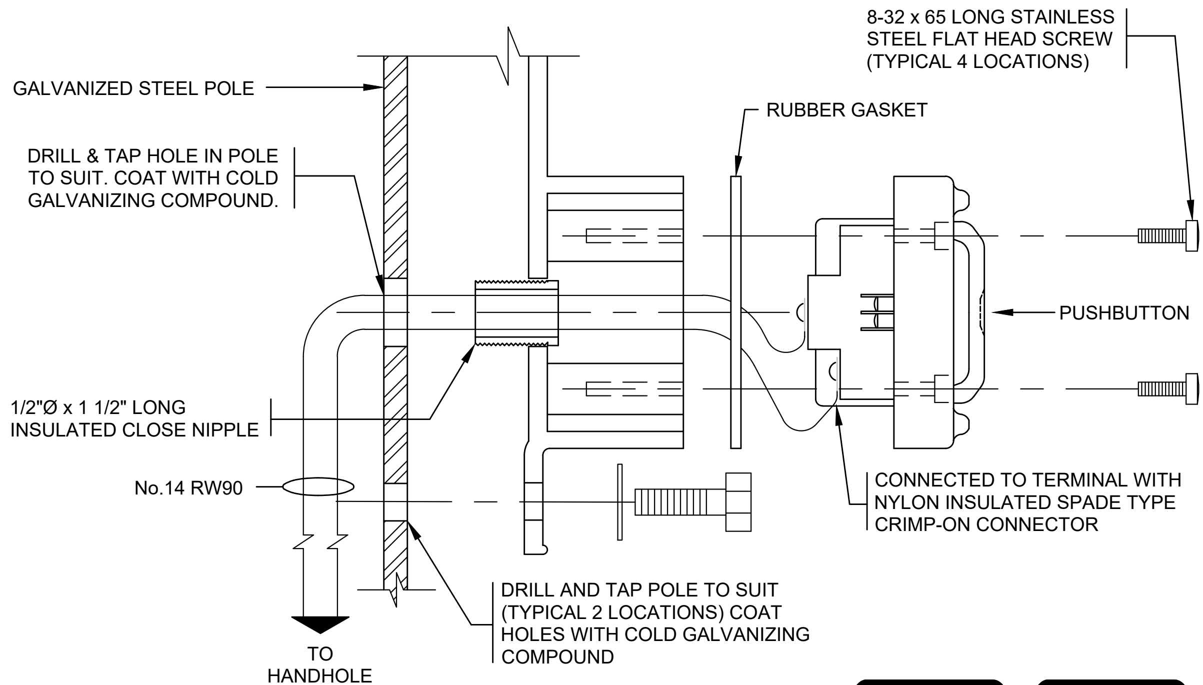
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. AIM, ADJUST AND CONNECT AUDIBLE SIGNAL AS PER MANUFACTURERS INSTRUCTIONS TO SATISFACTION THE CITY ENGINEER.
3. AUDIBLE SIGNAL TO `CHIRP' FOR EAST TO WEST CROSSINGS & `CUCKOO' FOR NORTH TO SOUTH CROSSINGS. AT INTERSECTIONS WHERE NORTH/SOUTH AND EAST/WEST ARE NOT EASILY DEFINED CONTACT CITY ENGINEER FOR DIRECTION.
4. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.
5. ORDER AUDIBLE SIGNAL HEAD WITH MINIMUM 3.0m OF CONDUCTORS.

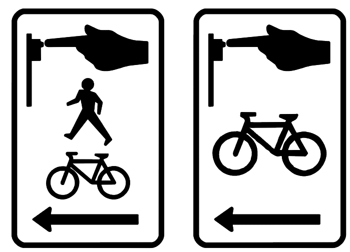
CITY OF NANAIMO
THE HARBOUR CITY

PEDESTRIAN & AUDIBLE SIGNALS

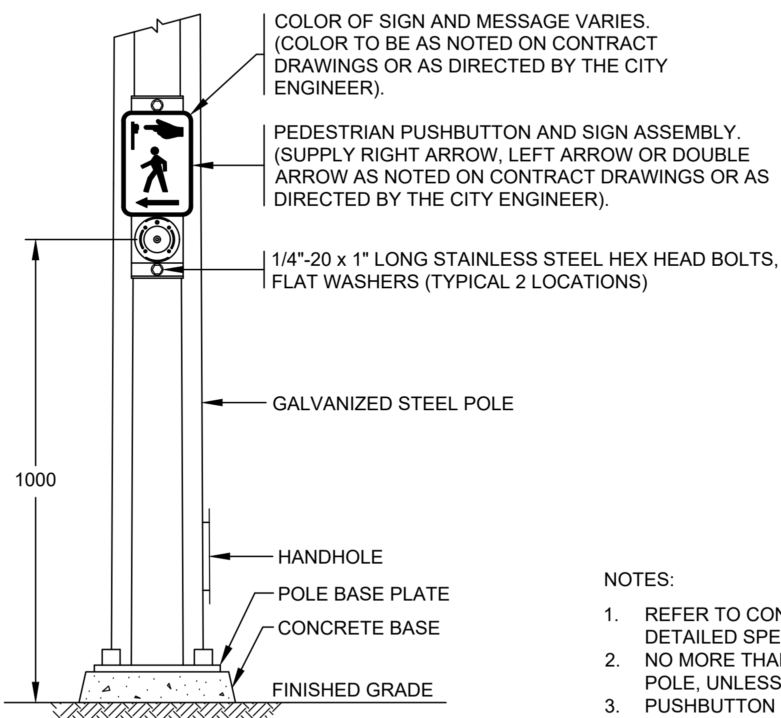
Scale:	NTS
Created:	MAY 2003
Rev Date:	MAY 2003
Dwg No:	E-7.1



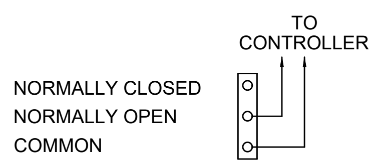
SIDE VIEW



ALTERNATE
PEDESTRIAN PUSHBUTTON
SIGNS



ELEVATION



PEDESTRIAN PUSHBUTTON
CONNECTIONS

NOTES:

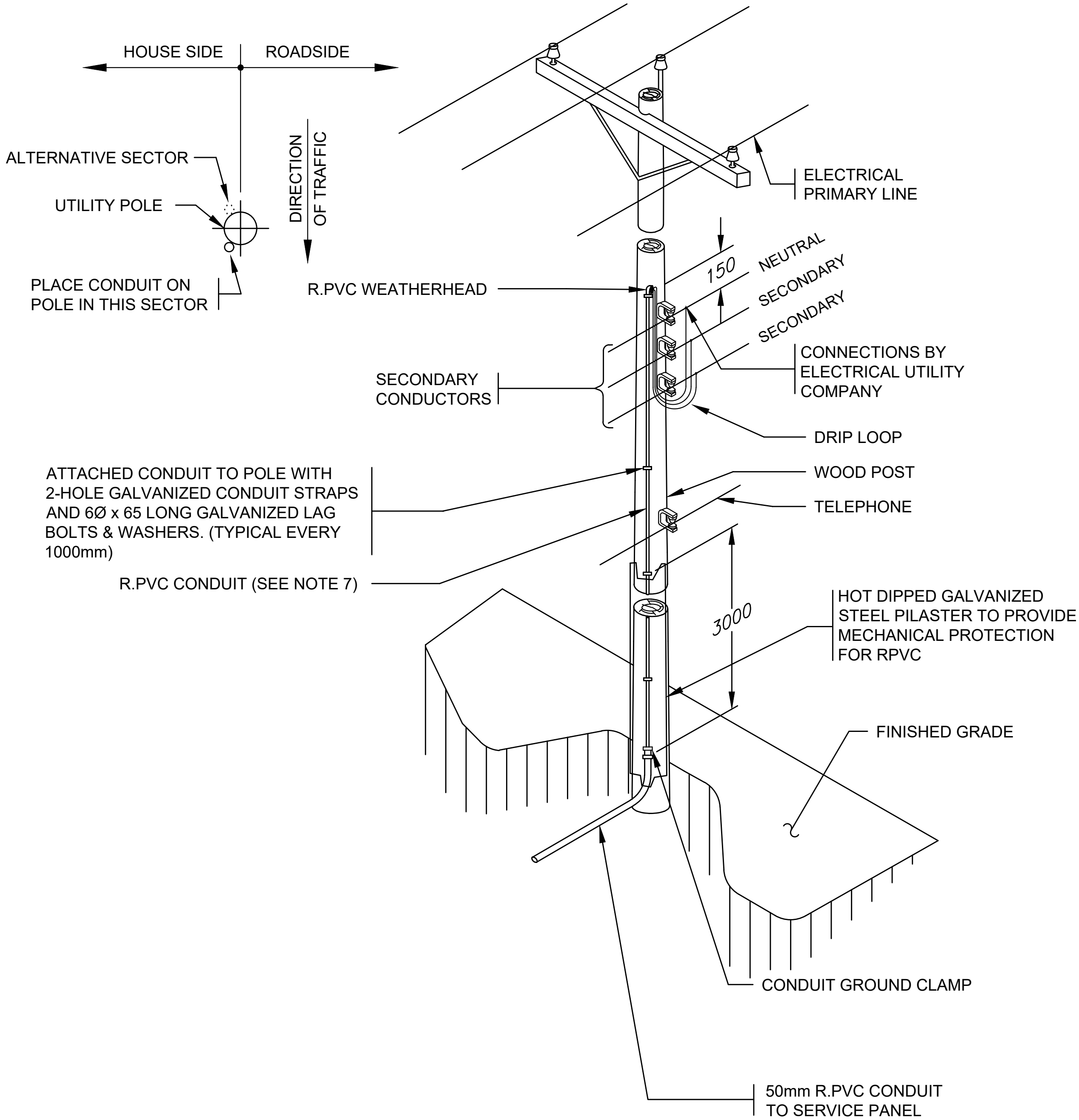
1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. NO MORE THAN 2 PUSHBUTTONS TO BE INSTALLED ON EACH POLE, UNLESS OTHERWISE NOTED.
3. PUSHBUTTON TO HAVE NORMALLY OPEN CONTACTS.
4. CYCLIST PUSHBUTTON TO BE INSTALLED AS DIRECTED ON THE DRAWINGS OR BY THE CITY ENGINEER.
5. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

PEDESTRIAN PUSHBUTTON WITH
INTEGRAL SIGN

Scale:	NTS
Created:	MAY 2001
Rev Date:	NOV 2016
Dwg No:	E-8.1



NOTES:

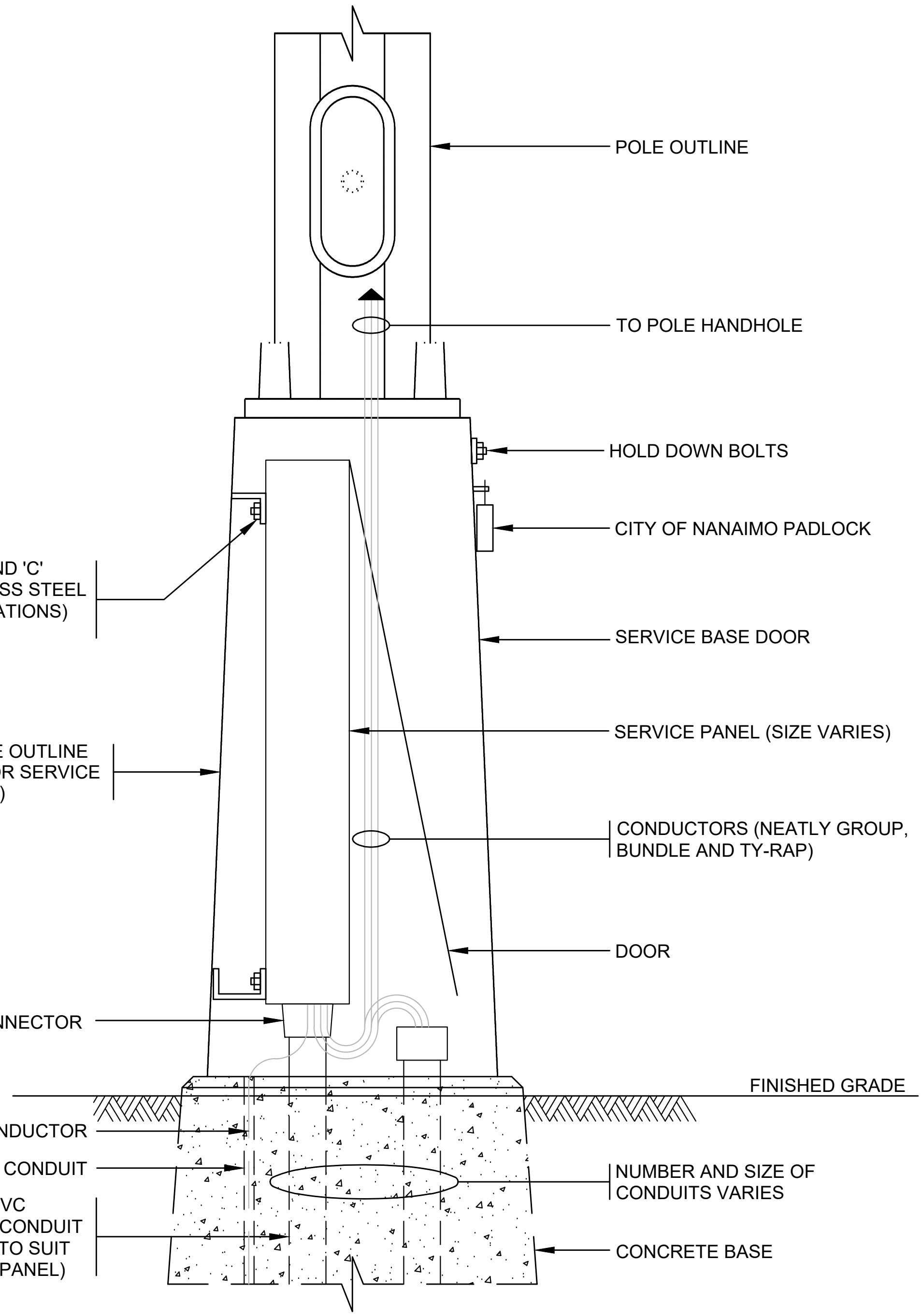
1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF SERVICE CONDUCTORS. CONNECTION BY ELECTRICAL UTILITY COMPANY UNLESS OTHERWISE NOTED.
3. CONTRACTOR TO OBTAIN PERMISSION FROM UTILITY COMPANY PRIOR TO INSTALLING CONDUIT ON THEIR POLE.
4. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.
5. SERVICE CONDUCTORS AS DETAILED ON CONTRACT DRAWINGS.
6. MOUNT CONDUIT ON CONCRETE POLE WITH 19mm STAINLESS STEEL BANDING.
7. CONDUIT UP POLE TO SUIT SERVICE CONDUCTORS (MINIMUM 30mmØ).

3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

UNDERGROUND DIP SERVICE

Scale:	NTS
Created:	NOV 2012
Rev Date:	NOV 2016
Dwg No:	E-9.1



NOTES:

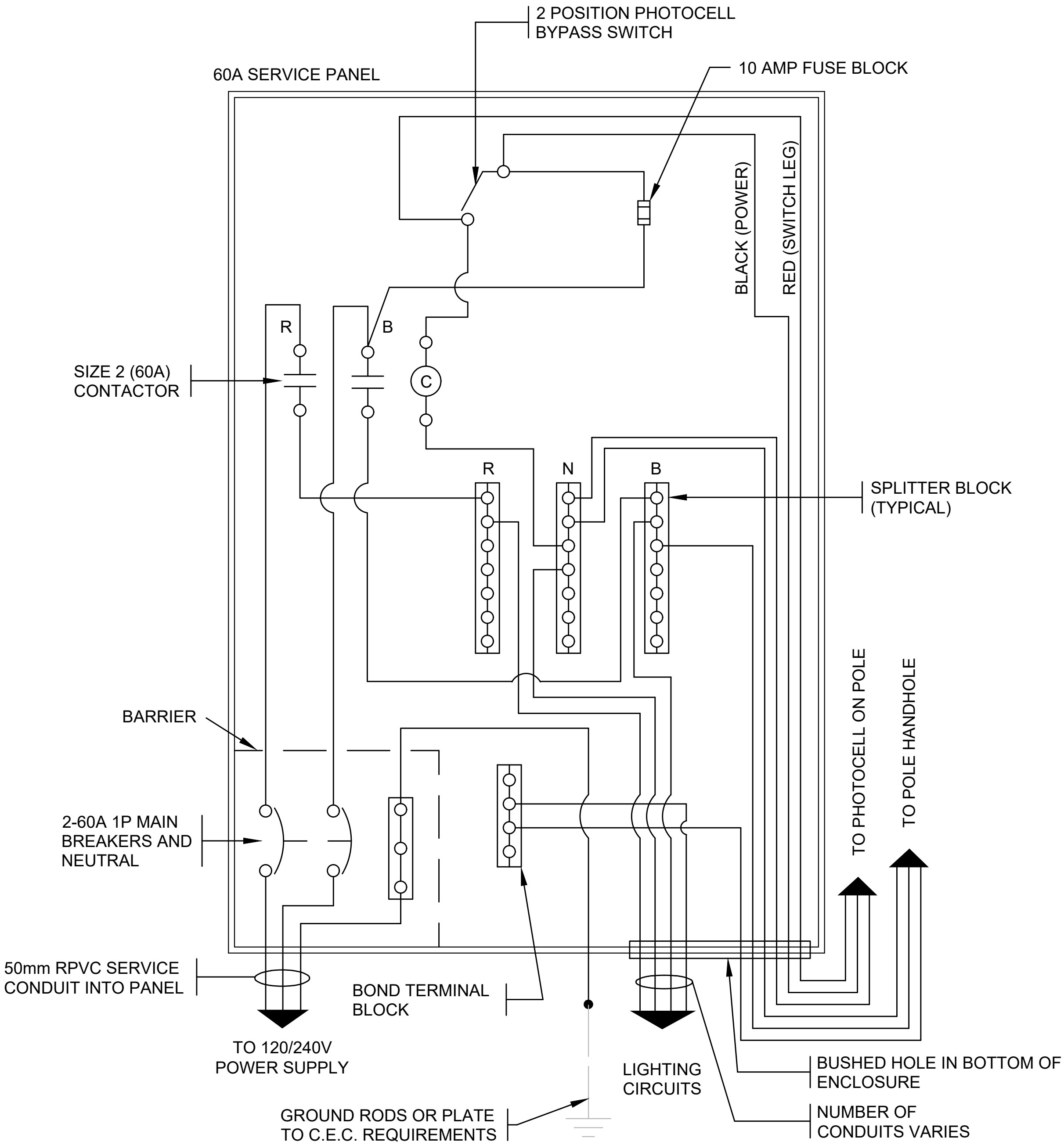
1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.

3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

SERVICE PANEL IN SERVICE BASE

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-10.1



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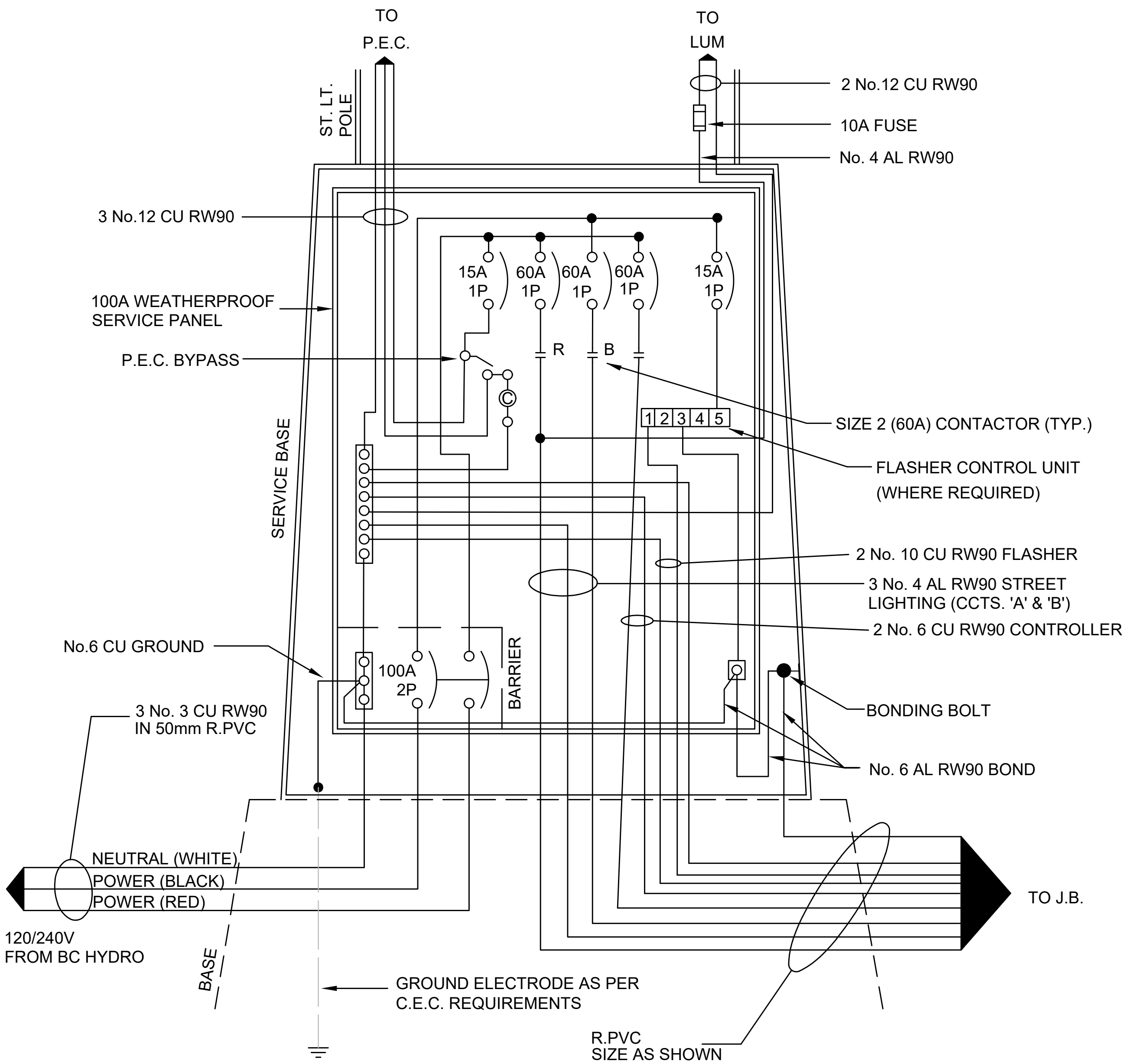
3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

TYPICAL 60A STREET LIGHTING WIRING
DIAGRAM (FOR USE IN SERVICE BASE)

Scale:	NTS
Created:	NOV 2012
Rev Date:	NOV 2012
Dwg No:	E-10.3



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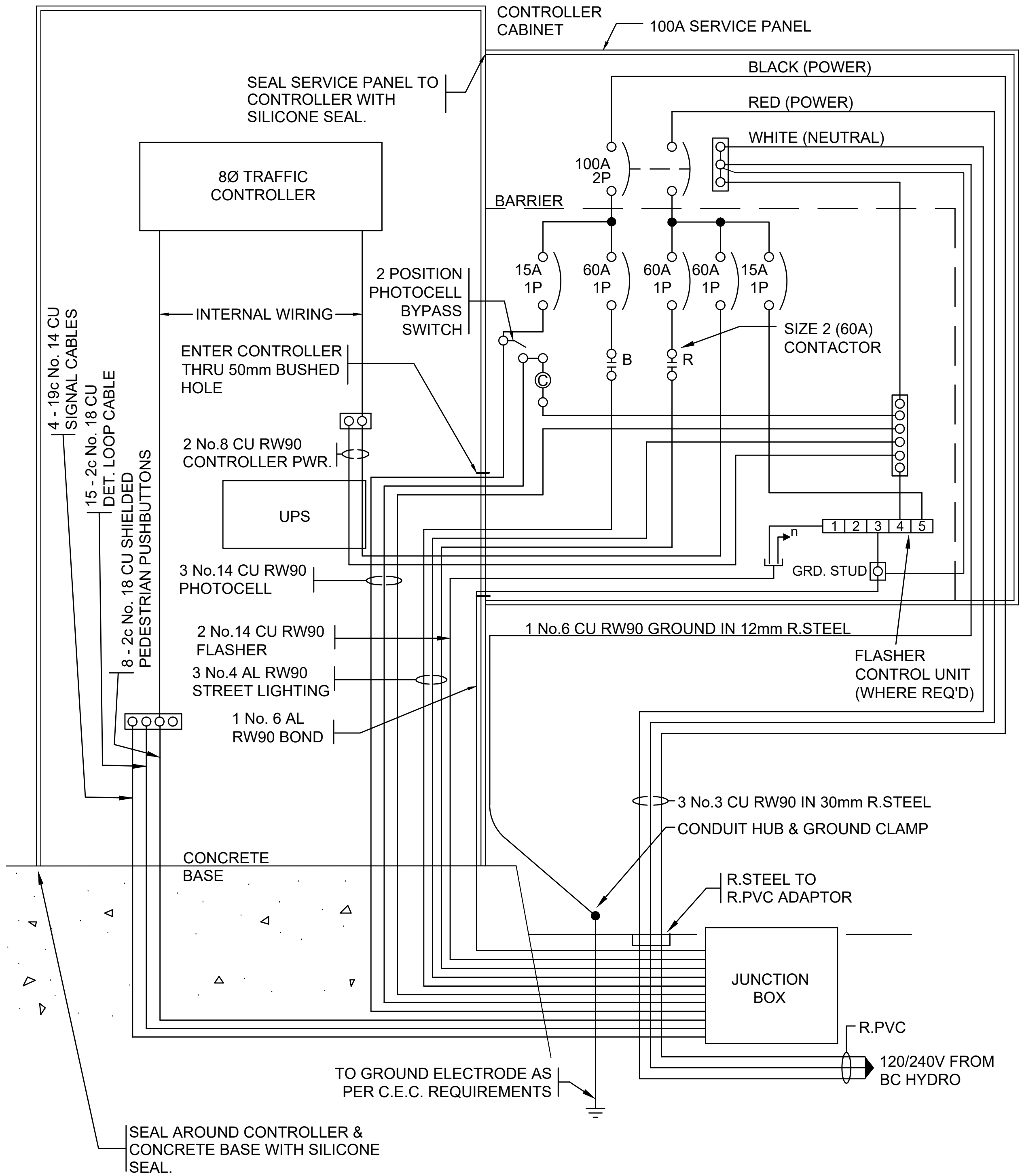
3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

TYPICAL 100A TRAFFIC SIGNAL / STREET LIGHTING / WIRING DIAGRAM (FOR USE IN SERVICE BASE)

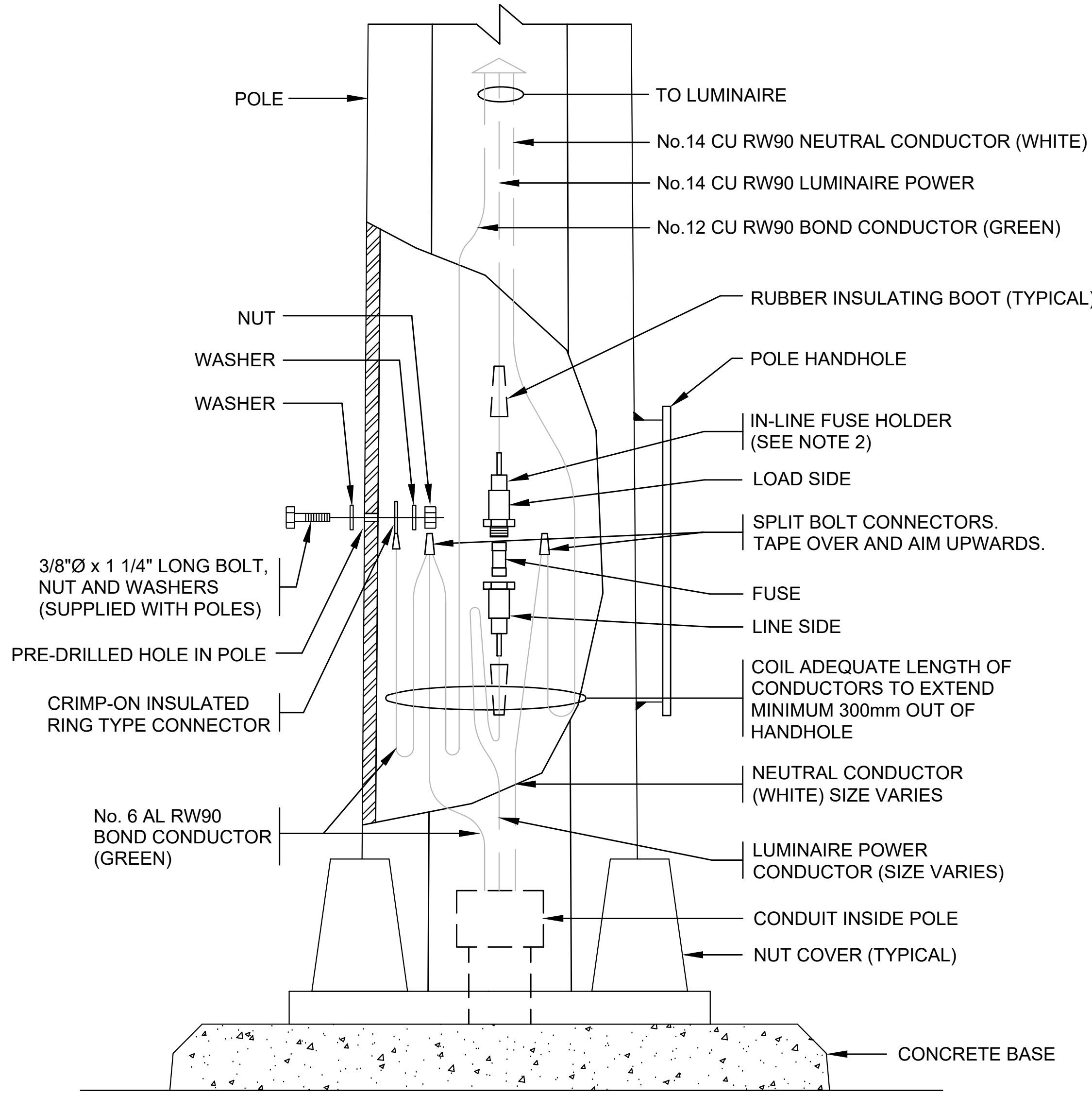
Scale:	NTS
Created:	NOV 2012
Rev Date:	NOV 2019
Dwg No:	E-10.4



CITY OF NANAIMO
THE HARBOUR CITY

WIRING DIAGRAM

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2019
Dwg No:	E-10.5



ELEVATION

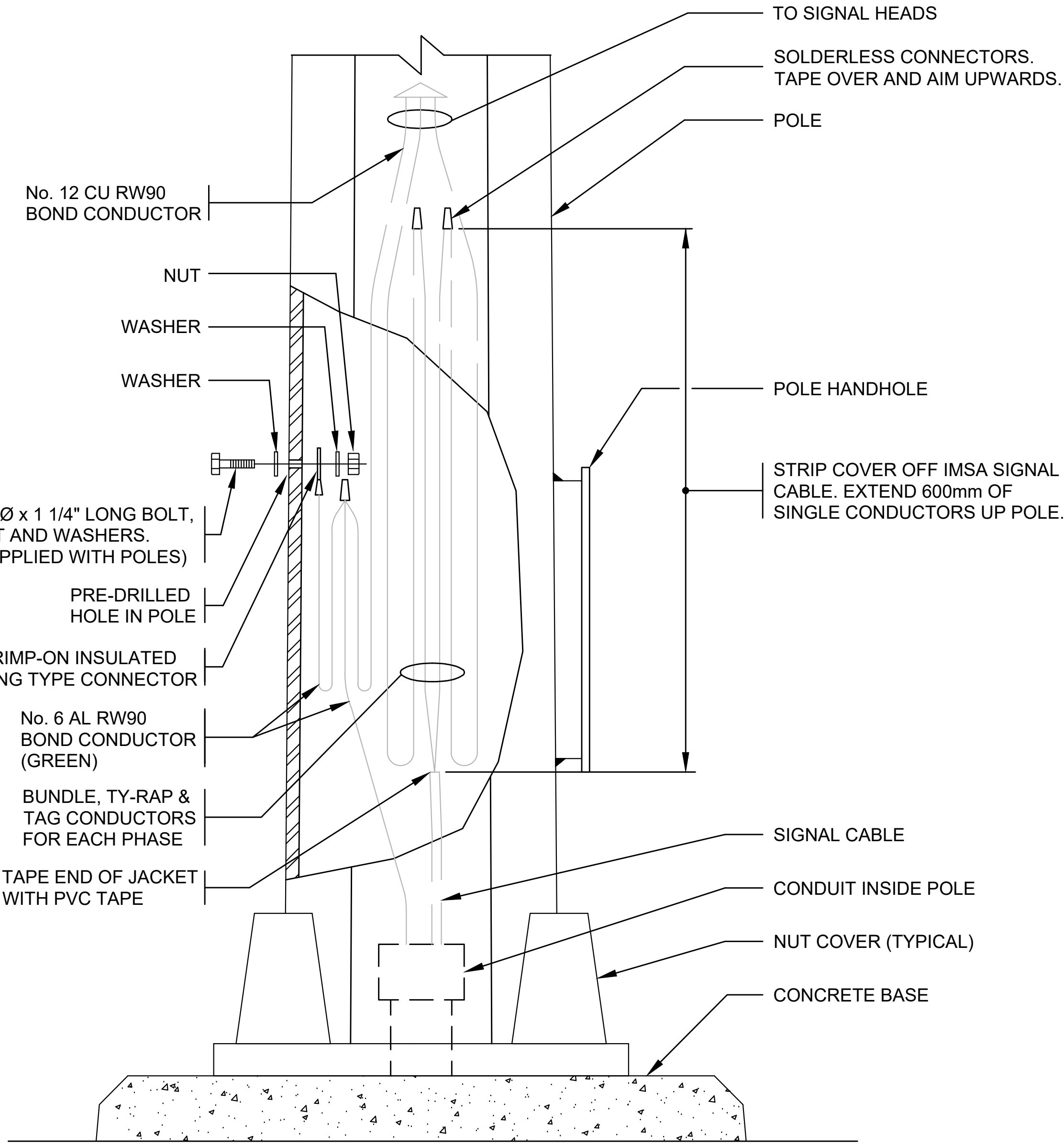
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. FUSE INSTALLATION IN JUNCTION BOXES SIMILAR.

CITY OF NANAIMO
THE HARBOUR CITY

LUMINAIRE WIRING IN POLE HANDHOLE

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-12.1



ELEVATION

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.

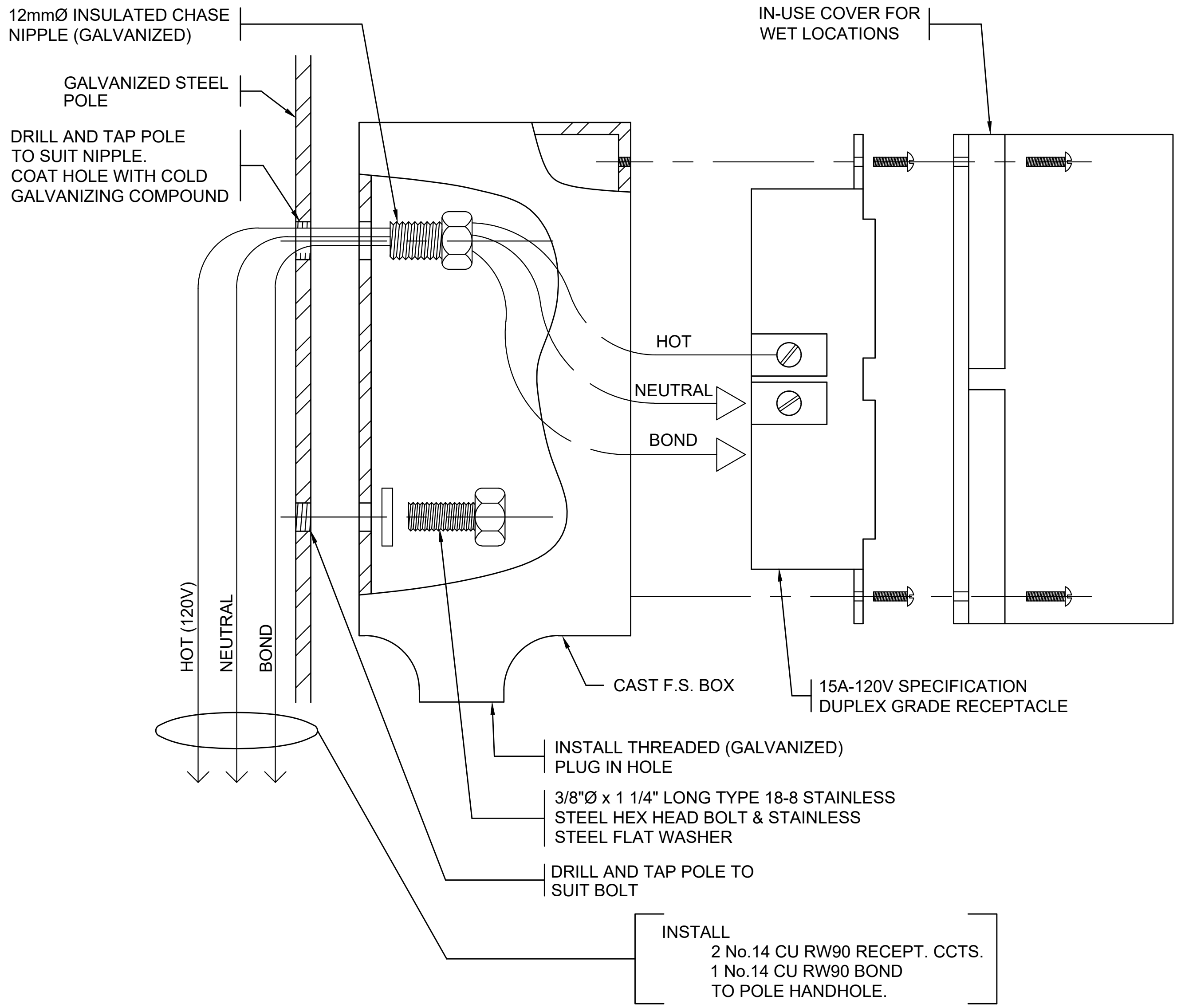
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 10 DWGS\E-12.2

3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

SIGNAL CABLE WIRING IN POLE HANDHOLE

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2019
Dwg No:	E-12.2



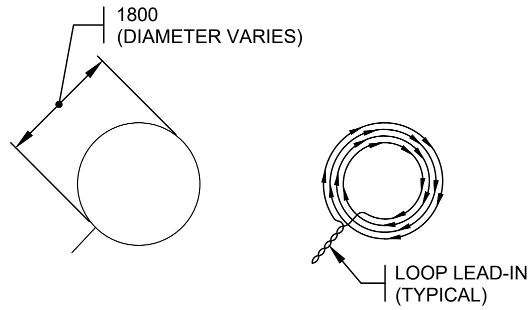
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. RECEPTACLE MOUNTING HEIGHT AND ORIENTATION ON POLE TO BE NOTED ON CONTRACT DRAWING.
3. FUSE RECEPTACLE CIRCUITS, WITH A 10AMP FUSE, IN HANDHOLE AT BASE OF POLE AS PER DRAWING E12-1.
4. RECEPTACLES TO NOT BE INSTALLED ON POLES WITHIN 50m OF A SIGNALIZED INTERSECTION AND NOT UNDER ANY CIRCUMSTANCES TO BE INSTALLED ON TRAFFIC SIGNAL OR SIGN POLES.

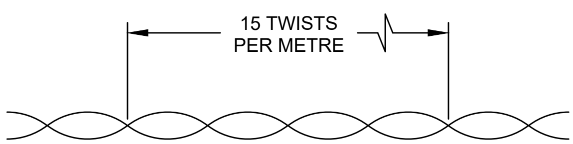
CITY OF NANAIMO
THE HARBOUR CITY

POLE MOUNTED RECEPTACLE

Scale:	NTS
Created:	JAN 1998
Rev Date:	MAY 2020
Dwg No:	E-13.1



ROUND LOOP



LOOP LEAD-IN CONDUCTORS

(TYPICAL FROM LOOP TO SHIELDED
CABLE SPLICE IN JUNCTION BOX)

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.
3. LOOP INDUCTANCE TO BE EQUAL TO OR GREATER THAN SHIELDED CABLE INDUCTANCE. (A 2:1 RATIO IS PREFERABLE) SHIELDED CABLE INDUCTANCE IS 0.72 μH PER METER.

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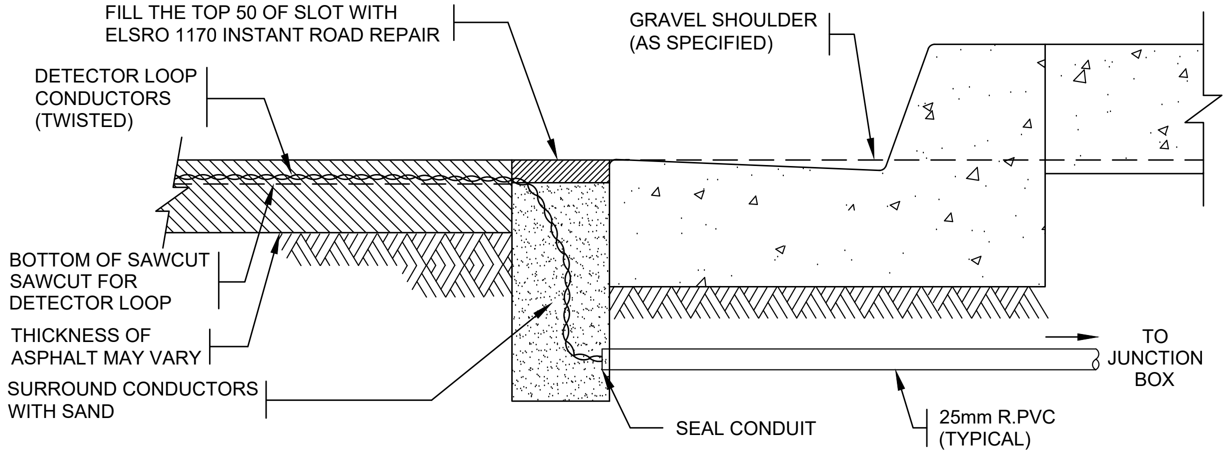
3.3.2020

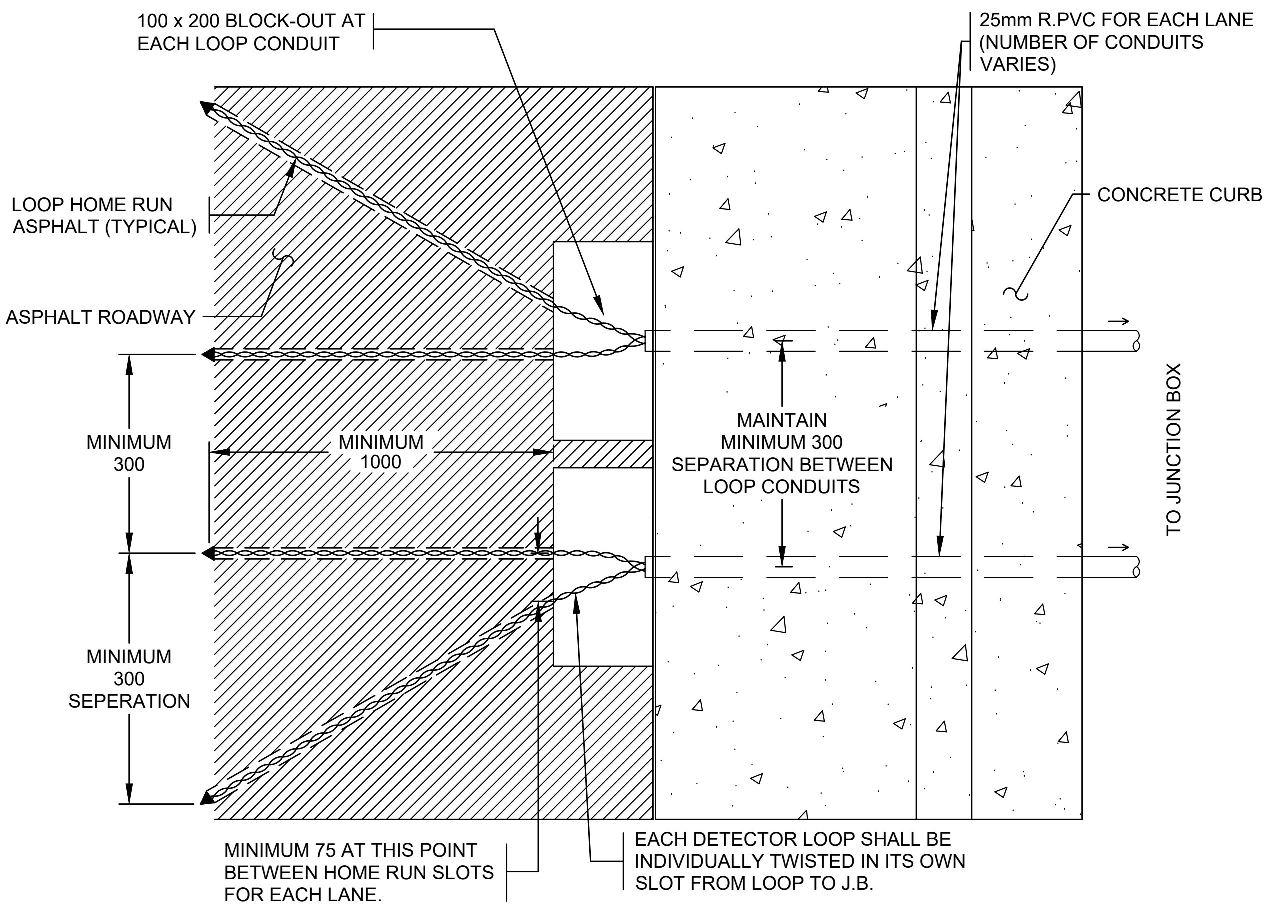
CITY OF NANAIMO
THE HARBOUR CITY

ROUND TRAFFIC SIGNAL DETECTOR LOOP

Scale:	N.T.S.
Created:	NOV. 2009
Rev Date:	MAY 2020
Dwg No:	E-14.1



ELEVATION



TOP VIEW

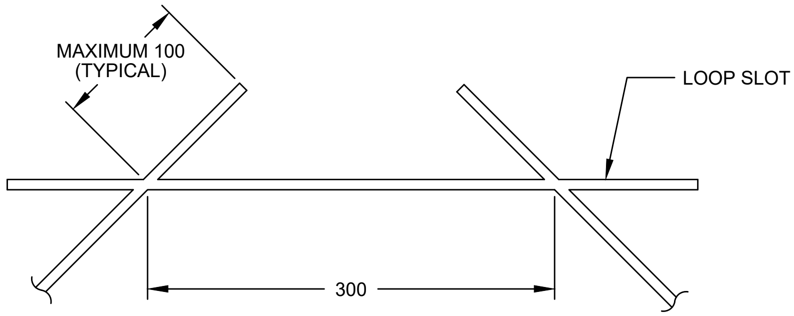
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

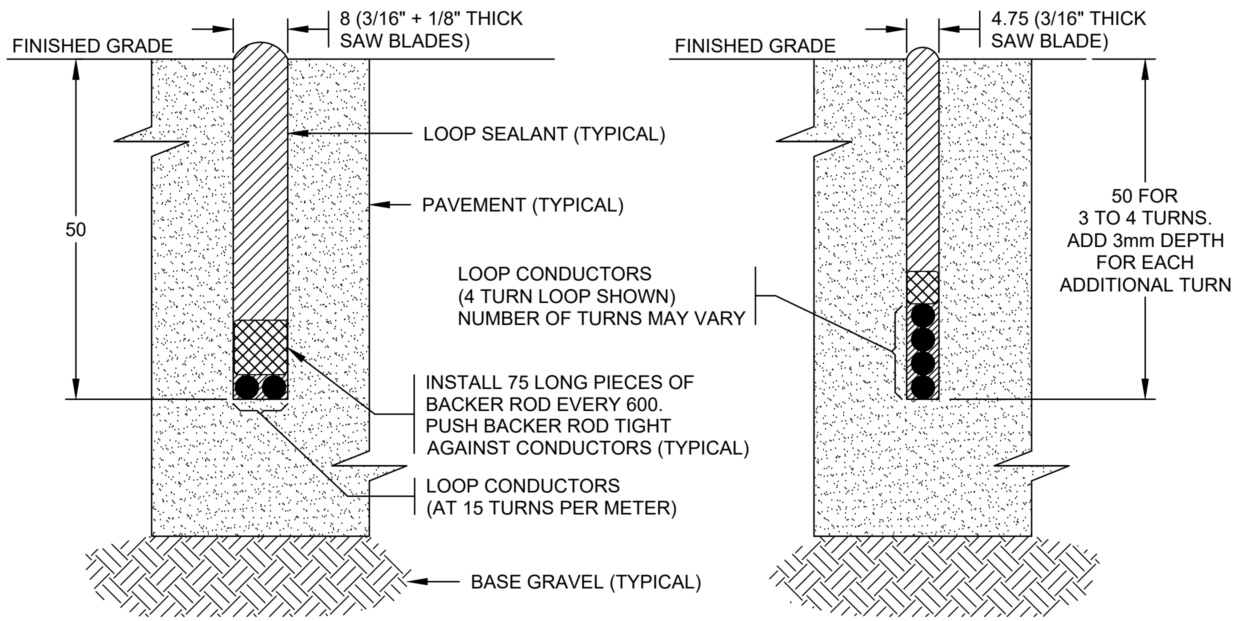
CITY OF NANAIMO
THE HARBOUR CITY

DETECTOR LOOPS RISER SERVICE CONNECTION

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-14.2



TYPICAL LOOP CORNER DETAIL



HOME RUN SLOT

LOOP SLOT

NOTES:

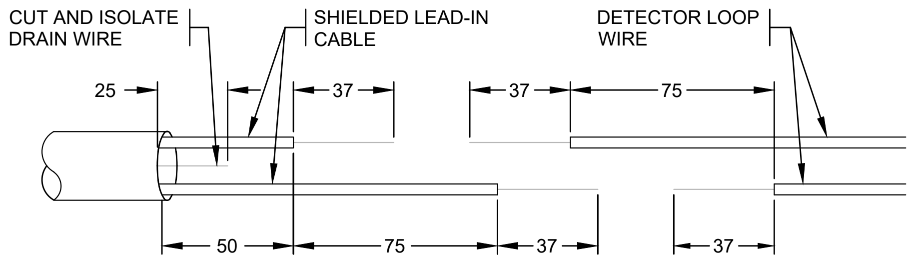
1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.
3. LOOP SLOT SEALANTS SHALL BE ELSRO HOT POUR CRACK FILLER No. 1190 OR B.P. BURFALT 16607 170, TYPE 2 OR APPROVED EQUAL.
4. BACKER RODS SHALL BE DETECTOR SYSTEMS BR-625 OR APPROVED ALTERNATE.
5. ONLY ONE LOOP SHALL BE INSTALLED IN EACH HOME RUN SLOT.

CITY OF NANAIMO
THE HARBOUR CITY

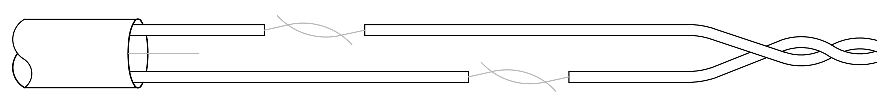
DETECTOR LOOPS RISER SERVICE CONNECTION

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-14.3

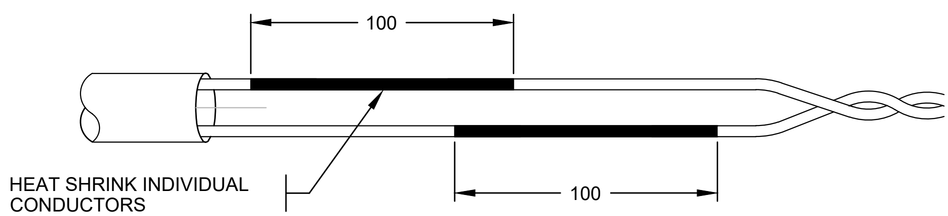
STEP 1. STRIP LOOP WIRES AND LEAD-IN CABLE AND SLIDE ON HEAT SHRINKS



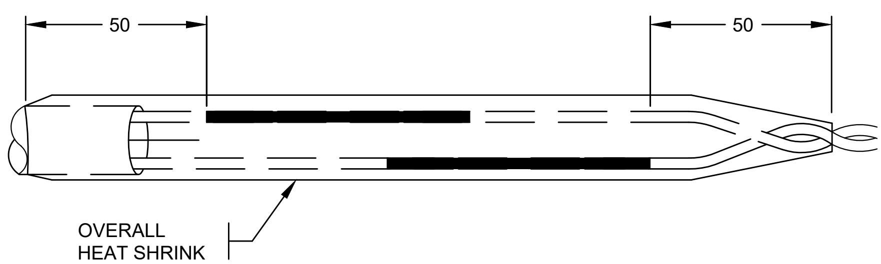
STEP 2. CONNECT AND SOLDER.
TWIST BARE CONDUCTORS TOGETHER AND SOLDER WITH 60/40 (TIN/LEAD) RESIN SOLDER.



STEP 3. INSULATE EACH SOLDER JOINT SEPARATELY



STEP 4. ENVIRONMENTALLY SEAL TOTAL SPLICE



NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.
3. HEAT SHRINK SHALL BE PREMIER CLEAR-SEAL (6mm I.D. INDIVIDUAL CONDUCTORS & 10mm I.D. FOR OVERALL)

CITY OF NANAIMO
THE HARBOUR CITY

DETECTOR LOOP TO SHIELDED CABLE SPLICES

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-14.4

STEP 1 LAYOUT DETECTOR LOOPS AND REVIEW LOCATIONS WITH THE ENGINEER PRIOR TO SAWCUTTING THE ROADWAY. THE GENERAL LAYOUT OF THE DETECTOR LOOPS IS INDICATED ON DRAWING E-14.7. STOP BARS AND LANE LINES MUST BE LAID OUT PRIOR TO LOCATING DETECTOR LOOPS.

RULE 1

DETECTOR LOOPS SHALL NOT BE INSTALLED WHEN THE ROAD IS WET OR WHEN THE AMBIENT (AIR) TEMPERATURE IS LOWER THAN 5°C, UNLESS APPROVED IN WRITING BY THE CITY ENGINEER. SEALANTS DO NOT ADHERE PROPERLY IN WET CONDITIONS. SHOULD THE CONTRACTOR BE ASKED IN WRITING BY THE ENGINEER TO INSTALL LOOPS IN THE WET AND/OR WHEN THE AIR TEMPERATURE IS BELOW 5°C, THE INSTALLATION WARRANTY WILL NOT BE ENFORCED.

RULE 2

DETECTOR LOOPS SHALL NOT BE INSTALLED WHEN THE PAVEMENT IS CRACKED OR BADLY RUTTED UNLESS THE INSTALLATION IS APPROVED BY THE CITY ENGINEER.
SAW CUTS CAN OFTEN CAUSE PAVEMENT CONDITIONS TO DETERIORATE FURTHER.
IF RE-SURFACING OF THE INTERSECTION IS NOT PLANNED THEN PHOTOGRAPHS SHOULD BE TAKEN TO DOCUMENT THE PAVEMENT CONDITIONS BEFORE AND AFTER THE LOOP INSTALLATION.

STEP 2 CUT LOOP AND HOME RUN SLOTS IN ASPHALT.
ALL LOOP AND HOME RUN SLOTS SHALL BE CUT TO THE SAME DEPTH, WITH A PAVEMENT SAW.
SLOTS SHALL NOT PASS THROUGH PAVEMENT INTO THE BASE GRAVEL.

RULE 3

LOOP AND HOME RUN SLOT MUST BE INSTALLED AT LEAST 300mm FROM ANY OTHER LOOP AND EACH LEAD-IN SLOTS, EXCEPT WHERE THE LEAD-IN CONDUCTORS ENTER THE 1" RPVC CONDUIT. THIS WILL REDUCE THE PROBABILITY OF INTERFERENCE BETWEEN LOOPS.

RULE 4

WHEN REPLACING LOOPS, CUT THROUGH TWICE ON EACH SIDE OF EXISTING LOOP. THIS MAY REQUIRE ADDITIONAL SAW CUTS, IF THE EXISTING LOOP IS NOT LOCATED IN THE SAW CUT PATH OF THE NEW LOOP. THIS WILL ELIMINATE THE POSSIBILITY OF INTERFERENCE BETWEEN THE OLD AND THE NEW LOOP.

STEP 3 CLEAN THE SLOT WITH A PROFESSIONAL GRADE PRESSURIZED WATER SYSTEM. REMOVE ALL WATER AND DIRT OUT OF THE SLOT CUT AND THE SURROUNDING 100mm OF ROAD SURFACE USING COMPRESSED AIR. SLOT MUST REMAIN COMPLETELY CLEAN AND DRY UNTIL THE SLOT IS SEALED.

STEP 4 INSTALL THE LOOP CONDUCTOR INTO THE LOOP SLOT. ENSURE CONDUCTORS ARE TIGHTLY WOUND AND PUSHED INTO THE BOTTOM OF THE SLOT. TWIST CONDUCTOR HOME RUN AT 15 TURNS PER METRE. INSTALL 75mm STRIPS OF BACKER ROD EVERY 600mm TO HOLD CONDUCTORS INTO SLOT.

RULE 5

ONLY ONE CONTINUOUS CONDUCTOR SHALL BE INSTALLED IN EACH LOOP AND HOME RUN SLOT TO THE JUNCTION BOX.

RULE 6

LOOP CONDUCTORS MUST BE INSTALLED IMMEDIATELY AFTER THE LOOP AND HOME RUN SLOTS ARE CUT.

STEP 5 INSTALL LOOP SEALANT AFTER CONDUCTORS HAVE BEEN INSTALLED. LOOP SEALANTS SHALL BE HEATED AS PER MANUFACTURER'S INSTRUCTIONS AND NEATLY APPLIED USING A FUNNEL WITH A NARROW SPOUT. ANY EXCESS SEALANT ON ROAD SURFACE SHALL BE REMOVED. AN ADDITIONAL APPLICATION OF LOOP SEALANT MAY BE REQUIRED WHERE THE SEALANT IS NOT UP TO THE PAVEMENT GRADE.

NOTES:

1. SEE DRAWING E-14.6 FOR CONTINUATION OF PROCEDURES AND RULES.

G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 10 DWGS\E-14.5

3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

DETECTOR LOOP PROCEDURES & RULES

Scale:	NTS
Created:	NOV 2009
Rev Date:	NOV 2009
Dwg No:	E-14.5

CONTINUED FROM DRAWING E-14.5

STEP 6 ONCE THE SEALING OF THE SLOT HAS BEEN PROPERLY COMPLETED, A DUST SUCH AS PORTLAND CEMENT SHALL BE SPRINKLED ONTO THE SEALANT TO PREVENT TRACKING BY ROADWAY TRAFFIC. ANY EXCESS DUST SHALL BE SWEPT OFF THE ROADWAY PRIOR TO ALLOWING TRAFFIC TO PASS OVER THE SEALED SLOT.

RULE 7

SPLICES WILL NOT BE ALLOWED IN LOOP CONDUCTORS OR SHIELDED CABLES.

STEP 7 THE SPLICES BETWEEN DETECTOR LOOP CONDUCTORS AND THE SHIELDED CABLE ARE TO BE SOLDERED AND SEALED WITH HEAT SHRINK IN ACCORDANCE WITH DRAWING E-14.4

STEP 8 REPEAT STEP 7 AT THE JUNCTION BOX OR VAULT NEAREST CONTROLLER.

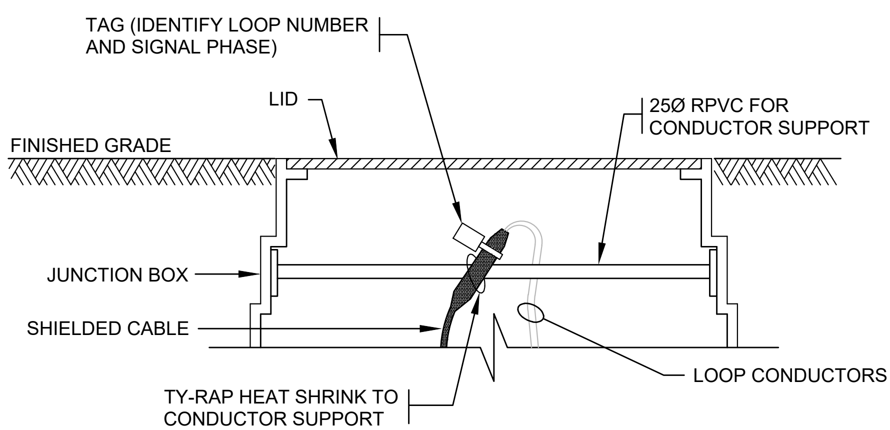
RULE 8

LOOP DETECTOR RESISTANCE TO GROUND SHALL BE GREATER THAN 1 MEGOHM, & LOOP INDUCTANCE SHALL BE WITHIN 25% OF THE VALUES SHOWN ON THE CONTRACT DRAWINGS.

STEP 9 TAG EACH LOOP CABLE AS INDICATED BELOW.

RULE 9

MAINTAIN THE MAXIMUM SEPARATION POSSIBLE IN THE JUNCTION BETWEEN THE LOOP CONDUCTORS AND POWER CONDUCTORS.



LOOP DETECTOR CONDUCTORS IN JUNCTION BOX

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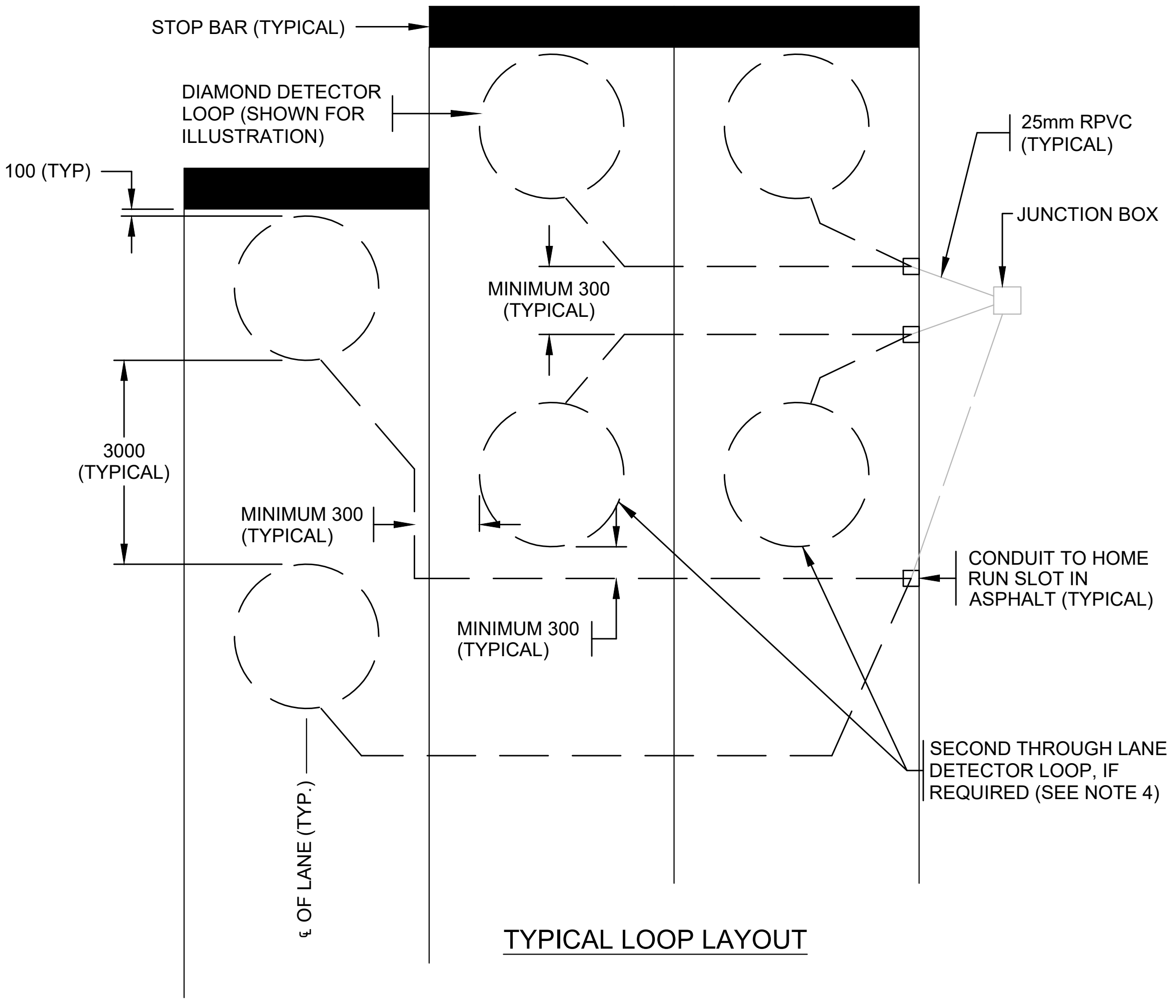
3.2.2020

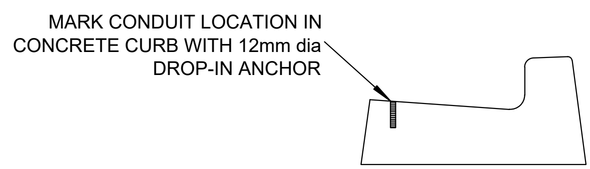
CITY OF NANAIMO
THE HARBOUR CITY

DETECTOR LOOP PROCEDURES & RULES (CONTINUED)

Scale:	NTS
Created:	NOV 2009
Rev Date:	NOV 2009
Dwg No:	E-14.6



TYPICAL LOOP LAYOUT



LOOP CROSSING AT CURB (DETAIL)

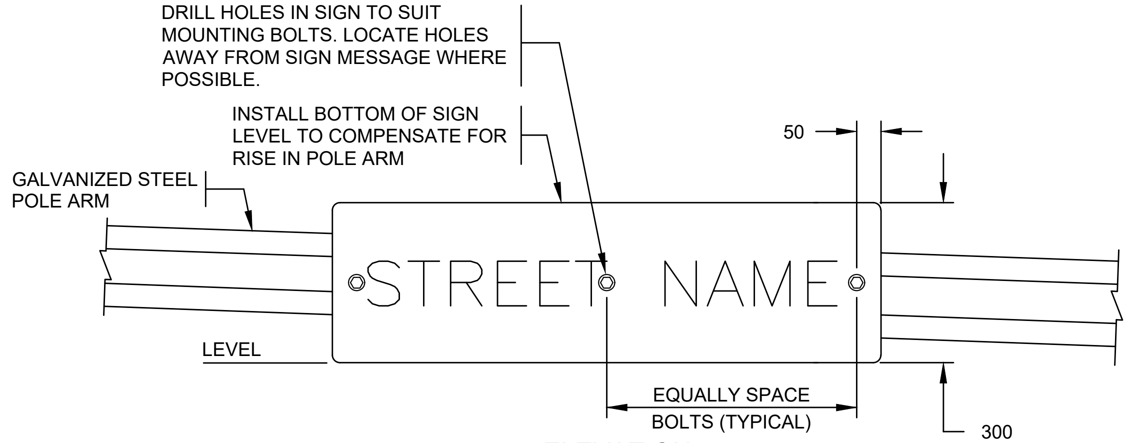
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.
3. LOCATE LOOP CONDUITS IN ASPHALT TO SUIT LOOP LOCATIONS & MINIMIZE THE LENGTHS OF HOME RUN SLOTS IN THE ASPHALT.
4. NORMALLY NOT REQUIRED WHERE THROUGH PHASE IS RECALLED TO GREEN.

CITY OF NANAIMO
THE HARBOUR CITY

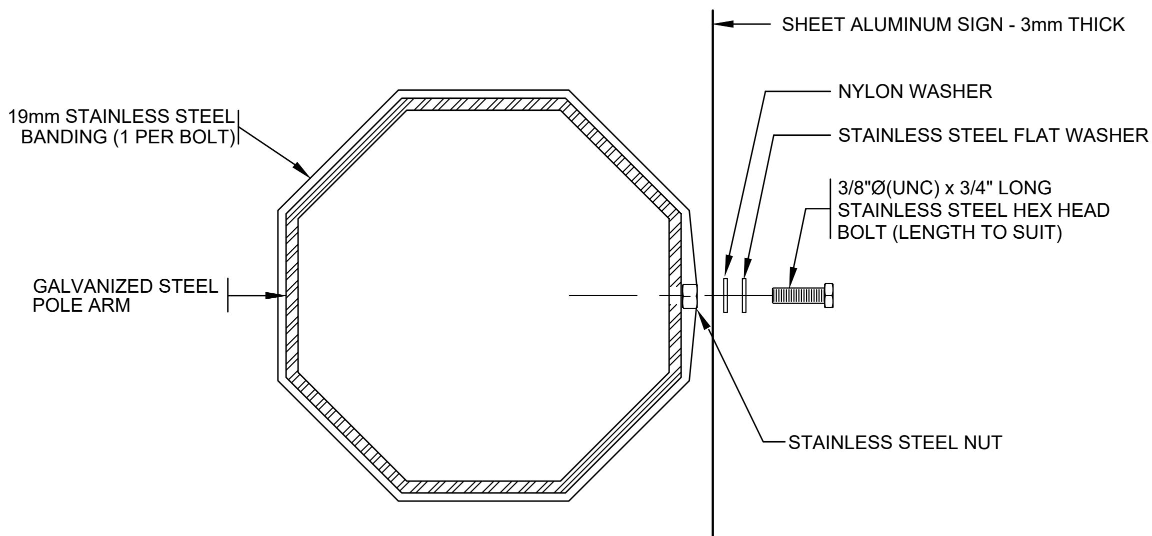
LAYOUT FOR ROUND TRAFFIC SIGNAL DETECTOR LOOPS

Scale:	NTS
Created:	NOV 2009
Rev Date:	NOV 2009
Dwg No:	E-14.7



ELEVATION

SIGN WIDTH	NUMBER OF BOLTS
900 WIDE	3
1200 WIDE	4
1500 WIDE	5
1800 WIDE	6
2100 WIDE	7



SIDE VIEW

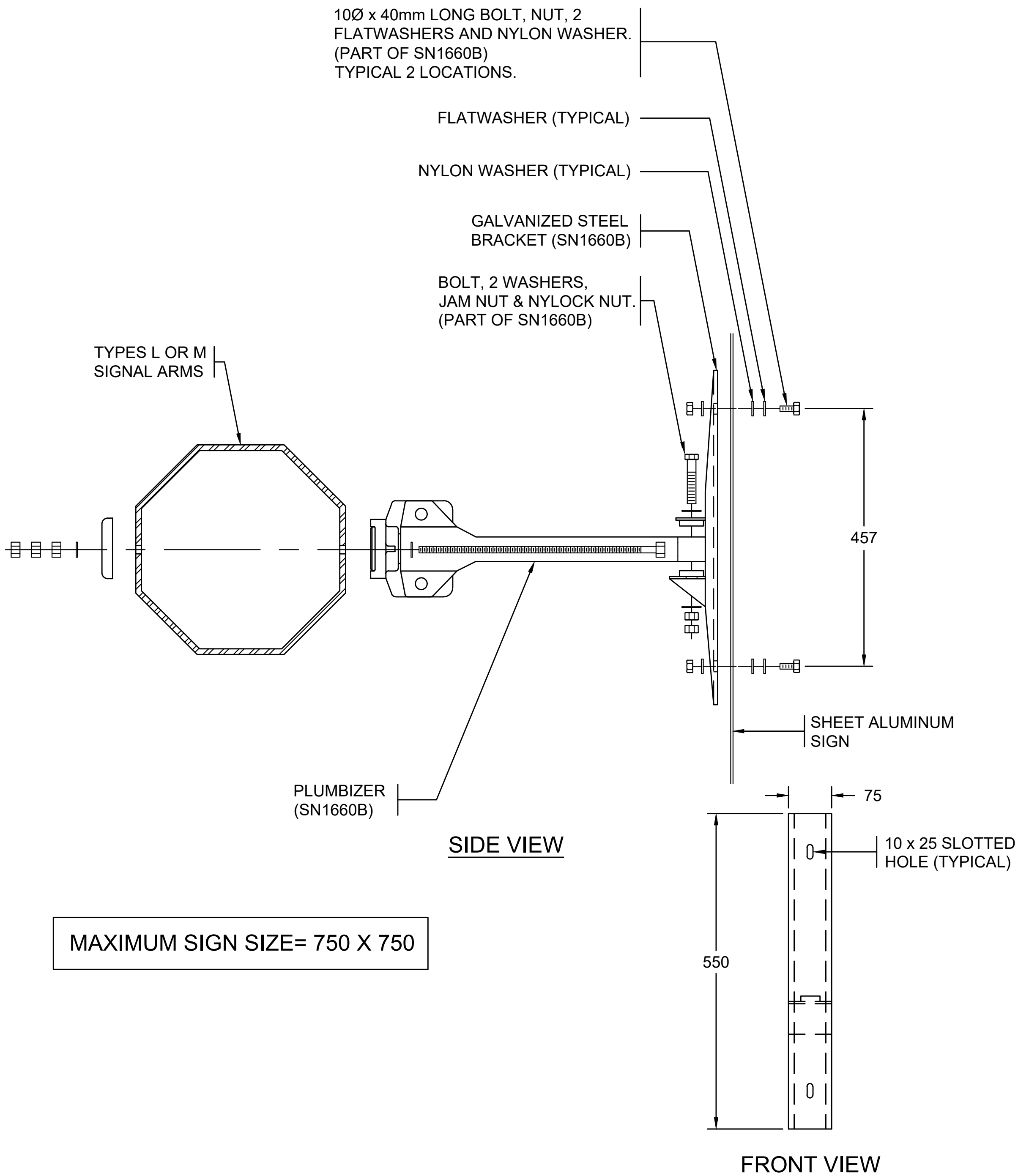
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. POSITION SIGN ON POLE ARM AS INDICATED ON THE PLANS OR AS DIRECTED BY THE CITY ENGINEER.
3. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

CITY OF NANAIMO
THE HARBOUR CITY

OVERHEAD STREET NAME SIGN INSTALLATION DETAILS (ON SIGNAL POLE)

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2016
Dwg No:	E-15.1



NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
3. AIM AS DIRECTED BY THE CITY ENGINEER.

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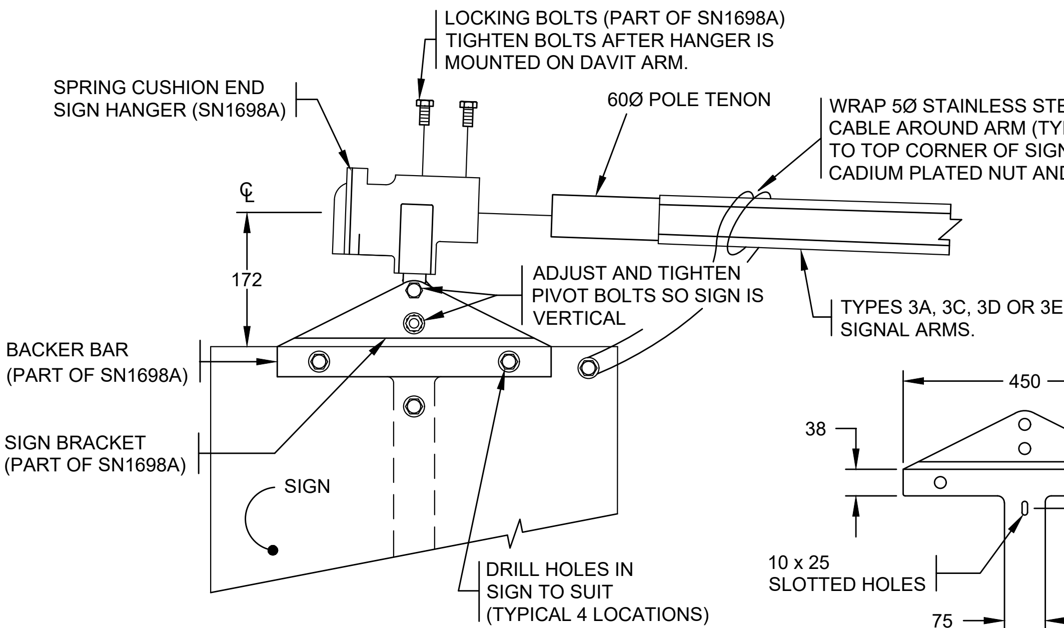
3.3.2020

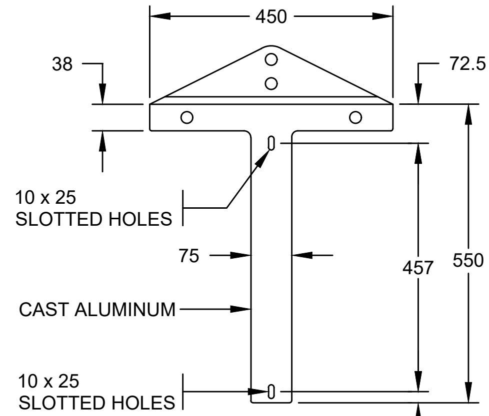
CITY OF NANAIMO
THE HARBOUR CITY

SMALL OVERHEAD SIGN INSTALLATION DETAILS
(TYPE L & M SIGNAL POST)

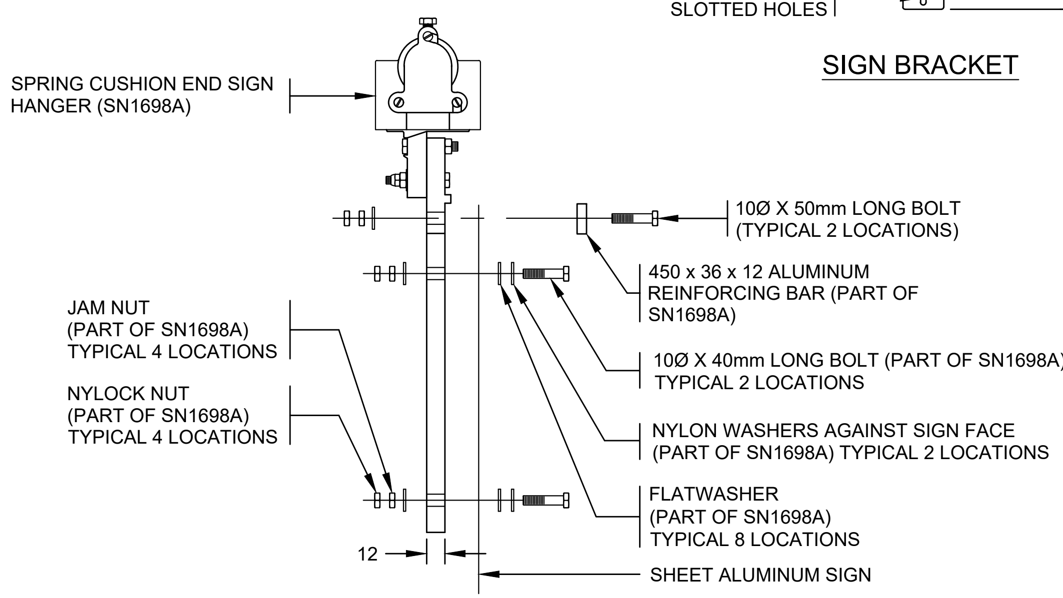
Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-15.2



ELEVATION



SIGN BRACKET



SIDE VIEW

MAXIMUM SIGN SIZE = 750 X 750

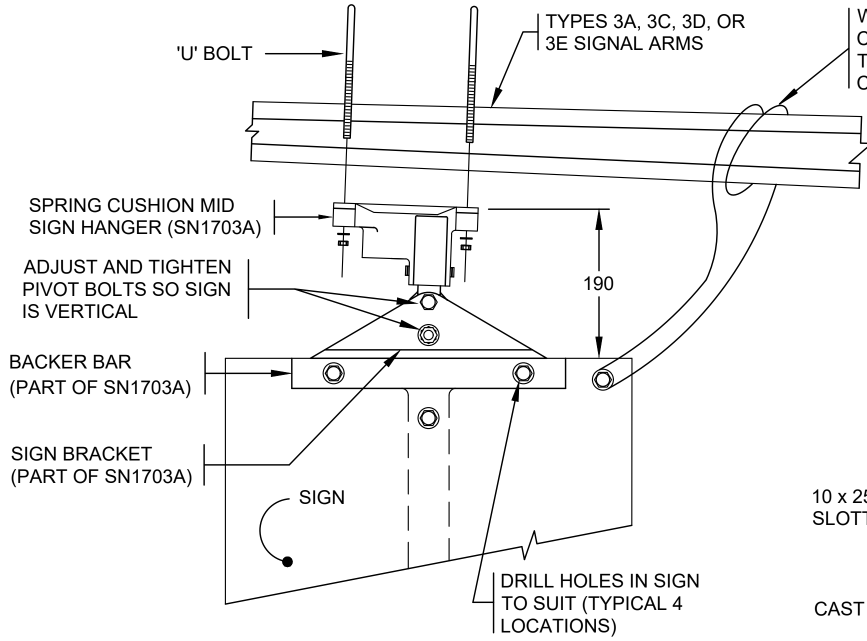
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. AIM SIGNS AS DIRECTED BY THE MINISTRY REPRESENTATIVE.
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

CITY OF NANAIMO
THE HARBOUR CITY

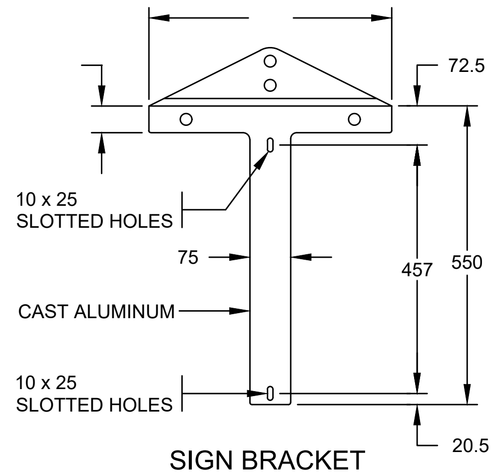
SMALL OVERHEAD SIGN INSTALLATION DETAILS
(TYPE 3 SIGNAL ARMS)

Scale:	NTS
Created:	MAY 1999
Rev Date:	MAY 1999
Dwg No:	E-15.3

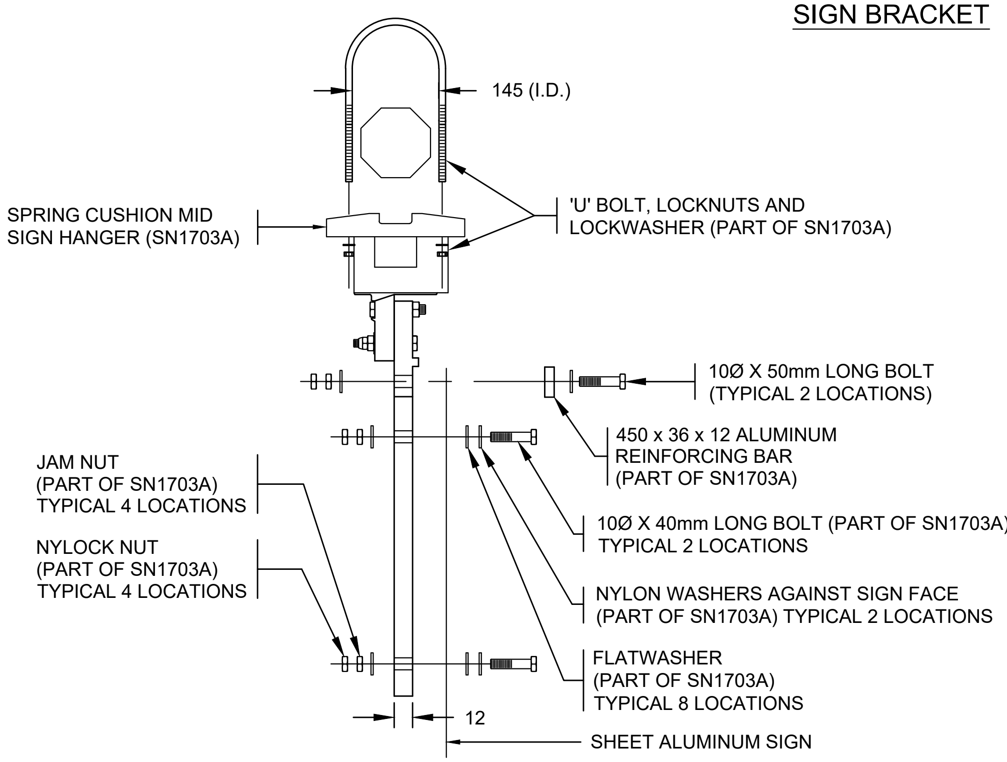


ELEVATION

MAXIMUM SIGN SIZE = 750 X 750



SIGN BRACKET



SIDE VIEW

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. AIM SIGNS AS DIRECTED BY THE CITY ENGINEER.
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

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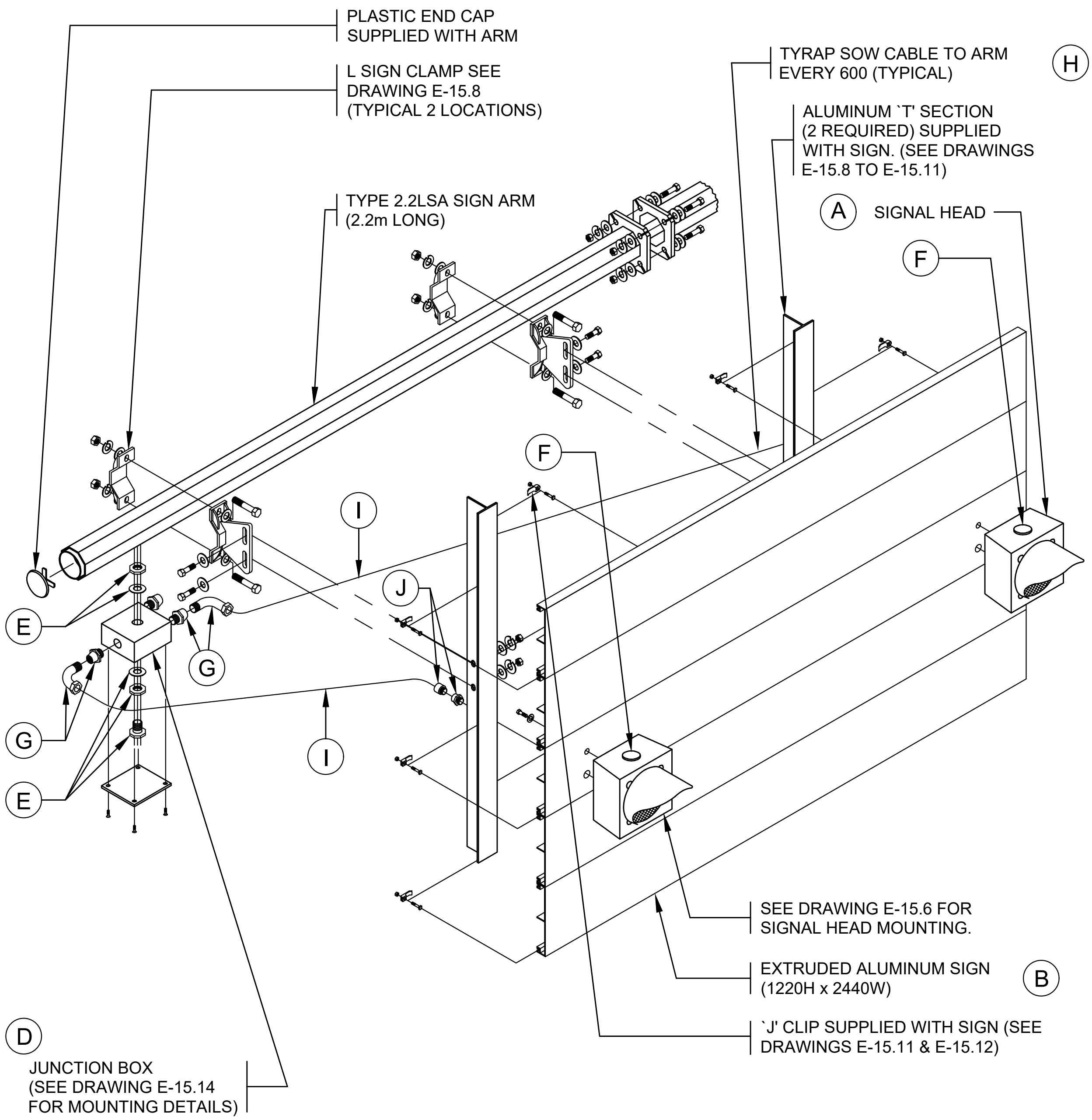
3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

SMALL OVERHEAD SIGN INSTALLATION DETAILS
(TYPE 3 SIGNAL ARMS)

Scale:	NTS
Created:	MAY 1999
Rev Date:	MAY 1999
Dwg No:	E-15.4



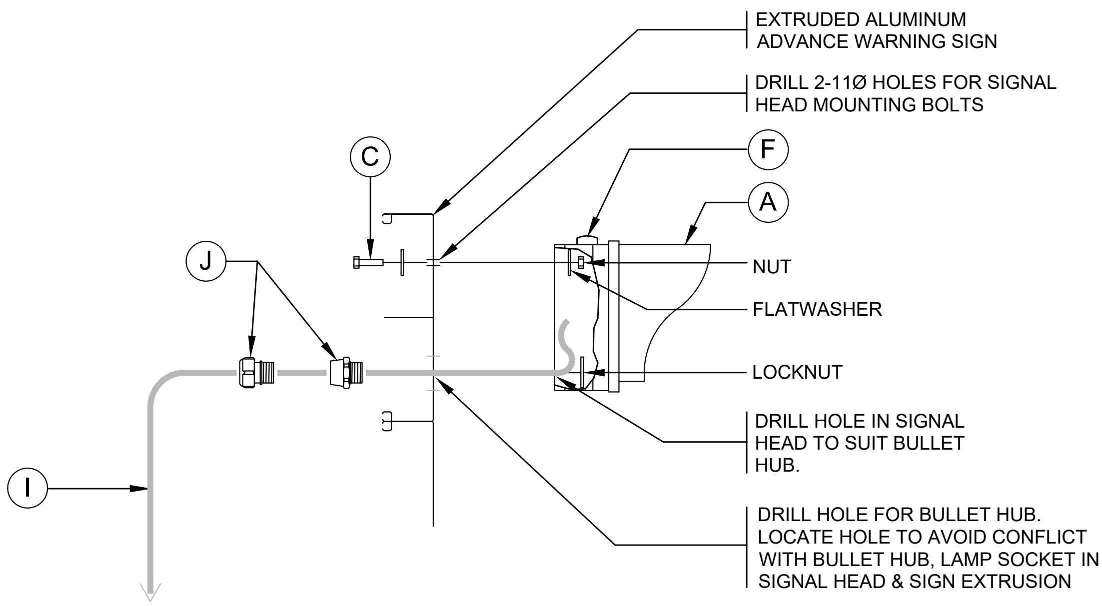
SEE DRAWING E-15.8 FOR NOTES AND ADDITIONAL DETAILS

3.20.2020

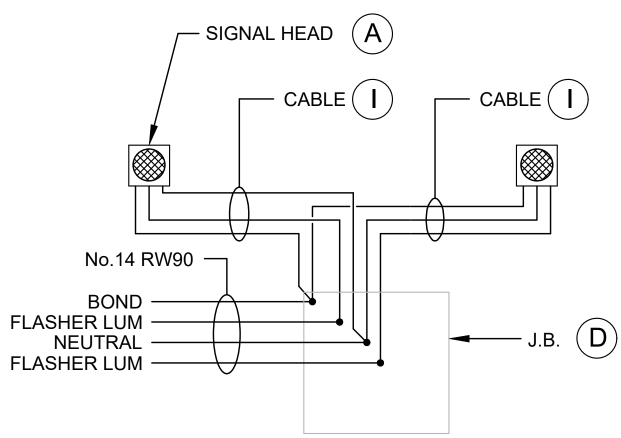
CITY OF NANAIMO
THE HARBOUR CITY

OVERHEAD EXTRUDED ALUMINUM ADVANCE WARNING SIGN ASSEMBLY DETAILS

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2019
Dwg No:	E-15.5



SIGNAL HEAD MOUNTING DETAIL



WIRING DIAGRAM

SEE DRAWING E-15.8 FOR NOTES AND ADDITIONAL DETAILS

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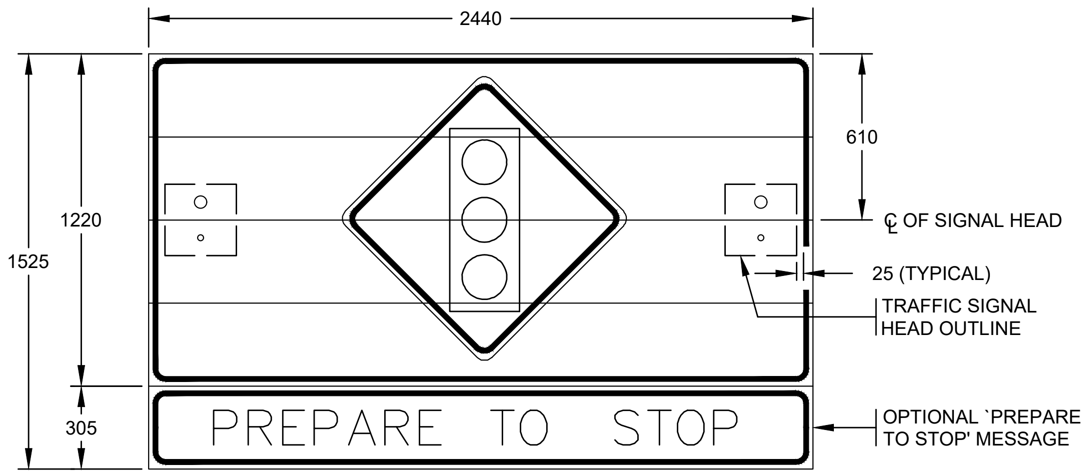
3.20.2020

CITY OF NANAIMO
THE HARBOUR CITY

OVERHEAD EXTRUDED ALUMINUM ADVANCE WARNING SIGN INSTALLATION DETAILS

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2019
Dwg No:	E-15.6



TRAFFIC SIGNAL ADVANCE WARNING SIGN

TRAFFIC SIGNAL ADVANCE WARNING SIGN KIT PARTS LIST	
ITEM	DESCRIPTION
A	200mm SIGNAL HEAD SECTION C/W YELLOW LENS, LAMP AND COWL VISOR
B	TRAFFIC SIGNAL EXTRUDED ALUMINUM ADVANCE WARNING SIGN COMPLETE WITH 3M DIAMOND GRADE REFLECTIVE SHEETING
C	10Ø x 25mm LONG STAINLESS STEEL HEX HEAD BOLT, NUT, 2 FLAT WASHERS AND 1 LOCKWASHER
D	150 x 150 x 100 PVC J.B.
E	INSULATED CHASE NIPPLE, 2 LOCKNUTS AND 2 FLAT WASHERS
F	FINIAL
G	12mm BULLET HUB AND 90° STRAIN RELIEF CONNECTOR AND LOCKNUT
H	LARGE TY-RAP
I	3c No. 14 S.O.W. CABLE
J	12mm BULLET HUB AND STRAIN RELIEF CONNECTOR AND LOCKNUT

SEE DRAWING E-15.8 FOR NOTES AND ADDITIONAL DETAILS

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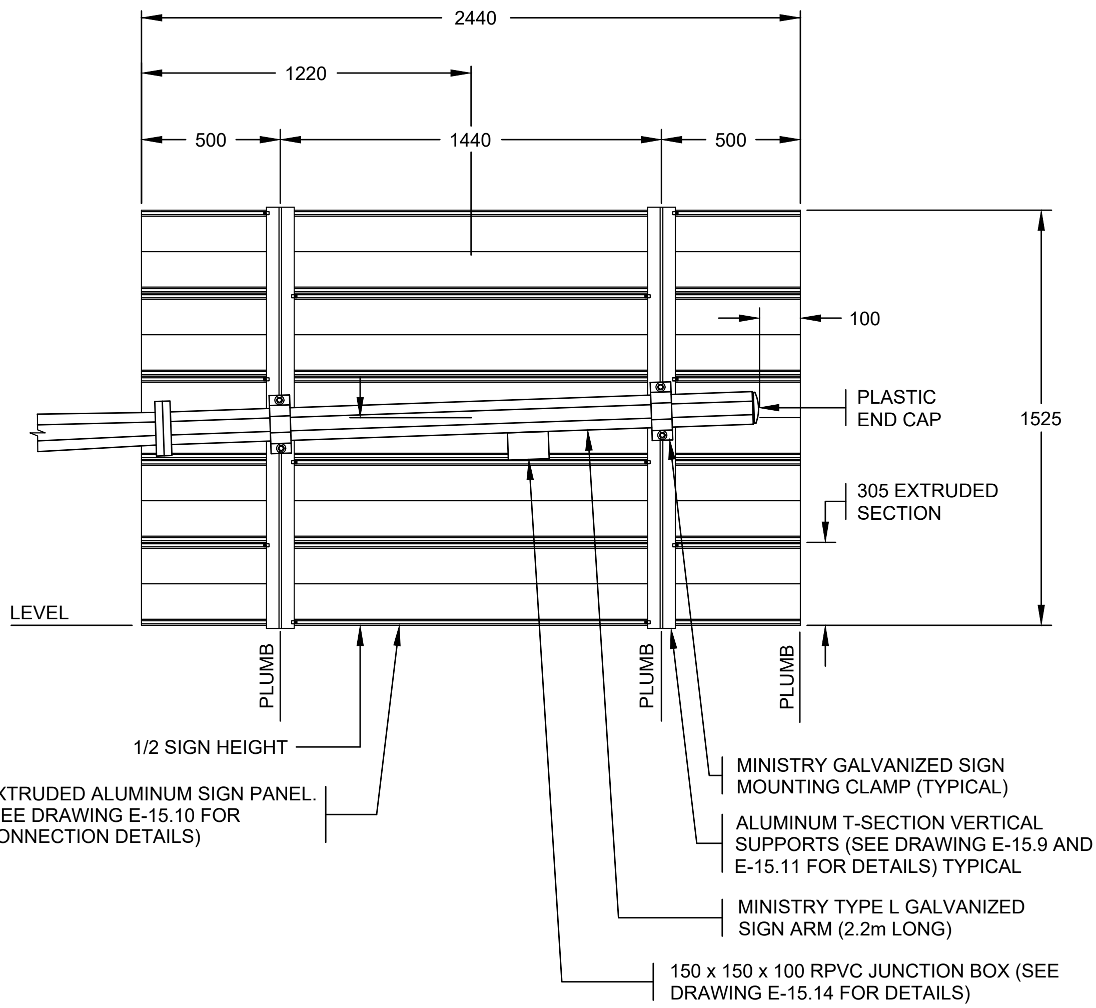
3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

OVERHEAD EXTRUDED ALUMINUM ADVANCE WARNING SIGN INSTALLATION DETAILS

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2019
Dwg No:	E-15.7



REAR ELEVATION

TOTAL MASS
EXTRUDED ALUMINUM SIGN = 48 kg

SEE DRAWING E-15.13 FOR SIGN LIGHTING DETAILS.

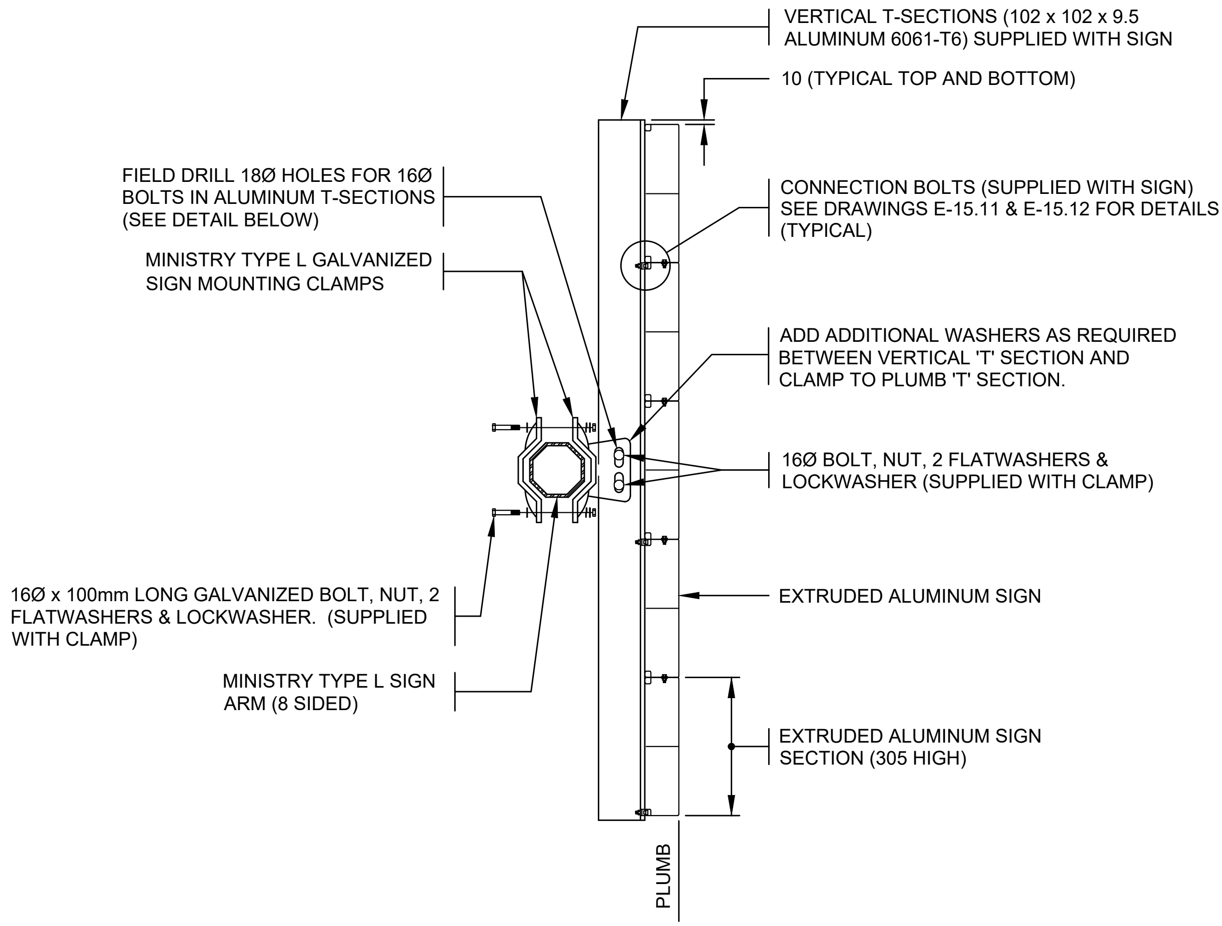
NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. SEE DRAWING E-15.5 FOR SIGN ASSEMBLY DETAILS.
3. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

CITY OF NANAIMO
THE HARBOUR CITY

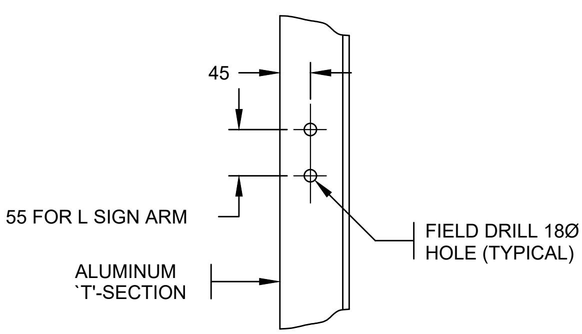
OVERHEAD EXTRUDED ALUMINUM ADVANCE WARNING SIGN INSTALLATION DETAILS

Scale:	NTS
Created:	JAN 1998
Rev Date:	NOV 2019
Dwg No:	E-15.8



SIGN BRACKET ASSEMBLY

SIDE VIEW



`T'-SECTION HOLE DETAIL

SEE DRAWING E-15.8 FOR NOTES AND ADDITIONAL DETAILS.

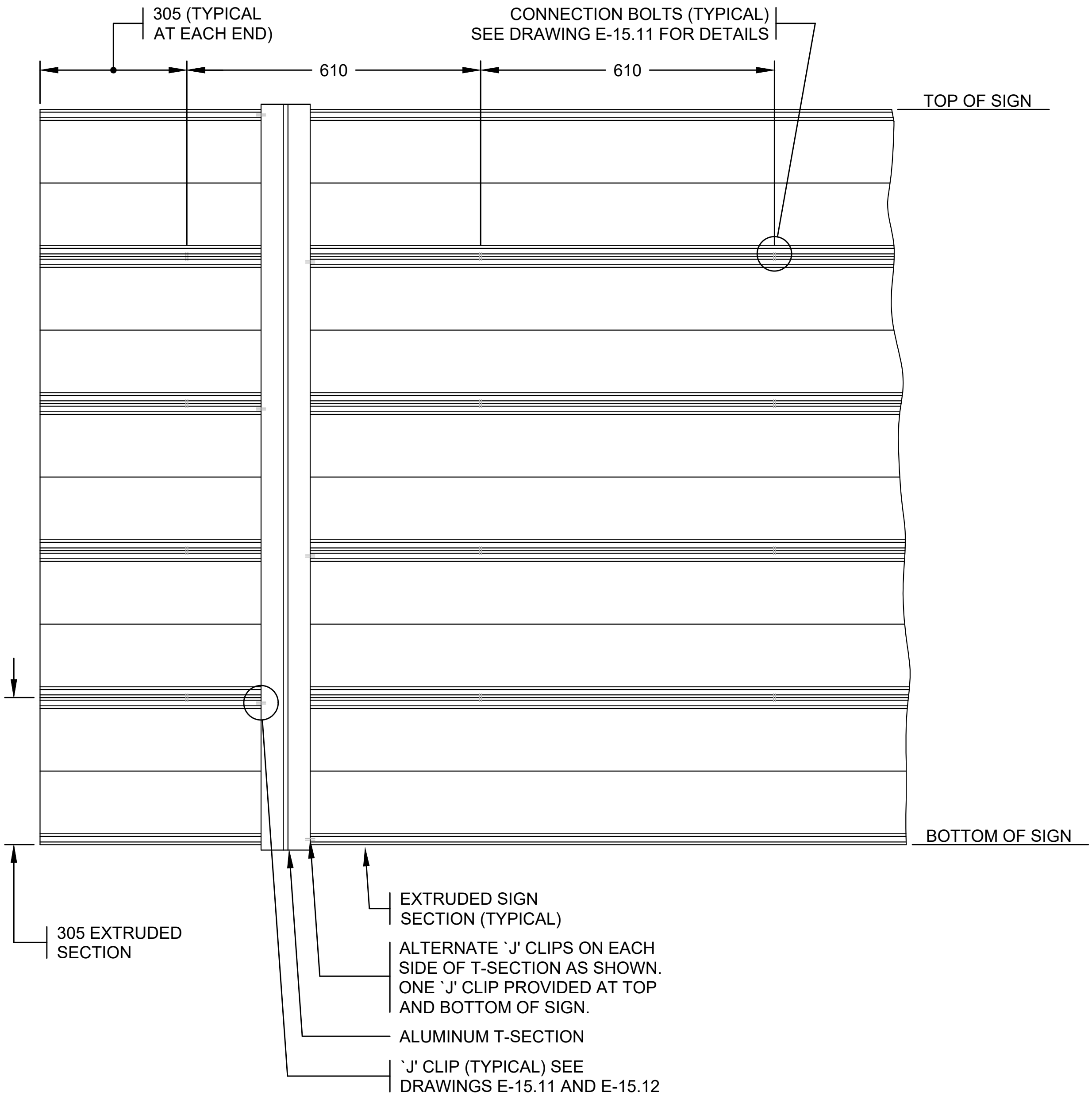
SIGN LIGHTING NOT SHOWN. SEE DRAWING E-15.13 FOR SIGN LIGHTING DETAILS.

3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

OVERHEAD EXTRUDED ALUMINUM ADVANCE WARNING SIGN INSTALLATION DETAILS

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-15.9



REAR VIEW OF SIGN

SEE DRAWING E-15.8 FOR
NOTES AND ADDITIONAL DETAILS.

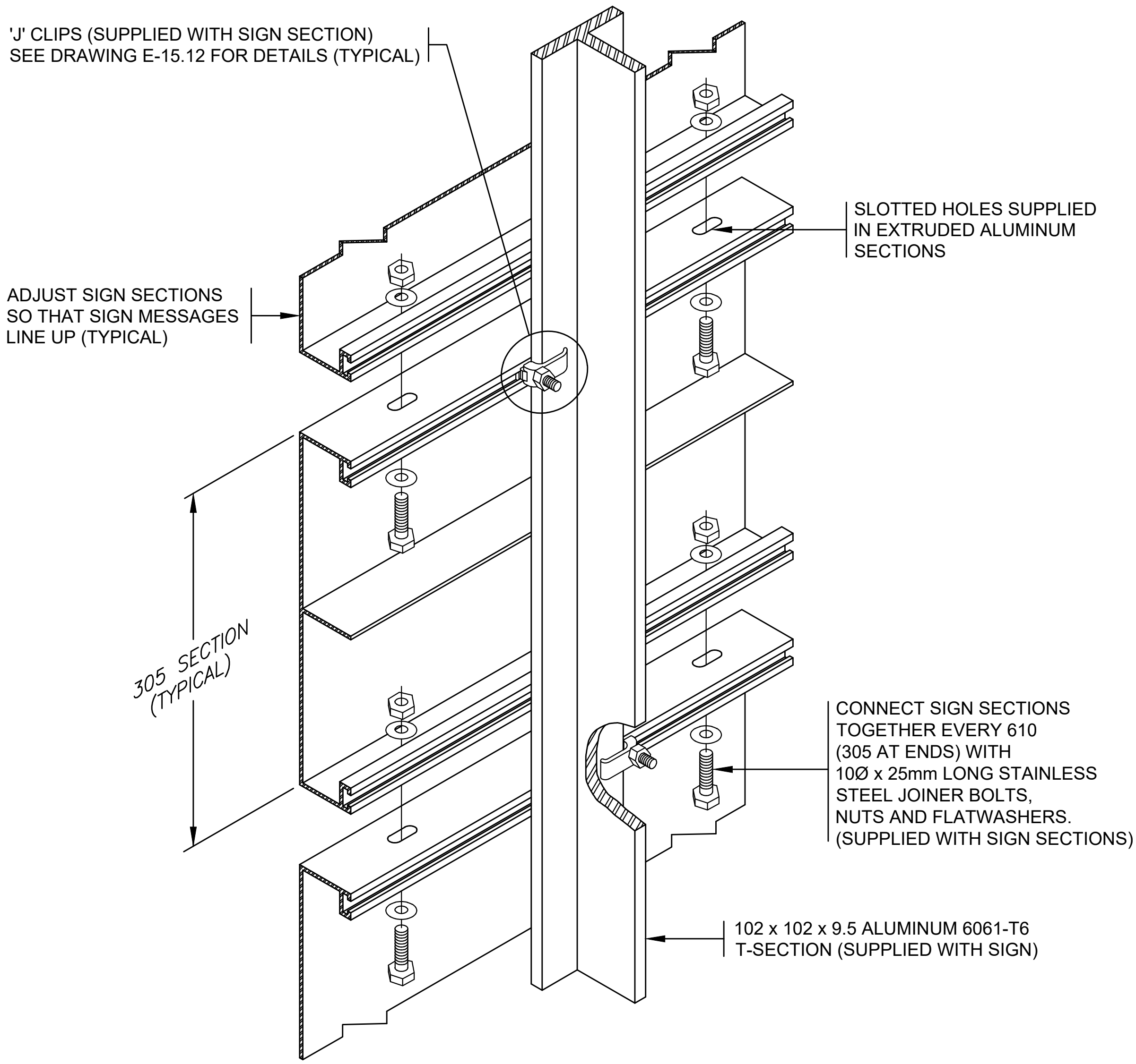
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 10 DWGS\E-15.10

3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

OVERHEAD EXTRUDED ALUMINUM ADVANCE
WARNING SIGN INSTALLATION DETAILS

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-15.10



ASSEMBLY VIEW

TORQUE JOINER BOLTS AND
'J' CLIPS TO 19 ft. lbs.

SEE DRAWING E-15.8 FOR NOTES
AND ADDITIONAL DETAILS.

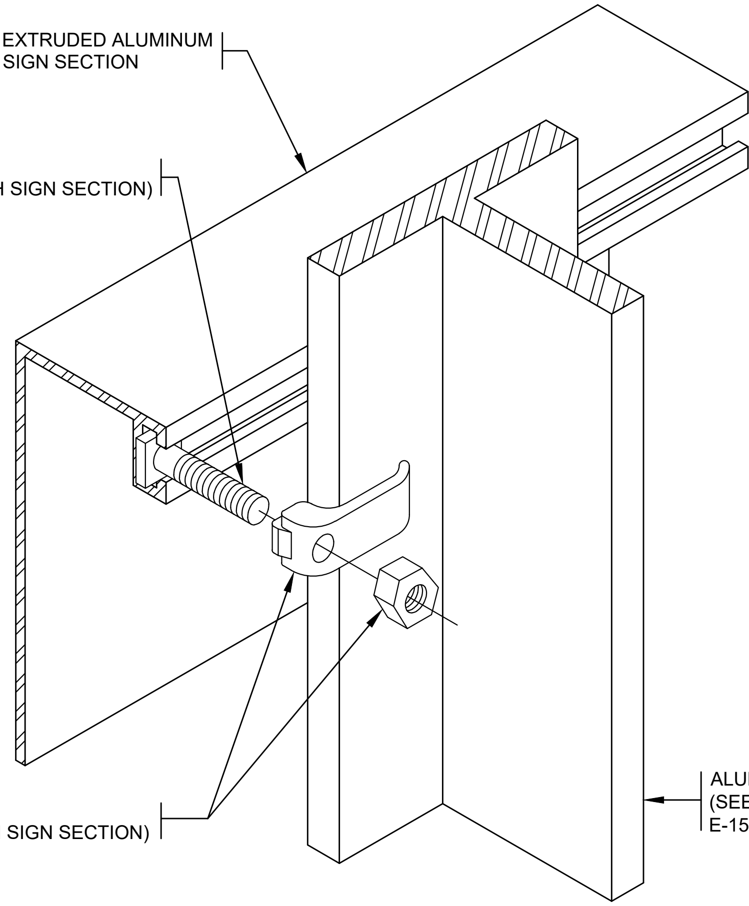
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 10 DWGS\E-15.11

3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

OVERHEAD EXTRUDED ALUMINUM SIGN
ASSEMBLY DETAILS

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-15.11



ASSEMBLY VIEW

TORQUE JOINER BOLTS AND
`J' CLIPS TO 19 ft. lbs.

SEE DRAWING E-15.8 FOR
NOTES AND ADDITIONAL DETAILS.

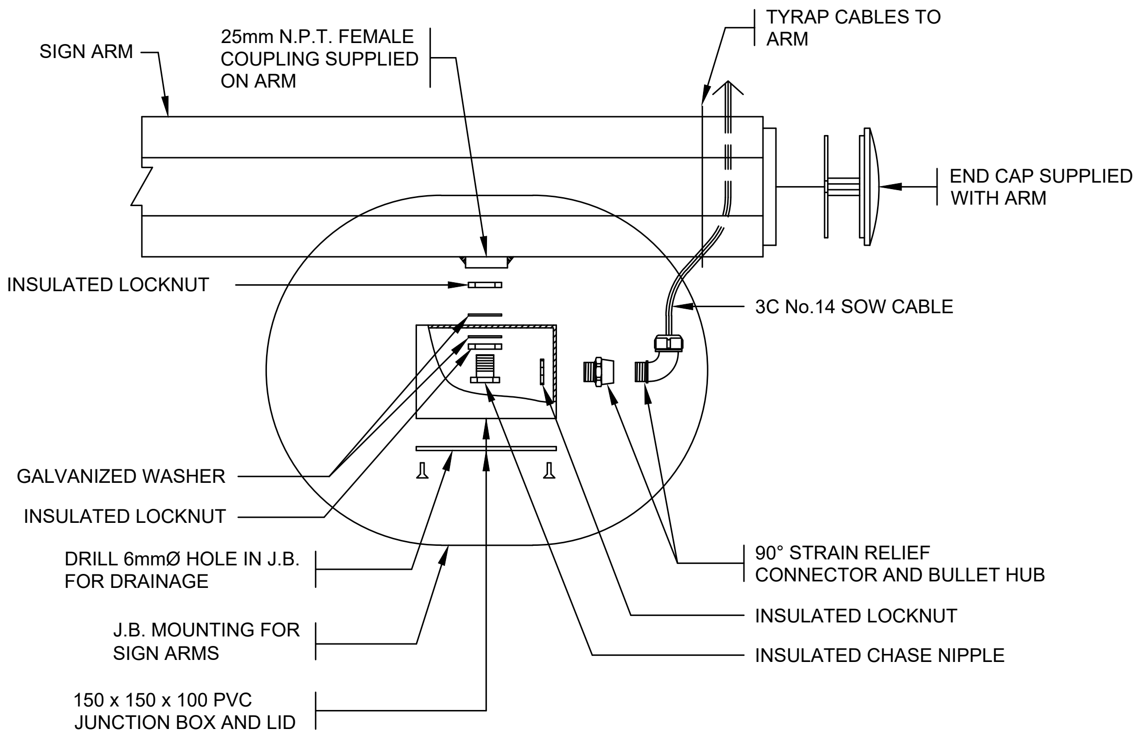
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 10 DWGS\E-15.12

3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

OVERHEAD EXTRUDED ALUMINUM SIGN
ASSEMBLY DETAILS

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-15.12



J.B. MOUNTING DETAIL

NOTES:

1. REFER TO CONTRACT DRAWINGS AND SECTION 10 FOR DETAILED SPECIFICATIONS.
2. ALL DIMENSIONS ARE IN MILLIMETerS UNLESS OTHERWISE NOTED.

G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 10 DWGS\E-15.14

3.2.2020

CITY OF NANAIMO
THE HARBOUR CITY

JUNCTION BOX INSTALLATION DETAILS ON SIGN ARMS

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	E-15.14

SECTION 11 – CAST IN PLACE CONCRETE WORKS
CONTENTS

11.20 SCOPE

.1 This specification refers to reinforced and plain cast in place concrete works for the construction of pavements, sidewalks, curbs and gutters, manholes, catch basins, concrete works associated with the installation of watermains and sewers and other works incidental to municipal services construction.

.2 This specification shall not be used for structural facilities such as buildings, bridges or other structure requiring site specific structural design.

11.21 RELATED SECTIONS

.1 Section 4.0 – Excavation, Trenching and Backfill.

.2 Section 8.0 – Transportation, and Section 9.0 Aggregates and Granular Material.

11.22 REFERENCES, CODES AND STANDARDS

.1 All references to this Specifications, Standards and Codes shall refer to the latest adopted version, including all amendments.

.2 American Concrete Institute (ACI):

(a) ACI 306 R – Cold Weather Concreting.
(b) ACI 305 R – Hot Weather Concreting.

.3 American Society for Testing and Materials (ASTM):

(a) ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
(b) ASTM C309 – Standard Specification for Liquid Membrane – Forming Compounds for Curing Concrete.

.4 Canadian Standards Association (CSA):

(a) CSA A23.1/A23.2:19 – Concrete materials and methods of concrete construction / Test methods and standard practices for concrete.
(b) CSA A283:19 – Qualification code for concrete testing laboratories.
(c) CSA A3000-18 – Cementitious Materials Compendium.

.5 Codes and Bylaws:

(a) Local codes and bylaws
(b) WorkSafeBC Regulations
(c) National Building Code (NBC)
(d) British Columbia Building Code (BCBC)

11.23 SUBMITTALS

.1 Mix Design:

(a) Provide certification by the Engineer that the mix proportions will produce concrete of specified quality and yield and that strength will comply with this specification and CSA A23.1:19.

.2 Plant and Material Certification:

(a) Concrete suppliers shall submit certification of concrete production facilities in accordance with the British Columbia Ready Mixed Concrete Association (BCRMCA) audit check list.

11.24 MATERIALS

.1 Hydraulic cement: Type GU (general use) to CSA A3000-18:

(a) Other types of cement shall only be permitted with the Engineer's approval.

.2 Fly Ash: Type F to CSA A3000-18.

.3 Water: to CSA A23.1:19.

.4 Aggregates: to CSA A23.1:19, Table 12:

(a) Coarse aggregate – combined grading of blended coarse aggregate to be within limits of Table 11 (Group 1).
(b) Nominal size of aggregate shall be 20 mm for concrete works and 14 mm for concrete patching.
(c) Fine aggregate – gradation to CSA A23.1:19, Table 10 and be within limits of FA1.

.5 Admixtures:

(a) Air entraining admixture: to ASTM C260.
(b) Chemical admixtures: to ASTM C494. Set retarding and accelerating admixtures shall not be used unless approved by the Engineer.

.6 Reinforcement:

(a) Reinforcement for concrete and methods of testing reinforcement shall conform to the requirements of CSA A23.1 Section 6.1 and CSA G30.18.

.7 Forms:

(a) All forms shall conform to CSA A23.1:19, Section 6.5.
(b) Form ties shall be metal and of the type such that no metal is left within 25 mm from the concrete surface when the forms are removed.
(c) Form release agent shall be approved by the Engineer prior to use and shall be a non-staining, mineral type, with chemically active release agents containing compounds that react with free time to produce water soluble soap.

.8 Support, Chairs and Spacers:

(a) Reinforcement shall be accurately positioned, secured and supported using bar supports, side form spacers and internal spacers to ensure proper concrete cover and spacing within allowable tolerances before and during placing of concrete.
(b) All support of reinforcement shall conform to CSA A23.2:19, Section 6.6.7.

.9 Premoulded Joint Filler:

(a) Premoulded joint fillers shall be bituminous impregnated fiber board in accordance with ASTM D1751.

11.25 CONCRETE MIXES

.1 Mix design for exterior walls and columns shall conform to the requirements of CSA A23.1. Table 1 and Table 2 or Class F-2.

(a) Minimum compressive strength at 28 days: 25 MPa.
(b) Maximum water to cementing materials ratio (w/cm): 0.55.
(c) Air entrainment: 5% - 8%.
(d) Slump shall be consistent with the placement and consolidation methods, equipment, and site conditions.

.2 Mix design for concrete curbs and sidewalks shall conform to requirements of CSA A23.1. Table 1 and Table 2 for Class C-2.

(a) Minimum compressive strength at 28 days: 32 MPa.
(b) Air entrainment: 5% - 8%.
(c) Slump shall be consistent with the placement and consolidation methods, equipment, and site conditions.

.3 Control density fill should comply with CSA A23.1:19.

(a) Minimum compressive strength at 28 days: 0.5 MPa.
(b) Air entrainment: 4% - 7%.
(c) Slump shall be consistent with the placement and consolidation methods, equipment and site conditions.

.4 Mix design for grout shall be approved by the Engineer. Proprietary grout mixtures shall be used in accordance with the manufacturer's recommendations.

11.26 CONSTRUCTION

.1 Install reinforced and plain concrete works, including surface tolerances, finishing and field quality control in accordance with CAN/CSA A23.1:19 except where specifically stated otherwise.

.2 All concrete accessories shall be as indicated on the drawings or as approved in writing by the Engineer.

.3 The Engineer shall be given 24 hours' notice in advance of placing concrete by the Contractor.

.4 Concrete production and delivery shall be in accordance with CSA A23.1:19, Section 5.0.

.5 Hot and cold weather concreting.

(a) When the ambient temperature is forecasted to be 27°C and raising, the requirements of VSA A23.3:19, Clause 7.8.3.3.1 shall be followed.
(b) During freezing weather, the requirements of VSA A23.3:19, Clause 7.8.3.3.2 shall be followed.

.6 Concrete Testing:

(a) The Engineer will arrange for a CCIL certified 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.
(b) Concrete sampling, curing and testing shall comply with CSA A23.2.

(c) CCompressive Strength Test:

(i) Compressive strength shall be performed in conformance with CSA A23.2.
(ii) One strength test shall consist of 3 – 100 mm x 200 mm cylinders; one tested at 7 days, 2 tested at 28 days.
(iii) At least one strength test shall be made from each 50 cubic metres of concrete placed, or 150 m of curb and/or sidewalk placed, with a minimum of one test for each pour of a specified concrete strength placed each day.
(iv) The average of all 28 day strength tests shall exceed the specified strength. When 3 or more tests of the same class of concrete are available, the average of any 3 consecutive tests shall be equal to or greater than the specified strength. No strength tests shall fall below 85% of the specified strength.
(v) Reporting shall follow the requirements of CSA A23.2 – 9C, clause 9 Reporting.

(d) All concrete trucks shall supply a copy of the delivery slip to the Engineer containing the following information:

(i) Minimum Compressive Strength
(ii) Maximum Slump
(iii) Air Content by Percent of Volume
(iv) Batch Time
(v) Maximum Size of Aggregate
(vi) List of Admixtures
(vii) Date
(viii) Name of Supplier

(e) Air content testing of plastic concrete shall be conducted in accordance with CSA A23.2-4C. At least one air content test shall be made for each strength test.
(f) Slump of concrete shall be determined in accordance with SA A23.2-5C. At least one slump test shall be made for each strength test. The slump test is not required for machine extruded concrete using a no-slump mix design.

.7 Inspection and testing by the Engineer shall not relieve the contractor of his responsibility for quality control.

.8 Concrete found to be in non-compliance with these specifications, shall be repaired or replaced by the Contractor at no additional cost to the Owner. The Contractor shall submit to the Engineer for approval, his proposed method to correct the noted deficiencies, prior to commencing the work.

11.27 <u>FORMWORK</u>

.1 Forms shall be so constructed that the finished concrete will conform to the shape, dimensions and finish specified.

.2 Forms shall be constructed in conformance with WorkSafeBC regulations.

.3 Forms and falsework shall be built sufficiently strong and rigid to maintain correct alignment and elevation and retain concrete pressures without deflection. Forms shall be sufficiently tight to prevent leakage of concrete.

.4 Forms shall be treated with form release agent prior to placing of reinforcement.

.5 Forms for surfaces which are to receive a plaster finish shall not be treated with form release agent.

.6 Forms shall not be stripped until concrete has attained sufficient strength to support safely its own weight and all loads to which it may be subjected.

.7 Forms shall be removed without damaging the concrete.

11.28 HOOKS AND BENDS IN REINFORCEMENT

.1 Fabrication of hooks and bends in reinforcing steel shall be in accordance with CAN/CSA A23.1.

.2 Bars shall be cold bent, unless otherwise authorized by the Engineer. Bars that are partially embedded in concrete shall not be field bent unless shown on the drawings or authorized by the Engineer.

.3 Replace bars which develop cracks or splits.

11.29 CLEANING REINFORCEMENT

.1 Bars shall be free from loose rust, mud, oil or other bond-reducing coating.

.2 Bars shall, if necessary, be recleaned prior to resumption of pouring if concrete placing is delayed during the course of a pour.

.3 Touch up damaged parts and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

11.30 PLACING REINFORCEMENT

.1 Fabricate reinforcing steel in accordance with CAN/CSA A23.1, ANSA/ACI 315 and 315R. Upon approval by the Engineer weld reinforcement in accordance with CSA W186.

.2 Reinforcement shall be placed accurately and securely supported by chairs, spacers and ties in accordance with the construction drawings.

11.31 SPLICES

.1 Bars shall be spliced only where shown on the construction drawings or as authorized by the Engineer. Splicing shall be carried out in conformance with CAN/CSA A23.1.

.2 Welding of reinforcement, where authorized by the Engineer, shall conform to CSA W186.

11.32 COVER FOR REINFORCEMENT

.1 Supports, chairs and spacers shall be provided to ensure the specified cover.

.2 A minimum of 75mm of cover for reinforcement shall be provided for concrete placed against the ground.

.3 For surfaces to be exposed to the weather or in contact with the ground after removal of forms, the concrete cover shall be at least 50mm.

.4 A minimum of 20mm concrete cover shall be provided for surfaces not exposed to earth or weather:

11.33 CONCRETE JOINTS

.1 Construction Joints:

(a) Construction joints shall comply with the requirement of CSA A23.1:19, Clause 7.3.1.
(b) Construction joints not shown on the drawings shall be approved by the Engineer prior to construction of formwork and placement of reinforcement. The interface between concrete pours is classified as construction joint if fresh concrete cannot be incorporated integrally by vibration with that previously placed.
(c) Joints shall be perpendicular to main steel.
(d) Reinforcing steel and/or welded wire fabric shall be continuous across joints.
(e) Before placing new concrete on hardened concrete, forms shall be re-tightened, the surface of concrete adequately roughened, laitance removed and the surface saturated with water in advance of concreting.
(f) Joint preparation and installation of jointing materials shall be in accordance with the manufacturer's instructions.
(g) Furnish filler for each joint in a single piece for the depth and width required for the joint, unless authorized by the Engineer. When more than one piece is authorized for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening methods.

.2 Curb and Sidewalk Expansion Joints:

(a) Transverse expansion joints for curb and gutter shall be formed at both sides of lanes and driveway crossings, at both ends of all curb returns, and both sides of catch basins1.0 m from the centerline of the catch basin and at all other locations designated by the Engineer.
(b) Transverse expansion joints for sidewalks shall be formed at both sides of lanes and driveway crossings, at both ends of curb returns, at both sides of manholes, 0.75 m from the centerline of the manhole and at all other locations designated by the Engineer.
(c) Extend joint through full depth of concrete. Fill joint with expansion joint material.

.3 Curb and Sidewalk Contraction Joints:

(a) Contraction joints shall be constructed by cutting a groove through the surface of the concrete to a minimum of ½ of the depth of the concrete section at the point of cut.

(b) Contraction Joints shall be Constructed:

(i) For sidewalks up to 3.0 m wide, lateral control joints shall be spaced at intervals equal to the width of the sidewalk.
(ii) For sidewalks wider than 3.0 m, lateral control joints shall be spaced at 3.0 m intervals, as well as longitudinal control joints, located such that a 2.0 m corridor is maintained.

(c) Contraction Joints for Curbs shall be Constructed:

(i) For curbs separated from sidewalk, control joints shall be spaced at 3.0 m intervals.
(ii) For curbs abutting sidewalk, control joints shall be spaced to match the contraction joints in the adjacent sidewalk or multi-use pathway, with a minimum spacing of 2.0 m and maximum spacing of 4.0 m.

(d) Sidewalk slabs shall be uniform in size and cut square where possible.

.4 Curb and Sidewalk Isolation Joints:

(a) Isolation joints shall be fabricated around telephone poles, light poles, hydrants, manholes, and all other structures located in the concrete section by wrapping 6 mm thick preformed bituminous impregnated fiber board material around the structure.
(b) Longitudinal isolation joints shall be formed between sidewalk and existing curbing and where sidewalk is installed directly against a wall or other structure.
(c) Bond break compound may be used in lieu of the isolation joint between sidewalk and abutting curb where approved by the Engineer.

11.34 SLEEVES AND OPENINGS

.1 Pipes, castings or conduits passing through walls or floors shall, wherever possible, be place in forms before pouring concrete. Boxes may be built into forms to make form openings for subsequent insertion of such items only with the Engineer's approval.

.2 Continuous keyways shall be provided throughout the perimeter of the opening and shall be flared slightly to facilitate the escape of entrapped air during grouting.

11.35 EMBEDDED ITEMS

.1 Items that are to be embedded in concrete shall be properly set, held, leveled and aligned in forms.

.2 Anchor bolts or other inserts shall be accurately set, held, leveled and aligned using templates.

.3 Suitable nailing blocks, plugs, strips and other items required for attachment of architectural trim and finish shall be placed such that there is no visible distortion or defacement of the completed installation.

11.36 MIXING, PLACING AND CONSOLIDATING

.1 Prior to placing concrete, obtain Engineer's approval of reinforcing material and placement.

.2 Mixing, placing and compacting of concrete shall conform to CAN/CSA A23.1 and to the approval of the Engineer.

.3 Pumping of concrete shall require approval by the Engineer.

.4 Placement and compacting of concrete shall not disturb reinforcement and inserts.

.5 Extruded concrete shall be free from waves or irregularities in line or grade and be sufficiently supported to ensure no deflection occurs.

.6 The Engineer, shall maintain accurate records of poured concrete to indicate date, location of pour, quality, air temperature and test samples taken.

11.37 <u>SURFACE FINISHING</u>

.1 Finishing of concrete shall follow the requirements of CSA A23.1:19, Clause 7.7.

11.38 <u>TYPES OF FINISHES AND TOLERANCES</u>

.1 <u>Float Finish:</u>

Surfaces received a wood float finish shall be screeded in conformance with CAN/CSA A23.1 and then the concrete surface shall be worked with a long-handled darby or float to remove high spots and ridges and to fill voids and hollows left in the concrete surface by screeding.

.2 <u>Broom Finish:</u>

After float finishing, surfaces to be broom-finished shall be slightly roughed by light brooming with a stiff brush or broom to a uniform non-skid surface to the satisfaction of the Engineer. Finished surfaces shall be true in all planes within 8mm in 3.0m as determined by a 3.0m straightedge placed anywhere on the concrete.

.3 <u>Trowel Finish:</u>

After float finishing, surfaces to be trowel-finished shall be power-trowelled and finally hand-trowelled once the surface has hardened sufficiently. Finished surfaces shall be true in all planes within 5mm in 3.0m as determined by a 3.0m straightedge placed anywhere on the slab. The surface shall have a smooth, even, dense texture free from blemishes.

.4 <u>Common Finish:</u>

For a common finish formed surfaces shall have fins and protrusions exceeding 5mm ground off. Honeycombed or defective concrete shall be removed to sound concrete, an approved bonding agent applied and patched with mortar of cement and sand mixed in the same proportions as the concrete patches. Damp burlap curing shall be applied. Tieholes shall be cut back 25mm from the face and filled.

.5 Rubbed Finish:

(a) Forms shall be removed and any necessary patching completed as soon as possible after placement of the concrete without damage to the structure. The rubbed finish shall be undertaken when the surfaces are completed and accessible.

(b) The concrete surfaces shall be thoroughly saturated with water and maintained wet for at least one hour before finishing operations are begun. All free water on the surface shall be removed prior to the application of the finishing mortar.

(c) The mortar shall consist of one part cement and two parts sand (passing a 1.18mm sieve) by volume. The mortar shall be preshrunk by mixing at least one hour before it is used and then remixed without the addition of water prior to its use.

(d) The sand and cement shall be the same materials as those used in the concrete.

(e) The mortar shall be rubbed thoroughly over sections of the prepared concrete surfaces with clean burlap pads or other suitable materials so that all surface voids are filled. While the application mortar is still plastic, the surfaces shall be rubbed with the sack pads using a mixture of mortar of the same proportions as previously specified, except that no mixing water shall be used. The final rubbing shall be performed in such a manner that the filled voids are left flush with the surface of the surrounding concrete.

(f) On exposed form surfaces, it may be necessary to blend white cement with the job cement in order to obtain a finish colour that will match the surrounding concrete surfaces. Trial batches of mortar should be made prior to application on the job surface to determine the correct mix proportions to be used.

11.39 SURFACE FINISHING

.1 Unformed surfaces not exposed to view shall receive a float finish.

.2 Unformed surfaces exposed to view, or receiving a floor covering, shall receive a trowel finish.

.3 Concrete curb and gutter shall have a steel trowel finish.

.4 Sidewalks shall receive a uniform broom finish.

.5 Formed surfaces not exposed to view shall receive a common finish.

.6 Formed surfaces exposed to view shall receive a rubbed finish.

.7 Surface finishing may be noted on the drawings or, if not clear, shall be as directed by the Engineer.

11.40 PROTECTION AND CURING

.1 Freshly placed concrete shall be protected from damage caused by weather, construction operations and vandalism. Where concrete shows evidence of damage or freezing, as determined by the Engineer, the entire section shall be removed and replaced at the Contractor's expense.

.2 Concrete curing shall comply with the requirements of CSA A23.1:19, Section 7.8. Curing requirements for the classes of exposure are given in Tables 2 and 19.

.3 Curing methods shall comply with CSA Awe.1:19, Clause 7.8.2.1.

.4 Moist curing shall commence immediately following the final set and shall continue uninterrupted for at least 7 days.

.5 Curing compounds shall not be used unless expressly authorized by the Engineer. If approved, curing compound shall be spray applied, liquid type conforming to ASTM C309 containing a fugitive dye or pigmented.

.6 Do not place load on the new concrete until authorized by the Engineer.

SECTION 12 – ASPHALTIC CONCRETE PAVING
CONTENTS

SECTION 12 – ASPHALTIC CONCRETE PAVING SPECIFICATIONS

12.20 SCOPE

.1 This specification outlines the requirements for the production, placing and compaction of hot mix, hot laid asphalt concrete for pavement construction and other uses.

12.21 SPECIAL MIXES

.1 For general purposes, such as road pavement, the requirements of this specification, and the 19 mm aggregate gradation shall apply unless otherwise approved by the City Engineer.

.2 For special purposes, such as patching, the paving of shoulders, boulevards walkways and sidewalks, and the construction of curb, gutter or combination curb and gutter, the requirements of this specification, particularly in respect to the mix design aggregate requirements, and the level of testing, shall be subject to amendment by the Engineer.

12.22 -NOT USED-

12.23 AGGREGATE

.1 Aggregate for asphaltic concrete shall be composed of hard, angular, durable, crushed gravel free from silt or clay lumps, cementation, organic material, frozen material and other deleterious materials.

.2 The aggregate gradation shall fall within the following limits when tested in accordance with ASTM C136 and ASTM C117.

Gradation Limits (% by Passing Weight)				
Size	19 mm	12 mm	10 mm	12.5 mm Superpave
19 mm	100	100	100	100
12.5 mm	70-100	90-100	100	90-100
9.5 mm	55-90	75-95	90-100	
4.75 mm	35-70	45-75	55-85	
2.36 mm	25-57	30-60	35-70	28-58
1.18 mm	18-45	20-45	25-55	
0.60 mm	13-34	15-35	15-40	
0.30 mm	8-26	6-20	8-25	
0.15 mm	5-17	4-15	5-18	
0.075 mm	2-8	2-10	2-10	2-10

.3 Recycled Asphalt Pavement (RAP):

(a) RAP is sourced for asphalt millings or excavated road mix. Suitable RAP shall not contain any other additives including, but not limited to, sulphur, crumb rubber, asphalt rubber, asbestos, produced sand, paving fabrics and reinforcement grids. Crush and screen so that 100% of the reclaimed asphalt pavement materials passes the 19 mm screen before mixing.

(b) RAP must be fed to the plant by separate feed systems capable of being sampled and metering at the design rate.

.4 All sample gradations shall fall within the gradation limits, and any deviations between the samples and the project gradation curve, based on the mix design, shall not exceed the following limits:

Sieve Size (mm)	Maximum Permissible Tolerance % by Weight Passing
4.75 - 19.0	± 4.5
1.18 - 2.36	± 4.0
0.60	± 3.5
0.30	± 3.0
0.15	± 2.0
0.075	± 1.0

.5 A minimum 75% of the material retained on a 4.75 sieve shall have at least 2 fractured faces. Percentages shall be determined by particle mass.

.6 (a) Deleterious material (clay lumps, soft shale, coal wood or mica) by weight shall not exceed 3% in the lower course nor 1.5% in the surface course.

(b) The maximum percentage of flat and elongated particles shall be 10% by mass for coarse aggregates.

(i) Flat particles are defined as those particles with a ratio of width to thickness greater than three (3).

(ii) Elongated particles are defined as those particles with a ratio of length to width greater than three (3).

.7 Aggregate deficient of material passing the 0.075 mm sieve shall have approved mineral filler added. Mineral filler shall be only material passing the 0.075 mm sieve and shall be finely ground particles of limestone, hydrated lime, Portland cement or other approved non-plastic materials when tested in accordance with ASTM D4318.

.8 The moisture content of the aggregate after leaving the drier and before mixing shall not be more than 0.5% by weight.

.9 The following tests may be required to confirm the gravel source is suitable for use in the production of aggregate for asphaltic concrete:

(a) Soundness of Aggregates to ASTM C88

(i) Maximum loss by mass after 5 cycles with $MgSO_4$
- Coarse aggregate = 15%
- Fine aggregate = 18%

(b) Micro-Deval Abrasion to ASTM D6928

(i) Maximum loss factor = 18%

(c) Sand equivalent to ASTM D2419

(i) Minimum = 40

(d) Absorption of Aggregate to ASTM C127

(i) Maximum absorption by mass = 2%

(e) Petrographic Examination to ASTM C295.

.10 <u>Additional Requirements for Superpave Aggregates:</u>

(a) Aggregates for Superpave mixes shall have properties and the gradation limits as specified below and in accordance with the latest version of the Asphalt Institute's *Superpave Series Publication – Superpave Mix Design (current version)*. Changes and/or variation from these limits shall be outlined within the Contract Special Provisions.

(i) 90% fractured aggregate with a 12.5 mm nominal maximum size, including sufficient manufactured fines to provide fine aggregate angularity.
(ii) The aggregates must meet all the requirements for angularity, toughness deleterious materials, clay content, and flat and elongated particles.
(iii) Design ESAL's will be 10 – 30 million.

12.24 <u>ASPHALT CEMENT</u>

.1 Performance grade 64-22 or penetration grade 80-100 asphalt cement shall be in accordance with MOTI SS 952. Asphalt cement shall be prepared from the refining of petroleum oils and be homogeneous, free from water and shall not foam when heated to 175°C. Vacuum Tower Asphalt Extender (VTAE) shall not be incorporated into the binder.

.2 The Contractor shall inform the Engineer of the name of his asphalt supplier and shall ensure that each load of asphalt is accompanied with a flow sheet showing compliance with the preceding requirements. Such flow sheets shall be submitted to the Engineer.

12.25 ASPHALTIC CONCRETE MIX DESIGN CRITERIA

.1 Marshall Mixes:

(a) The asphalt mix design for pavements shall be carried out under Marshall design criteria using the designated equipment and procedures as contained in the Asphalt Institute's *Mix Design Methods for Asphaltic Concrete MS-2*, latest edition.

(b) If requested by the Engineer, the Contractor shall supply an asphaltic concrete mix design conforming to the following specifications as based on the Marshall method of design Asphalt Institute Manual series No. 2 (MS-2) for approval:

		Local	**Collector**	**Arterial**	**Special Mixes**
(a)	Number of blows each face of test specimen	75	75	75	50
(b)	Minimum % voids in Mineral aggregate (VMA), based on Bulk SG 25 mm Aggregate 19 mm Aggregate 12 mm Aggregate 10 mm Aggregate	 - 13 14 16	 - 13 14 16	 - 13 14 16	 - 13 14 16
(c)	% air voids in compacted mixture, surface and lower course	3-5	3-5	3-5	3-5
(d)	Minimum modified Marshall load, N @ 60°C	5000	7000	7000	4500
(e)	Flow index, (mm)	2-4	2-4	2-4	2-4
(f)	Minimum asphalt film thickness (µm)	8	8	8	
(g)	Minimum index of retained stability after immersion in water @ 60°C for 24 hours	75%	75%	75%	75%
(h)	Asphalt content in the mix shall be as specified in the mix design ±0.3%				

.2 Superpave Mixes:

(a) The Superpave asphalt mix design shall be carried out in accordance with the latest edition of the Asphalt Institute's Superpave Mix Design, Superpave Series No. 2 (current version) and these Standard Specifications.

(b) If requested by the Engineer, the Contractor shall supply an asphaltic concrete mix design conforming to the following specification for approval:

CRITERIA PROPERTY OF LABORATORY COMPACTED PAVING MIXTURE For Design ESAL's = 10-30 **million**, at N_{Design} = 100 gyrations	SUPERPAVE nominal 12.5 mm
% voids in the Mineral Aggregate, minimum	14
Required density: % of Theoretical Maximum Specific Gravity in a Laboratory compacted mix: • at N_{max} = 160 gyrations • at N_{Design} = 100 gyrations • at $N_{Initial}$ = 8 gyrations	 98 maximum 95-97 89 maximum
% voids filled with Asphalt Cement	65-75
Dust to Binder ratio[1]	0.6-1.2

.3 Reclaimed Asphalt Product (RAP):

(a) The maximum RAP allowed in the asphalt mix shall be determined by the contribution of the RAP Asphalt Cement (AC) towards the total AC content in the mix by weight as per the percentages shall be 15%. Contractor shall notify the City Representative, 14 days in advance of Paving if RAP will be used in the project.

(b) The amount of the total AC replaced by the AC in the RAP will be calculated as follows:

% AC Replacement = (axb)/c

Where:

a = AC content of RAP
b = RAP percent in mixture by total weight of mix
c = Total percent AC content in mixture

[1] Consideration shall be given to increasing the dust to binder ratio to 0.8 – 1.6

12.26 JOB MIX AND PLANT CALIBRATION

.1 If requested by the Engineer, a job mix formula shall be provided by the Contractor and shall contain the following information:

(a) Sieve analysis of combined aggregate in mix.
(b) Aggregate size range in each bin separation to be used.
(c) Weight of aggregate to be used from each bin for one batch of mix.
(d) Weight of asphalt cement to be used for one batch of mix.
(e) Optimum mixing and compacting temperatures.

.2 If requested by the Engineer, a plant calibration for continuous mix plants shall be provided by the Contractor.

12.27 TACK COAT

.1 Bituminous tack coat shall be Grade SS-1 or SS-1h asphalt emulsion, in accordance with MOTI SS 952 (or the latest AASHTO M140-13 or the latest ASTM D977) or as approved. Manufacturer’s laboratory analysis of each tack coat shipment shall be submitted to the Engineer for approval.

12.40 RESPONSIBILITY FOR ALIGNMENT, GRADE AND BASE

.1 The Contractor shall examine the base, existing surface and tack coat to ensure they conform to the specifications, and the grade and alignment conform to the construction drawings, prior to commencing paving operations. The Contractor shall be satisfied that the base is properly prepared for the placement of asphaltic concrete and shall notify the Engineer of any observed deficiencies prior to paving. The Contractor's responsibility for pavement failures shall include those caused by base failure, misalignment or incorrect grade.

.2 Prior to delivery of the asphaltic concrete to the job site, the prepared base shall be cleaned of all loose or foreign material.

12.41 TRAFFIC CONTROL

.1 The Contractor shall be responsible for traffic control during all operations in accordance with Section 3.61 – Control of Public Traffic – General.

.2 Traffic shall not be permitted on the finished pavement until it has cooled to atmospheric temperature.

12.42 CUTTING AND REMOVAL OF EXISTING PAVEMENT

.1 The Contractor shall cut, remove and dispose of existing pavement as directed by the Engineer. Pavement cutting shall be in accordance with Section 4.28 – Final Cutting Paved Surfaces. ***(REVISED MAY 2020)***

12.43 ADJUSTMENT OF SERVICES

.1 The Contractor shall adjust manholes, catch basins, valves, etc. to the proper finished grade at least 48 hours prior to paving in accordance with Section 6.53 – Frames and Covers and Section 6.54 – Manhole Steps.

12.44 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 specification, 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 test programs listed below are the minimum testing requirements. The Engineer shall determine if additional testing is required.

(a) Aggregates:

(i) One aggregate gradation test shall be carried out either for each 300 tonnes of production or a minimum of once per day (ASTM C136 and ASTM C117).
(ii) Additional testing as outline in Section 12.23 as required by the Engineer.

(b) Asphaltic Concrete:

One Marshall test consisting of three briquettes for every three hundred tonnes of production, or a minimum of one test per day shall be performed to determine the following:

(i) Marshall stability
(ii) Specific gravity
(iii) Air voids and voids in mineral aggregate (VMA)
(iv) Flow index
(v) Asphalt content extraction
(vi) Gradation of Asphalt aggregate

Testing shall use the 75 Blow Marshall test method. The 50 Blow Marshall test method may be used for walkways, sidewalks, driveways or other City Engineer approved locations.

(c) Compaction:

(i) Upon completion of the asphalt paving operation, one core from each 400 m^2 of pavement with a minimum of three (3) cores shall be obtained at locations determined by the Engineer for the purpose of determining the asphaltic concrete density in accordance with ASTM D2723, and the asphaltic concrete thickness.
(ii) Final compaction results shall be expressed as a percentage compacted density which is defined as follows:

$$\text{Percentage compacted density} = \frac{\text{Density of sample}}{\text{Marshall density}} \times 100$$

(iii) Test result data will be subjected to statistical analysis and the final compaction shall not be considered satisfactory unless the mean and the standard deviation of the test result data is in accordance with Section 12.51 – Asphaltic Concrete Acceptance Requirements.

(d) Other testing as may be required to confirm conformance of materials and workmanship to the specifications.

.4 The test programs outlined above are minimum requirements and may be modified by the Engineer. Full testing may be required during the first few days of paving to determine quality control and construction procedures. As paving progresses sufficient tests to maintain uniformity will be required.

.5 Inspection and testing by the Engineer shall not relieve the Contractor of his responsibility for quality control.

.6 Asphaltic concrete found to be in non-compliance with the specifications shall be repaired or replaced by the Contractor. The Contractor shall submit to the Engineer for approval, the proposed method to correct the noted deficiencies and work schedule, prior to commencing the work.

12.45 <u>TACK COAT</u>

.1 The existing asphaltic concrete surface shall be thoroughly cleaned by a power-driven sweeper immediately prior to applying the tack coat.

.2 Tack coat shall be applied to all existing asphaltic concrete which is to be overlaid. Tack coat shall be applied to the edge of existing asphaltic concrete, curbs and structures where these surfaces will be in contact with the new asphaltic concrete pavement.

.3 Tack coat shall be applied only when the surface is dry and clean, and the air temperature is over 10°C.

.4 Tack coat shall not be diluted unless directed by the Engineer.

.5 Tack coat shall be uniformly applied with an approved pressure distributor at a rate of 0.25 litres per square metre. The temperature of the material shall be maintained between 32°C and 38°C.

.6 Traffic shall, where possible, be kept off tack coat areas. Where traffic has been allowed on the tack coat, these areas shall be thoroughly cleaned by a power-driven sweeper immediately prior to laying asphaltic concrete.

.7 No hot mix shall be placed upon the tack coat until it has dried to a proper condition of tackiness, as determined by the Engineer.

.8 Tack coat shall be placed only on the area being paved. Work shall be planned so that no more tack coat than is necessary for the days operation is placed on the surface.

.9 Any damage to persons, vehicles or private property during the application and curing of the tack coat is the Contractor’s responsibility.

12.46 TRANSPORTATION OF HOT PLANT MIX

.1 Trucks used for the transport of hot mix shall be equipped with tarpaulins and, where required, with insulated boxes. Trucks shall not leak fuel, lubrication oils or hydraulic oil.

.2 Inside surface of truck boxes shall be free of all deleterious materials and lubricated with suitable thin soap, but excessive use of lubricant will not be permitted.

.3 The mixture shall be transported from the paving plant to the job site utilizing City of Nanaimo designated truck routes where possible, and shall use local streets only to obtain local access.

.4 Loads shall be delivered continuously in covered trucks to provide a uniform, non-stop paving operation.

.5 Delivery of the mix shall be scheduled to permit completion of the paving operation in daylight hours unless otherwise approved by the Engineer.

12.47 PLACEMENT

.1 Surfaces onto which asphaltic concrete pavement is placed shall be dry, above 5°C, and cleaned of all loose and foreign materials. Mixtures shall normally not be laid when the atmospheric temperature is less than 5°C and falling.

(a) Bottom lift shall be placed onto surfaces above 5°C and rising.
(b) Top lift shall be placed onto surfaces above 10°C and rising.

.2 The mixture at time of placing shall be not less than 120°C or greater than 160°C or as required by the mix design and requires approval by the City Engineer.

.3 An approved, self-propelled mechanical paver shall be used to spread the mixture to the specified thickness. The paver speed shall be adjusted to correspond to the rate of delivery to provide a uniform, non-stop paving operation.

.4 The Contractor may use such methods as approved by the Engineer in narrow areas, irregular sections, intersections, turnouts or driveways, where it is impractical to spread with a paver.

.5 Minor inequalities in spreading and shaping the paved surface adjacent to existing structures such as manholes, catch basins or valves shall be performed to a condition satisfactory to the City Engineer.

12.48 COMPACTION

.1 Equipment:

(a) Unless otherwise directed by the Engineer, the Contractor shall furnish a minimum of two (2) self-propelled rollers to roll and compact the asphaltic concrete mixture. All rollers shall be in good condition and capable of reversing without backlash.

.2 General:

(a) Compaction shall commence immediately after the bearing capacity of the asphalt mat is adequate to support compaction equipment without undesirable displacement or cracking.
(b) Maximum speed for initial rolling shall not exceed 5 km/hr, and subsequent rolling, 8 km/hr. Speeds shall be maintained at all times such that displacement of asphaltic concrete does not occur.
(c) During the rolling operation, roller wheels shall be kept moist with only enough water to avoid picking up material. Fuel oil, lubricating oil, or kerosene shall not be permitted as lubricants for the surface of the roller wheels.
(d) The line of rolling shall not be suddenly changed nor the direction of rolling suddenly reversed. Pronounced changes in direction shall be made on stable material.
(e) Heavy equipment including rollers shall not be permitted to stand on the finished surface.
(f) Where rolling causes displacement of material, loosen affected areas immediately with lutes or shovels and restore to original grade of loose material before re-rolling.
(g) Should the testing results or the Contractor’s quality control indicate compaction requirements are not being met, the Contractor shall immediately modify his compaction procedure to satisfy the compaction requirements.

.3 Breakdown Rolling:

Breakdown rolling shall immediately follow the rolling of transverse and longitudinal joint and edges. Rollers shall be operated as close to the paver as necessary to obtain adequate density without causing undue displacement. Initial rolling shall be performed by steel wheel rollers with the drive roll or wheel forward in the direction of paving. Rolling shall commence on the low side of the mat and progress to the high side.

.4 Secondary Rolling:

Secondary rolling shall follow the initial rolling as closely as possible, and shall be continuous until the mix has been thoroughly compacted.

.5 Finish Rolling:

Finish rolling shall be by steel wheel roller to remove all marks left by pneumatic rolling. Finish rolling shall be accomplished with the minimum number of passes required to produce a satisfactory surface.

12.49 JOINTS

.1 General:

(a) All transverse and longitudinal joints shall be painted with a thin tack coat immediately prior to paving. Application of tack coat to longitudinal joints may be omitted if the previously laid pavement has not cooled to less than 50°C.
(b) Transverse joints in succeeding courses shall be offset a minimum of 600 mm. In adjacent lanes they shall be offset a minimum of 3.0 m.
(c) Longitudinal joints in succeeding courses shall be offset 150 – 200 mm.
(d) Wherever possible, longitudinal joints shall be offset 100 mm from future traffic markings (paint lines).

.2 Transverse Joints:

Transverse joints shall have a vertical face and shall be carefully constructed and thoroughly compacted to provide a smooth riding surface over the joint. Horizontal alignment of joints shall be straight-edged to ensure smoothness. Rolling of transverse joints shall be performed immediately after raking is completed.

.3 Longitudinal Joints:

Longitudinal joints shall have a vertical face and shall be rolled directly behind the paving operation. Joints shall be rolled by passing the roller on the previously compacted lane letting one wheel project 100 mm to 150 mm on the new lane. A minimum of 2 passes shall be required to thoroughly compact this narrow strip down to and even with the existing lane.

.4 Edges:

Pavement edges shall be rolled concurrently with the longitudinal joints and shall not be exposed more than 15 minutes before rolling. After longitudinal joints and edges have been compacted, longitudinal rolling shall start at the edge and progress to the centre of the pavement, overlapping at least one-half the width of the roller with each successive pass. On super-elevated curves, rolling shall begin on the low side and progress to the high side.

12.50 CLEANING

.1 The Contractor shall thoroughly remove from all culvert, catch basins, curbs, gutters and other structures such contamination by asphaltic or other materials as may have occurred during the performance of the work.

12.51 ASPHALTIC CONCRETE ACCEPTANCE REQUIREMENTS

.1 The finished grade surface shall be free from bumps, depressions or other irregularities and shall be within 6 mm of the design grade and cross-section, but not uniformly high or low, when measured with a 3.0 m straight edge in any direction.

.2 The finished elevation of the compacted asphaltic concrete shall be 0 - 6 mm above the finish elevation of structures, including but not limited to curbs, gutters, manhole lids, catch basins, valve boxes and survey monuments.

.3 The finished surface of the asphaltic concrete shall be homogenous, free from segregation and consistently uniform in surface texture.

.4 Asphaltic concrete shall be compacted to 97% mean compacted density when tested in accordance with Section 12.44 – Testing. Maximum acceptable standard deviation of test data shall be 1.5%, with no individual test results less than 95% compacted density.

.5 Asphaltic concrete thickness, as measured in accordance with ASTM D3549, shall not be less than the specified thickness for all test cores.

SECTION 13 – SURFACE TREATMENTS *(REVISED MAY 2020)*
CONTENTS

SECTION 13 – SURFACE TREATMENTS *(REVISED MAY 2020)*
DESIGN CRITERIA

13.01 SCOPE

.1 For the purpose of this specification the following definitions shall apply:

(a) Alternative Surface Treatments refer to alternate hardscaping treatments that include, but are not limited to: concrete pavers, stamped concrete, and any other treatment deemed appropriate by the design engineer and approved by the City Engineer.
(b) Concrete pavers refer to concrete pre-manufactured for the purpose of hardscaping a lateral space.
(c) Stamped Concrete refers to concrete stamped once poured, to achieve a decorative appearance.

.2 All alternative surface treatments must be designed in accordance to the design criteria within this section, while also following the design criteria, specifications, and installation requirements captured throughout all sections of the MoESS.

13.02 OBJECTIVES

.1 Alternative surface treatments shall be used within a streetscape or park to add visual and artist interest to the public realm through colours, patterns, and textures.

.2 Applications include, but are not limited to:

(a) Pedestrian realm including, but not limited to, sidewalks, walkways, plazas, open spaces, and parklets.
(b) Vehicle surfaces including, but not limited to, mountable truck aprons and crosswalks.
(c) Buffers to provide visual and textural separation of travel modes.
(d) Universal and accessible design features including, but not limited to, Tactile Warning Service Indicators (TWSIs).

.3 For any application where vehicular traffic is anticipated within road right-of-way, concrete pavers are to be avoided and stamped concrete is to be used.

13.03 EDGE RESTRAINTS

.1 Edge restraints shall include:

(a) Concrete curbs, as per Section 8.0 - Transportation.
(b) Concrete grade beams with a minimum width of 200 mm that conform to concrete specifications within Section 11.0 – Cast In Place Concrete Works.

13.04 THICKNESS

.1 Concrete pavers shall have a minimum thickness of 60 mm, when used within the pedestrian realm absent of vehicular traffic.

.2 Stamped concrete is to meet the specified thicknesses outlined within the Section 8.0 – Transportation Standard Drawings.

13.05 BASE AND SUB-BASE

.1 Sub-base beneath concrete pavers shall be crushed or pit-run aggregate compacted to a minimum thickness of 150 mm or as specified in Section 9.0 – Aggregates and Granular Materials.

.2 Concrete paver base shall be from one of the three categories:

(a) FLEXIBLE BASE - consists of compacted crushed stone, gravel, or coarse sand. Joint sand shall be used when laying concrete pavers on a Flexible Base.

(b) SEMI-RIGID BASE - consists of asphalt. Joint sand shall be used when laying concrete pavers on a Semi-Rigid Base.

(c) RIGID BASE - consists of a reinforced or unreinforced concrete slab on grade.

.3 All concrete pavers in the pedestrian realm are to be grouted in place.

13.06 PATTERNS

.1 All patterns or design features require prior approval by the City Engineer.

.2 Patterns for non-standard concrete pavers shall conform to the manufacturer's specifications.

.3 Truck aprons within the road right-of-way shall be stamped concrete with a red brick pattern.

.4 Banding/buffer on either side of the bike path shall be stamped concrete with transverse score lines at 0.3m intervals.

13.07 UTILITY SURROUNDS

.1 Covers and grates are to be avoided in walking areas, but when they are necessary, they shall be installed flush with the surrounding surface and slip-resistant.

.2 The maximum opening on any grate or cover should be 13 mm, and if elongated, placed at right angles to the predominant direction of travel.

.3 Metal rims and covers up to 300 mm in diameter shall have a minimum 150 mm thick concrete surround.

SECTION 13 – SURFACE TREATMENTS *(REVISED MAY 2020)*
SPECIFICATIONS

13.20 SCOPE

.1 Only those products approved by the City Engineer will be accepted for installation.

.2 These specifications apply to, alternative surface treatments, in addition to the specifications as outlined within all sections of the MoESS, including:

(a) Section 4.0 – Excavation, Trenching, and Backfill.
(b) Section 8.0 – Transportation.
(c) Section 9.0 – Aggregates and Granular Materials.
(d) Section 11.0 – Cast In Place Concrete Works.
(e) Section 12.0 - Asphaltic Concrete Paving.
(f) Section 14.0 – Landscape.

13.21 CONCRETE PAVERS

.1 Concrete pavers refer to precast concrete units manufactured and supplied by a member of the Concrete Paver Institute. Concrete pavers must conform to the following requirements.

(a) Concrete pavers shall have an average compressive strength of 55 MPa (8000 psi), with no individual paver under 50 MPa (7250 psi) in accordance with ASTM C579 or CSA A231.1/A231.2.
(b) Concrete pavers shall have an average absorption of 5% with no paver having a greater absorption than 7% when tested in accordance with ASTM C140.
(c) Concrete pavers must be shown to be resistant to fifty (50) freeze-thaw cycles when tested in accordance with ASTM C67 or in accordance with CSA A231.1/A231.2.

13.22 BEDDING AND JOINT SANDS

.1 Sands to be used for concrete paving shall be clean, non-plastic and free from deterious or foreign matter. Bedding and Joint Sands may be natural or manufactured from crushed rock.

.2 For Bedding Sand the material shall conform to ASTM C33 as follows:

Grading Requirements for Bedding Sand (ASTM C33)	
Sieve Size	**Percent Passing**
9.5 mm (3/8 in)	100
4.75 mm (No. 4)	95 to 100
2.36 mm (No. 8)	85 to 100
1.18 mm (No. 16)	50 to 85
0.600 mm (No. 30)	25 to 60
0.300 mm (No. 50)	10 to 30
0.150 mm (No. 100)	2 to 10

.3 For Joint Sand the material shall conform to ASTM C33 as follows:

Grading Requirements for Joint Sand (ASTM C144)	
Sieve Size	**Percent Passing**
4.75 mm (No. 4)	100
2.36 mm (No. 8)	95 to 100
1.18 mm (No. 16)	70 to 100
0.600 mm (No. 30)	40 to 75
0.300 mm (No. 50)	10 to 35
0.150 mm (No. 100)	2 to 15
0.075 mm (No. 200)	0

.4 Bedding Sand may be used as a replacement for Joint Sand, but Joint Sand shall not be used to replace Bedding Sand as a laying base.

.5 Geotextile used to prevent the migration of bedding sand shall meet the requirements as described in AASHTO M288 Class 2.

13.23 SUB-BASE

.1 Select granular Sub-base shall conform to Section 9.0 – Aggregates and Granular Materials.

13.24 BASE MATERIALS

.1 Flexible Base:

(a) The minimum thickness of a compacted aggregate base is 100 mm. A compacted aggregate base shall have a 25 to 50 mm compacted sand setting bed placed between the base and the pavers.

.2 Semi-Rigid Base:

(a) For any paving application, semi-rigid bases consist of a minimum 100 mm thickness of asphalt base, with a 19 to 25 mm asphalt setting bed on top. Semi-Rigid bases may be installed using existing asphalt pavement at the base.

.3 Rigid Base:

(a) The setting bed shall be compacted sand approximately 13 mm thick.

(b) Rigid bases shall have a minimum thickness of 100 mm of concrete base. Rigid bases shall be used in areas of heavy traffic and where surface drainage is necessary. A rigid base shall have a 10 to 13 mm mortar setting bed to seat the concrete pavers.

SECTION 13 – SURFACE TREATMENTS *(REVISED MAY 2020)*
INSTALLATION

13.40 SCOPE

.1 These installation specifications apply to alternative surface treatments, in addition to the installation specifications as outlined within all sections of the MoESS.

13.41 EDGE RESTRAINTS

.1 Edge restraints shall be formed not extruded. Reinforcement shall be used as required.

.2 Edge restraints must be in place prior to laying concrete pavers.

.3 Edge restraints shall not be installed on top of bedding sand.

13.42 BEDDING SAND

.1 Bedding sand shall be spread evenly over the base course and screeded to plan thickness. Screeds shall be standard lumber, having minimum length as required by the edge restraints. Screeded sand shall not be disturbed.

.2 Depressions in the base course shall be filled with base course material and compacted.

.3 The maximum thickness of bedding sands shall not be exceeded.

13.43 CONCRETE PAVERS

.1 Concrete pavers, when used, must be laid in a smooth, uniformed manner, have a small chamfer edge 2 – 6 mm.

.2 Joints between concrete pavers shall be as per manufacturer's specifications and shall not exceed 5 mm.

.3 Gaps at the edge of the paved area shall be filled with cut or edge pavers.

.4 Pavers shall be cut using double bladed splitter or masonry saw to achieve a smooth cut. No pieces shall be smaller than 10 mm; smaller gaps shall be filled with sand. Adjust bond pattern at pavement edges such that cutting of edge pavers is minimized.

13.44 COMPACTION

.1 A low amplitude vibrator capable of 22 kN with 75-100 Hz frequency shall be used to vibrate and compact the concrete pavers into the bedding sand. Vibrators shall not be used within 1 m of an unrestrained edge of the concrete pavers.

.2 Joint sand shall be swept in between the concrete pavers during vibration.

.3 Mechanical - laying machines require prior to approval of the City Engineer.

13.45 TOLERANCES

.1 Final surface elevation of concrete pavers shall be 3 to 6 mm above adjacent drainage inlets, concrete collars or channels.

.2 The final surface elevation shall not deviate more than 10 mm under a 3 m long straightedge.

.3 Ensure all joints are as flush as possible with a maximum tolerance of 6 mm, as per the BC Building Access Handbook 2014.

13.46 MOISTURE PROTECTION

.1 Stockpiled material shall be covered with a waterproof covering to prevent exposure to rainfall.

.2 Concrete pavers shall not be installed during rainfall or over wet base and Sub-base materials.

13.47 CLEANUP

.1 At the end of each day, all work within 1 m of the laying face shall be left fully compacted and shall have sand filled joints.

.2 All excess sand shall be swept off the laid pavers.

SECTION 14 – LANDSCAPE
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SECTION 14 – LANDSCAPE
CONTENTS

<u>SPECIFICATIONS</u> Cont'd **<u>SECTION NO.</u>**

(REVISED MAY 2020)

<u>Irrigation</u>

(REVISED MAY 2020)

<u>INSTALLATION</u>

<u>Planting</u>

SECTION 14 – LANDSCAPE
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INSTALLATION (cont'd) **SECTION NO.**

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CONTENTS

LANDSCAPE MAINTENANCE Cont'd — **SECTION NO.**

(REVISED MAY 2020)

STANDARD DRAWINGS — **DWG. NO.**

(REVISED MAY 2020)

SECTION 14 – LANDSCAPE
DESIGN CRITERIA

14.01 SCOPE

.1 These landscape standards and specifications shall apply to all new parkland and trailways acquired through subdivision development as well as to all landscape areas within rights-of-way (R.O.W.) of roadways and utilities in the City of Nanaimo including: medians, soft landscape areas between the curbs and the R.O.W. lines, and plantings in urban plaza and sidewalk areas. Safety for utility lines, drivers and pedestrians must be ensured when developing treed boulevards.

.2 The general design and construction of the landscape shall be in accordance with the standards set out in this section. All standards and specifications must be followed. Specific projects may warrant amendments to the standards herein but those amendments must be approved in writing by the City Engineer.

.3 During Pre-Construction Stage, the following must be completed and accepted: ***(REVISED MAY 2020)***

(a) Submission of a landscape plan complete with restoration planting, tree locations and irrigation design by a Landscape Architect following the standards and specifications herein.
(b) Installation of landscaping may be completed with the exception of the trees once the plan is accepted and only if timing is appropriate for planting.
(c) Submission of a detailed maintenance plan which addresses maintenance requirements outlined in the Landscape Maintenance sub-section of Section 14 – Landscape. ***(REVISED MAY 2020)***

.4 During Construction Stage the City Engineer must be notified of the following:

(a) Inspection of all pipe in ground (if required) to ensure it is exposed with bedding material prior to back fill.
(b) Inspection of the backflow prevention assembly and point of connection as per Standard Drawing I-1 if required before back fill. ***(REVISED MAY 2020)***
(c) Inspections to ensure T-joint couplings and installed (if required) before back fill at the location where future trees will be planted.
(d) Inspection of the irrigation controller installed (if required).
(e) Completion of soil samples and testing to be done in accordance with Section 14.14. A copy of the report must be sent to the City Engineer prior to installation.
(f) Inspection of the seed, turf and plantings must be done by the City Engineer when installed by the developer.

.5 During Maintenance Stage, the following must be completed: ***(REVISED MAY 2020)***

(a) Inspection of planted material immediately after planting; ***(REVISED MAY 2020)***
(b) Follow accepted maintenance plan; ***(REVISED MAY 2020)***
(c) Occur once per month from April to October; ***(REVISED MAY 2020)***
(d) Watered on a regular basis during dry conditions; ***(REVISED MAY 2020)***

(e) Weeding, invasive plant removal, pest and disease control, remedial pruning; ***(REVISED MAY 2020)***

(f) Plant replacement as required, ***(REVISED MAY 2020)***

as per Section 14.0 - Landscape, sub-section of Landscape Maintenance. ***(REVISED MAY 2020)***

.6 At the End of Maintenance Inspection Prior to Bond Release, the following must be completed:

(a) Final inspection of irrigation and all landscaping.

(b) Where a final inspection includes a parkland acquisition, the inspection shall ensure all requirements have been completed as per the request of the City Engineer.

(c) Testing of irrigation after installation. All lines are to be charged to ensure there are no breaks or leaks in the system.

(d) As-built drawings (with any revisions noted) must be provided to the City Engineer.

(e) If not already installed, the City of Nanaimo Urban Foresty Department will install boulevard trees in planned locations when the majority of build out has occurred and maintain with irrigation, watering truck or adopt a tree program. ***(REVISED MAY 2020)***

PLANTING

14.02 DRIVER VISIBILITY AND CLEARANCE

.1 Do not obstruct the line of vision at intersections within the triangular area bounded by the intersection of lot lines and a line joining each lot line 7 m from their intersection.

.2 The maximum mature maintained height for plant materials located within sight distance triangles at intersections shall be 300 mm above finish grade.

.3 Specify trees near approaches to left turn slots, driveways or pedestrian crosswalks which can be pruned up from the base to a minimum height of 1.5 m. Shrubs in these areas shall not exceed 300 mm in mature height.

.4 Locate trees a minimum of 1.0 m distance from the pavement or curb face, unless planted in accordance with Standard Drawing P-5 or P-6.

.5 Tree branch clearances requirements are: 5 m the over traveled portion of road and 2 m over the sidewalk.

14.03 MINIMUM SETBACKS FOR TREES

.1 Setbacks for trees to objects shall be as follows:

TABLE 14-1

SETBACK TREES FROM	DISTANCE
Underground streetlight conduit or irrigation main	0.6 m
Other underground utilities	1.2 m
Lamp Standards	6.0 m
Steel and wooden utility poles	3.0 m
Driveways	2.0 m
Catch basins	2.0 m
Manholes, valves boxes, services	1.2 m
Sewer service boxes	1.5 m
Fire Hydrants	2.0 m
Road intersection	7.0 m
Curb Face	1.0 m
Sidewalk	0.85 m
Buildings – fastigiate (columnar) tree	2.0 m
Buildings – regular crown tree	3.0 - 5.0 m

14.04 MINIMUM LANDSCAPE AREA DIMENSIONS AND MAXIMUM GRADES

.1 The minimum width for grass boulevard shall be 1.0 m, 1.5 m or greater preferable. Maximum slope for lawns to be 3:1.

.2 The minimum width for shrub or ground cover beds shall be 0.6 m, 1.0 m or greater is preferred. Maximum slope for shrub or ground cover beds to be 2:1.

.3 The minimum width for a landscaped median shall be 2 m from curb face to curb face. This will allow for the minimum 1 m wide planting bed and 0.5 m wide splash aprons to be constructed in accordance with Standard Drawing No. P-4 and Standard Drawing No. CS-7. ***(REVISED MAY 2020)***

.4 Median Islands narrower than 2 m from curb face to curb face shall be poured with a broomed or stamped finish in accordance with Standard Drawing No. CS-7. ***(REVISED MAY 2020)***

.5 The minimum width of boulevards for tree planting shall be 1.85 m measured from face of curb.

14.05 PLANT MATERIAL SELECTION

.1 All plant materials shall meet the following criteria:

(a) Plants shall have the ability to withstand adverse conditions such as airborne pollutants, maximum sun exposure and reflected heat from pavements, high winds and abrasive forces, occasional snow loading and exposure to salt from road clearing operations, and limited root zone soil volumes.

(b) Plants shall be hardy to Zone 7 or colder.

(c) Plants shall be capable of reduced water demand following a minimum of two years establishment period. ***(REVISED MAY 2020)***

(d) Plants shall have relatively low maintenance attributes including: fine to medium leaf size and canopy density; non-fruit bearing or having only berry-sized non-staining fruits; low susceptibility to disfiguring or fatal diseases and infestations; infrequent demands for pruning; fertilizing and other cultural requirements.

(e) Plants shall be of appropriate size and form at maturity to meet criteria in Section 4.02 – Driver Visibility and Clearance.

.2 Lawns/Fine Grass, Rough Grass and Wildflowers:

(a) Sod shall be used on all lawn/fine grass areas. Seeding shall require approval of the City Engineer.

(b) Rough grass and wildflowers areas shall be seeded. Seeding method shall be noted on drawings.

(c) Areas to be seeded with grades greater than 4:1 and/or highly erodible soils shall be hydroseeded with a nurse crop seed mix, a hydraulically applied erosion control mulch, or erosion control blanket. Erosion control method to be noted on drawings.

.3 Trees shall be selected such that:

(a) Boulevard or ‘street’ trees shall be of at least two different genus, species and cultivar, alternately planted, within a given block. Median tree species may vary. ***(REVISED MAY 2020)***

(b) Street trees species shall vary between intersecting streets.

.4 All streets trees shall meet the following criteria:

(REVISED MAY 2020)

(a) Ability to withstand pruning for pedestrian, vehicle and/or building clearance without compromised to tree health or form.

(b) Absence of species/varietal characteristics of structural weakness, susceptibility to wind damage, or thin, easily damaged bark,

.5 Select street trees according to proposed site conditions either from: Table 14-2 or:

(a) An alternative source provided that the proposed trees meet the site criteria contained within the relevant Parts of Table 14-2 and all other criteria contained in this section.

(b) Obtain written approval from the City Engineer for tree selections not take from Table 14-2.

TABLE 14-2

PART 1 – Trees For Directly Under Hydro Lines

Minimum allowable soil volume per tree 13.5 cu.m. with 1 m depth pit. ***(REVISED MAY 2020)***
Selection criterion for alternative trees not listed in Part 1: Mature height not greater than 7.62 m.

SCIENTIFIC NAME	COMMON NAME
Albizia Julibrissin ***(REVISED MAY 2020)***	Silk Tree ***(REVISED MAY 2020)***
Acer ginnala	Amur Maple (tree form)
Acer platinoides ‘Globosom’	Globe Norway Maple
Prunus yedoensis	Akebono Cherry
Cercis Canadensis ‘Forest Pansy ***(REVISED MAY 2020)***	Red Bud
Carpinus Caroliniana ***(REVISED MAY 2020)***	Pink Perfection Cherry American Hornbeam ***(REVISED MAY 2020)***
Cornus Eddie’s White Wonder	Eddie’s White Wonder Dogwood
Parrotia Persien ***(REVISED MAY 2020)***	Persian Ironwood ***(REVISED MAY 2020)***
Styrax Japonica***(REVISED MAY 2020)***	Japanese Snowbell ***(REVISED MAY 2020)***

PART 2 – Trees for Beside Hydro Lines (Min. 2.75 m Lateral Distance from Nearest Line)

Minimum allowable soil volume per tree 13.5 cu.m. with 1 m depth pit.
Trees listed in Part 1 may also be used.
Selection criterion for alternative trees not listed in Part 2: Mature spread not greater than 5 m.

SCIENTIFIC NAME	COMMON NAME
Acer platanoides ‘Columnare’	Columnar Norway Maple
Acer platanoides ‘Crimson Sentry’	Crimson Sentry Norway maple
Acer rubrum ‘Bowhall’	Bowhall Red Maple
Carpinus betulus ‘Fastigiata’	Fastigiate Hornbeam
Ginkgo biloba ‘Princeton Sentinel’	Princeton Sentinel Gingko
Fagus sylvatica ‘Fastigiata’ (‘Dawyckii’)	Fastigiate Beech
Prunus sargentii ‘Columnaris’	Columnar Sargent’s Cherry
Quercus robur ‘Fastigiata’	Fastigiate English Oak
Tilia cordata ‘Corzam’	Corinthian Linden

(REVISED MAY 2020)

PART 3 -NOT USED-

PART 4 – Trees for Available Soil Volumes of 20 cu.m. per Tree or More, 1 m pit Depth

Trees listed in Parts 1-3 may also be used.
Selection criterion for alternative trees not listed in Part 3: Mature height no greater than 20 m.

SCIENTIFIC NAME	COMMON NAME
Acer rubrum cvs.	Red Maple cultivars
Quercus coccinea	Scarlet Oak
Quercus rubra	Red Oak
Tilia x euchlora	Crimean Linden
Robinia pseudoacacia	Black Locust
Robinia pseudoacacia cvs	Black Locust cultivars
Nyssa Sylvatica ***(REVISED MAY 2020)***	Blackgum ***(REVISED MAY 2020)***

PART 5 – Trees for Wide Boulevard or Wide Median Use Only

Trees listed in Parts 1-4 may also be used.
Trees in the Part require a minimum available root zone of 20 cu.m. per tree with a minimum width of 3.5 m.

SCIENTIFIC NAME	COMMON NAME
All non-dwarf coniferous spp.	
Fagus sylvatica (sp., & full size cultivars)	European beech
Liquidambar styraciflua	Sweetgum
Liriodendron tulipifera	Tulip tree
Platanus acerifolia	London Planetree
Ginkgo biloba ***(REVISED MAY 2020)***	Ginkgo Tree ***(REVISED MAY 2020)***
Zelkova serrata cv.	Japanese Zelkova
Quarcus robur	English Oak

14.05A RIPARIAN AND RESTORATION PLANT MATERIAL SIZE, SPACING AND LOCATION ***(REVISED MAY 2020)***

.1 Minimum size and spacings for riparian and restoration replanting specifications for level 4, level 5 and level 6 areas shall be as follows: ***(REVISED MAY 2020)***

VEGETATION TYPE	MINIMUM SIZE	MINIMUM SPACING
Native trees	2 gallon or 4 cm caliper	1 plant / 3 m on center
Native willows	Whips	1 plant / 1.5 m^2
Shrubs	1 gallon	1 plant / 0.75 – 0.5 m^2
Small shrubs and ground covers	1 gallon	1 plant / 0.5 m^2
Perennials	4 inch pot	1 plant / 0.5 m^2

(REVISED MAY 2020)

14.06 STREET TREE SIZE, SPACING AND LOCATION

.1 Trees shall be minimum 5 cm caliper measured at 1.4 m above the rootball at the time of planting, and of uniform size if planted in a boulevard row.

.2 Minimum number of boulevard trees shall be calculated as follows:

TREE SIZE	SINGLE FAMILY RESIDENTIAL
Medium Trees (± 10 – 20 mm ht.)	Greater of 1 per lot or 15 m
Small Trees (Under 10 m ht.	Greater of 1 per lot or 10 m

.3 Plantings of trees closer than 6 m on centre shall require the written approval of the City Engineer.

.4 Locate trees at least 1 m offset from the curb face.

.5 Locate trees on fronting on single family lots at the center of the lot frontage unless otherwise approved by the Engineer.

14.07 URBAN TREES IN PAVEMENT

.1 Select urban trees in pavement in accordance with Table 14-2.

.2 Select and site urban trees in pavement to eliminate long term above-ground and below-ground conflicts with utilities, buildings and structures, and pedestrian and vehicular traffic.

.3 Urban Trees in Pavement shall be referenced to City of Nanaimo Standard Drawing P-5, P-6 or P-7, or when alternates are proposed, the drawings shall include project-specific tree planting details show, by plan and cross section:

(a) Typical view of surrounding pavements, curbs, above and below ground utilities, light standards, and adjacent buildings and structures.
(b) Typical details of proposed rooting environment including tree pit dimensions, subgrade scarification, drainage structure if required, topsoil mix layers or 'horizons', root deflecting structure location and type if required, location and type of irrigation device and pipe, and soil surface treatment such as tree grate, porous pavement or other; and
(c) Typical above ground details such as staking, special appurtenances, pruning for headroom etc.

14.07A STRUCTURAL SOILS COMPOSITES ***(REVISED MAY 2020)***

.1 Structural soils composites such as soil cells shall be used with the approval of the City Engineer. ***(REVISED MAY 2020)***

IRRIGATION

14.08 GENERAL IRRIGATION DESIGN REQUIREMENTS

.1 Design irrigation in industry-standard metric units on standard metric sheets.

.2 Irrigation design requirements shall be identified by the Road Classification as per Section 9.0 – Streets, Traffic Signs and Markings as summarized below:

ROAD TYPE	IRRIGATION REQUIREMENTS
Locals	Watering truck for specified time period, followed by adopt-a-tree program, above ground donuts and bags around trees. Consider front yard trees and trees in boulevard.
Collectors Arterials	Supportive of irrigated landscaping with maintenance under private landowner's control. Fully irrigated boulevards and/or medians attached to central control for the waterwise program.
(REVISED MAY 2020)	

.3 An automatic irrigation system is required where boulevard trees, shrubs and ground covers are to be irrigated.

.4 Each urban tree shall be irrigated with at least two visible 0.5 gpm bubblers in accordance with the City of Nanaimo Standard Drawing No. I-10.

.5 Irrigation systems shall be designed to supply water on a demand basis by employing a soil moisture probe to override the controller during periods of soil moisture.

.6 In grassed boulevards fronting institutional, commercial and residential uses with potential for heavy pedestrian traffic between the curb and the sidewalk, grass areas shall be irrigated. Low traffic grassed boulevards may be installed without irrigation, but manual watering for establishment and maintenance is required. The City Engineer's decision on irrigation requirements for grass areas shall be final.

14.09 IRRIGATION SERVICE CONNECTIONS

.1 Design service connections from City of Nanaimo water main to, and including, water meter chamber, to be in accordance with Section 5- Water Distribution System.

.2 Required backflow prevention in accordance with the City of Nanaimo Standard Drawing No. I-1 and Section 5 – Water Distribution System, Cross Connection Control. ***(REVISED MAY 2020)***

.3 Measure static water pressure at or near the point of connection and include with irrigation system design.

14.10 IRRIGATION SYSTEM PARAMETERS

.1 Maximum design flow velocity to be 1.5 m/sec.

.2 Size pipes and valves for minimum friction loss.

.3 Specify all irrigation components from a coordinated manufacturer's line listed in the Approved Products List.

.4 Design head-to-head coverage for turf and shrub areas.

.5 Design sprinkler circuits with matched precipitation heads. Do not mix heads with varied precipitation rates on the same circuit.

.6 Specify low flow heads for sloping areas.

.7 Where surface sprinklers are used, ensure unobstructed sprinkler coverage to tree bases from at least two sides.

.8 Every drip circuit shall be designed with a filter, pressure regulator, flush valve and air relief valve. The drip component manufacturer's instructions for installation and maintenance shall be included in the project specifications.

.9 Minimize overspray on paved surfaces.

SECTION 14 – LANDSCAPE SPECIFICATIONS

PLANTING

14.11 SUBSTITUTIONS

.1 Requests for substitutions in plant material species shall be submitted to the Engineer in writing, with proof of a plant search area that extends throughout BC wholesale nurseries, and may only be submitted after the Contract has been awarded to the successful bidder.

14.12 REFERENCE STANDARDS

.1 Unless otherwise specified, all planting, sodding, and seeding procedures to be in accordance with BCNTA/BCSLA Landscape Standard latest edition.

.2 Do all pruning to International Society of Arboriculture (ISA) Best Management Practices Tree Pruning 2008.

.3 Reference standards for landscape maintenance shall include project specifications and the most recently amended version of the following:

(a) B.C.S.L.A./B.C.N.T.A. British Columbia Landscape Standard
(b) International Society of Arboriculture Guide for Establishing Values of Trees and Other Plants, a Guide to Plant Appraisal and Best Management Practices.
(c) Canadian Fertilizer Act
(d) Canadian Fertilizer Quality Assurance Program
(e) Canadian Nursery and Landscape Association – Standards for Nursery Stock
(f) Seeds Act
(g) Canadian Soil Conservation Act
(h) BC Landscape Standard
(i) Bylaw No. 4695 – Nanaimo Tree Protection
(j) Bylaw No. 7102 – Pesticide Use
(k) ANSIA300 Tree Care Operations – Tree, Shrub and other Woody Plant Maintenance – Standard Practices
(l) Field Guide to Noxious Weeds and other Selected Invasive Plants of British Columbia, Ministry of Agriculture and Lands.
(m) Guide to Weeds in BC and Seven Steps to Managing your Weeds, Weeds BC
(n) Federal Pest Control Products Act
(o) Federal Plant Quarantine Act
(p) Federal Fisheries Act
(q) Federal Migratory Bird Regulations
(r) Federal Food and Drug Act
(s) Federal Pesticide Residue Compensation Act
(t) Provincial Integrated Pest Management Act
(u) Provincial Plant Protection Act
(v) Provincial Wildlife Act
(w) Federal and Provincial Weed Control Act
(x) Handbook for Pesticide Applicators and Pesticide Dispensers, Ministry of Environment

(y) IPM Manual for Landscape Pests, Ministry of Environment
(z) Ministry of Environment, Pesticide Control Branch: 810Blanshard Street, Victoria, BC, V8W 3E1
(aa) WorkSafeBC: Standard Practices for Pesticide Applicators.
(bb) BC Ministry of Transport Guidelines for Maintenance
(cc) Invasive Plant Alerts, Ministry of Agriculture and Lands.

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.

14.13 PROTECTION

.1 Prevent damage to all existing curbs, sidewalks, pavement, utilities and structures, plants, trees etc. Refer to Section3 – General Requirements for conditions affecting work around existing structures and utilities. ***(REVISED MAY 2020)***

14.14 SOIL SAMPLES AND TESTING

.1 City Engineer’s approval of topsoil, sub-soil and bulk organic amendments at source, or for re-use of on-site native soils, is required. A reference sample of topsoil taken from the same source pile as the analysis sample shall delivered to the Engineer, accompanied by a memorandum of assurance from the Contractor that the soil so delivered shall be the soil used in the Contract. On-site soils used shall be tested before the landscape work is tendered to establish suitability. Copies of test results and required modification reports shall be included in the bid documents.

.2 All soils and bulk organic amendments supplied by the Contractor shall be tested by a soil testing laboratory agreed to by both the Contractor and the City Engineer, at the Contractor’s expense. The Contractor shall arrange for such testing in a timely fashion to meet the requirements set out in Section14.14.4.

.3 Except where otherwise indicated in the drawings or specifications, the recommendations of the soil testing laboratory shall be the bases of requirements for soil amendments.

.4 The Contractor shall submit the soil analysis report to the City Engineer 48 hours prior to commencement of work.

.5 The submission for soil analysis shall include:

(a) Minimum 1 kg, sample of each: topsoil, native sub-soil intended for re-use, and bulk organic amendments.
(b) Project planting details and information regarding intended landscape applications for the soil.

.6 The soil analytical requirements shall include:

(a) pH
(b) lime requirement to achieve a pH of 6.5
(c) soluble salts or electrical conductivity (E.C.)
(d) % Sands + % Fines (Silt and Clay) + % Organic Matter = 100%
(e) % Total Nitrogen
(f) Available levels of phosphorus, potassium, calcium and magnesium.

.7 The laboratory analysis shall include recommendations for:

(a) Soil amendments to bring soil attributes to acceptable levels as outlined in this specification. Fertilizer applications, by category of plant type, to bring topsoil mix fertility to levels outlined in this specification.

14.15 TOPSOIL FOR GRASS AREAS

.1 Topsoil for lawn and fine grass areas shall be unamended topsoil.

.2 Topsoil for rough grass and wildflower areas shall be unamended topsoil or native subsoil.

14.16 UN-AMENDED TOPSOIL

.1 All supplied topsoil shall be fertile, friable natural loam containing minimum 4% organic matter for clay loams and 2% organic matter for sandy loams. When modified according to the recommendations of the soil testing laboratory, topsoil shall be capable of sustaining vigorous plant growth.

.2 Topsoil shall be free from any inclusions of sub-soil, lumps of clay, stones and roots over 50 mm diameter, toxic materials, crabgrass, couch grass, blackberry, morning glory, horsetail, or other noxious weeds and weed seeds.

.3 Unamended topsoil shall have a texture falling within the allowable ranges for percentage dry-weight mineral fraction:

Gravel	>2 mm & <75 mm	0-10%
Sand	>0.05 mm & <2 mm	50-70%
Silt	>0.002 mm & <0.05 mm	10-25%
Clay		0-15%

.4 Un-amended topsoil shall have the following chemical properties:

pH	5.5 - 7.0	
salinity	sat. extract conductivity	<3.0 millimhos/cm @ 25°C
boron	concentration in saturated extract	<1.0 ppm

14.17 SUB-SOIL

.1 Sub-soil shall be either:

(a) native subsoil, free of stones larger than 75 mm, and having the chemical and physical properties falling within the acceptable ranges specified in Section14.16.3 and Section14.16.4 for un-amended topsoil, or
(b) un-amended topsoil

.2 Native sub-soil not meeting the criteria specified in Section14.17.1(a) shall be removed from site and legally disposed of.

.3 Sub-soil shall be free of any toxic materials, pavements, construction debris, deleterious materials, (crabgrass, couch grass, blackberry, morning glory, horsetail, or other noxious weeds and weed seeds).

.4 On-site subsoil intended as a component of growing medium shall be protected against contamination from plants, plant parts, invasive and noxious species, insect plants, plant pathogenic organisms and other extraneous organic and non-organic materials and toxins. Refer to the following regulations:

(a) WorkSafeBC – Occupation Health and Safety Regulations
(b) BC Ministry of Environment Regulations
(c) Canadian Environmental Protection Act
(d) Weed Control Act (Federal and Provincial)
(e) BC Ministry of Agriculture and Lands Regulations
(f) Canadian Master Specifications, Construction Specifications Canada
(g) National Master Specifications, Construction Specifications Canada

.5 Submit sub-soil for testing as required in Section 14.14.1.

14.17A GROWING MEDIUM PROPERTIES

.1 Growing medium properties are based on different levels of maintenance and irrigation in accordance to the British Columbia Landscaping Standard as follows:

(a) Properties of Growing Medium for Level 1 "Well Groomed" Area:

Level 1 areas: intensive, high standard of maintenance is anticipated, after the end of the Construction Maintenance Period as specified within Section 14.87.4. Irrigation is recommended in all instances and is necessary in all areas, "on-slab" or under cover. The textural classification for these growing media by the Canadian System of Soil Classification is "Sand" to "Loamy Sand". Plant selection, irrigation requirements and maintenance intensity should consistently respond to the exceptional nature of the growing medium. ***(REVISED MAY 2020)***			
Growing Medium Types:	*1L*	*1H*	*1P*
Applications:	Low traffic Lawn Areas Trees and Large Shrubs	High Traffic Lawn Areas	Planting Areas
Texture:	Percentage of Dry Weight of Total Growing Medium		
Coarse Gravel • Larger than 19 mm • Smaller than 40 mm	0 - 1%	0 - 1%	0 - 1%
All Gravel • Larger than 2 mm • Smaller than 40 mm	0 - 5%	0 - 5%	0 - 5%
Sand: • Larger than 0.05 mm • Smaller than 2 mm	50 - 70%	80 - 90%	50 - 70%
	Percentage of Dry Weight of Total Growing Medium Excluding Gravel		
Silt: • Larger than 0.002 mm • Smaller than 0.05 mm	10 - 25%	5 - 15%	10 - 25%
Clay: • Smaller than 0.002 mm	0 - 20%	0 - 5%	0 - 20%
Clay and Silt Combined	Maximum 25%	Maximum 15%	Maximum 25%
Organic Content	3 - 10%	3 - 5%	10 - 20%
Acidity (pH)	6.0 - 7.0	6.0 - 7.0	5.5 - 6.5
Drainage	Percolation shall be such that no standing water is visible 60 minutes after at least 10 minutes of moderate to heavy rain or irrigation.		

(b) Properties of Growing Medium for Level 2 “Groomed and Level 3 “Moderate” Areas:

Level 2 and 3 areas: routine, high to moderate standard of maintenance is anticipated, after the end of the Construction Maintenance Period as specified within Section 14.87.4. Automatic irrigation is recommended, however such areas can be adequately irrigated through consistent use of manual irrigation equipment. The textural classification for these growing media by the Canadian System of Soil Classification is “Loamy Sand” to “Sandy Loam”. These growing media accommodate a wide selection of plants; they create a balance between good drainage and water retention and are suited to moderate, normal maintenance practices. “On-slab” areas should be treated as Level 1 areas, with corresponding increase in sand content and decrease in silts and clays. ***(REVISED MAY 2020)***			
Growing Medium Types:	*1L*	*1H*	*1P*
Applications:	Low traffic Lawn Areas Trees and Large Shrubs	High Traffic Lawn Areas	Planting Areas
Texture:	Percentage of Dry Weight of Total Growing Medium		
Coarse Gravel • Larger than 19 mm • Smaller than 40 mm	0 - 1%	0 - 1%	0 - 1%
All Gravel • Larger than 2 mm • Smaller than 40 mm	0 - 5%	0 - 5%	0 - 5%
	Percentage of Dry Weight of Total Growing Medium Excluding Gravel		
Sand: • Larger than 0.05 mm • Smaller than 2 mm	50 - 80%	70 - 90%	40 - 80%
Silt: • Larger than 0.002 mm • Smaller than 0.05 mm	10 - 25%	0 - 15%	10 - 25%
Clay: • Smaller than 0.002 mm	0 - 25%	0 - 15%	0 - 25%
Clay and Silt Combined	Maximum 35%	Maximum 15%	Maximum 35%
Organic Content	3 - 10%	3 - 5%	10 - 20%
Acidity (pH)	6.0 - 7.0	6.0 - 7.0	4.5 - 6.5
Drainage	Percolation shall be such that no standing water is visible 60 minutes after at least 10 minutes of moderate to heavy rain or irrigation.		

(c) Properties of Growing Medium for Level 4 "Open Space/Play", Level 5 Background and Natural Area", and Level 6 "Service & Industrial" Areas:

Level 4, 5, and 6 areas: high standard of maintenance is neither anticipated nor required, after the Construction Maintenance Period as specified within Section 14.87.4. Irrigation may be provided, but more frequently only temporary watering is done for establishment maintenance. The textural classification for this growing medium by the Canadian System of Soil Classification is "Sandy Loam" to "Loam". These soils provide a quality growing medium, albeit with reduce percolation and resistance to compaction. These may be imported soils, however existing soils may meet these requirements or it may be possible to amend them to meet the requirements. Plant selections must respond to the limitations of the growing medium and to modest maintenance expectations. If soil must be imported to augment existing topsoil (due to insufficient volumes on-site or damage to on-site topsoil by constructive activities), the imported growing medium should be similar to the on-site soil and should be mixed with it. Different soil types should not be layered. Where the growing medium has reduced percolation characteristics additional drainage measures may be required.		
Growing Medium Types:	*3L*	*3H*
Applications:	All Lawn Areas, Trees & Large Shrubs	Planting Areas
Texture:	Percentage of Dry Weight of Total Growing Medium	
Coarse Gravel • Larger than 19 mm • Smaller than 40 mm	0 - 3%	0 - 3%
All Gravel • Larger than 2 mm • Smaller than 40 mm	0 - 10%	0 - 10%
	Percentage of Dry Weight of Total Growing Medium Excluding Gravel	
Sand: • Larger than 0.05 mm • Smaller than 2 mm	30 - 70%	30 - 70%
Silt: • Larger than 0.002 mm • Smaller than 0.05 mm	15 - 50%	15 - 50%
Clay: • Smaller than 0.002 mm	15 - 30%	15 - 30%
Clay and Silt Combined	Maximum 60%	Maximum 60%
Organic Content	2 - 10%	5 - 20%
Acidity (pH)	6.0 - 7.0	4.5 - 7.0

14.18 ‘A HORIZON’ SOIL MIX

.1 ‘A horizon’ soil mix shall be topsoil amended as recommended by the soil testing lab to have the following properties, in addition to the physical and chemical properties of un-amended topsoil:

(a) Dry weight not to exceed 1350 kg/cu.m.
(b) Saturated weight not to exceed 1600 kg/cu.m.
(c) Total nitrogen to be between 0.2% & 0.6% by weight.
(d) Available phosphorus to be 20-250 ppm.
(e) Available potassium to be 50-1000 ppm.
(f) Percentage by dry weight of organic matter to be:
   (i) 3-5 % for high traffic lawn areas
   (ii) 3-10 % for low traffic lawn areas, trees and large shrubs
   (iii) 10-20 % for planting areas
   (iv) 5-20 % for natural areas
(g) Carbon to Nitrogen Ratio shall not exceed 40:1.
(h) Fertility (nitrogen, phosphorus and potassium) and pH may be modified either during mixing and screening, or after growing medium is placed.
(i) Salinity – the saturation extract conductivity shall not exceed 3.0 milliohms/cm at 25°C (77°F). If higher, it shall be leached with fresh water through irrigation or precipitation prior to planting.
(j) Boron – the concentration in the extract shall not exceed 1.0 ppm.
(k) Sodium – the sodium adsorption ratio (SAR) as calculated by analysis of the saturation extract shall not exceed 8.0.

.2 Stripping of topsoil shall commence only after the area has been cleared of all scrub, plant material, invasive and noxious plants and their reproductive parts, grass, stumps, rocks 100 mm (4 in) or greater, and other extraneous organic and non-organic materials and contaminants.

.3 Where testing shows topsoil suitable for use in its present condition or as a component of a growing medium, it shall be stockpiled where shown on the drawings or in areas designated for stockpiling as approved by the City Engineer and it must be protected from adverse weather conditions as well as other contaminants.

.4 Onsite topsoil used as a growing medium shall have an acidity range of pH 6.0-7.5 and shall contain a dry weight percentage of organic matter as referred to in Section 14.18.1(f).

.5 Onsite topsoil shall have a salt conductivity of less than 3.0 milliohms/cm at 25°C (77°F). If higher, it shall be leached with clean water through irrigation or precipitation prior to planting.

.6 Death of plants during the first year that can be attributed to plant pathogenic organisms or toxic materials in the growing medium may be an indication that the growing medium did not meet the City of Nanaimo's Standards and Specifications at the time of installation may result in a requirement that the contractor remove and replace affected plants and faulty growing medium at no additional cost to the Owner.

.7 Excessive weed and invasive plant growth in a growing medium during the first year may be an indication that unacceptable levels of invasive plant seeds or parts were present in the growing medium at the time of installation. Such a determination may result in a requirement that the contractor remove all weeds and invasive plant roots and reduce the growth to acceptable levels at no additional cost to the Owner.

14.19 PEAT MOSS

.1 Soil Amendments shall be virtually free from sub-soil, sawdust, commercial wood products, stones, lumps, plants or their roots, building materials, invasive of noxious plants and their reproductive parts, non composted wood, wood waste, insect pests, plant pathogenic organisms, chemical pollutants or substances at levels toxic to plants, and other extraneous materials that detract from the desirable physical and chemical properties required for landscaping purposes.

.2 Peat moss shall be Horticultural grade, partially decomposed fibrous or cellular stems and leaves of Sphagnum Mosses with a texture varying from porous to spongy fibrous, fairly elastic and substantially homogeneous with a pH value of not less than 3.5 and not greater than 6.5. It shall be brown in colour and medium to coarse shredded, particles 10 mm size or less.

(a) Salinity: the saturation extract conductivity <2.0 millimhos/cm @ 25°C.
(b) Nitrogen content shall be >0.8% based on dry weight.

14.20 MANURE

.1 Manure shall be well-rotted farm animal manure or mushroom manure, such that liquids have been eliminated, and the material is crumbly, free from weed seeds, rocks, sticks, and other deleterious material and contain not more than 40% by volume of sawdust, straw, or shavings.

(a) Manure shall be free of harmful chemicals, and shall have salt content that gives and electrical conductivity reading of between .5 and .6 mmhos/cm.
(b) Manure shall contain not less than 1.0% nitrogen based on dry weight.
(c) All particles in manure shall pass a 6.35 mm standard sieve.
(d) Manure shall be virtually free from weed and invasive plants and their seeds and reproductive parts, coliform, pathogens, rocks, sticks and rubble.

14.21 COMPOSTED LEAF OR WOOD WASTES

.1 Submit samples of composted wood waste or leaf mould for chemical analysis to soil testing lab for consideration for use as an organic amendment in the 'A horizon' topsoil mix.

.2 The total carbon to total nitrogen ratio in the composted leaf or wood waste shall not exceed 40:1.

.3 Uncomposted wood wastes or leaves shall not be present in the topsoil mix.

.4 Composted leaf of wood wastes must be virtually free from all viable weed and invasive plants and their seeds or other plant reproductive parts, coliform, pathogens and chemical or organic contaminates that may be detrimental to plant or animal health.

.5 Composted leaf or wood wastes must contain less than 0.5% by volume of contaminants such as rocks, plastic, metal or glass.

.6 Refer to Section 14.29 for much specifications.

14.22 FERTILIZERS

.1 Fertilizers shall meet the requirements of the Canada Fertilizer Act.

.2 Types, formulations and rates of application of fertilizers and liming agents shall be as recommended by a laboratory soil specialist and based on test results of the growing medium.

.3 Fertilizers shall be in granular, pellet or prill and must be dry and free slowing and have a guaranteed N-P-K analysis and be in manufacturer's original packaging, stored in waterproof containers clearly marked with the name of the manufacturer, weight and analysis.

.4 Fertilizers shall be spread evenly over the placed growing medium with an appropriate mechanical spreader and incorporated into the grow medium.

.5 There should be a minimum of at least three (3) weeks separation between the application of lime and fertilizers.

.6 Lime may be added to the growing medium at the time of screening or cultivated into the top 100 mm (4in) of growing medium after it is in place.

14.23 -NOT USED-

14.24 LIME

.1 Lime shall be applied as per soil analysis recommendations.

.2 Growing medium shall require not more than 0.5kg/m^2 (0.10lb/ft^2) of dolomite lime to reach the required pH level.

14.25 WATER

.1 Water for landscape installation shall be free from organic or chemical contaminants detrimental to healthy plant growth.

14.26 <u>TREE, PLANT MATERIALS, RIPARIAN AND RESTORATION</u> ***(REVISED MAY 2020)***

.1 All plant materials shall meet or exceed the standards identified on the landscape construction drawings with respect to size, grading and quality.

.2 All riparian and restoration plant materials shall meet or exceed the minimum size and spacing design criteria as per Section 14.05. ***(REVISED MAY 2020)***

.3 Plants shall be characteristic of the genus, species and cultivar as indicated on the construction drawings and specified herein.

.4 All plants shall be nursery grown under similar climatic conditions to the project site. Plants shall not be pruned prior to delivery unless pre-approved by the Engineer. Container stock shall have been established in the size of container specified for at least six (6) months prior to delivery. The roots shall not have grown beyond the limits of the container.

.5 It is the Contractor's responsibility to verify and comply with all regulations regarding the inter-regional movement of plant material, including nursery stock, within the Province of British Columbia. Imported plant materials must be accompanied by copies of the necessary permits and import licences required by Federal and Provincial regulations.

.6 Plants shall be properly proportioned; not weak, thin or elongated.

.7 Plants shall have normal, well-developed branches and vigorous, fibrous root systems. They shall be healthy and free from defects, decay, girdling roots, sunscald injuries, abrasions of the bark, and plant diseases, insect pests eggs, borers and all forms of infestation.

.8 Trees shall have straight stems unless uncharacteristic for the species/cultivar. Pruning wounds shall show healthy callous growth at the branch collar without bark tearing or fungal growth. Cambium tissue shall be moist and exhibit the correct colouration for the species. Plants exhibiting fungal staining shall be rejected.

.9 All plant materials shall conform to the measurements specified in the drawings except that plants larger than specified may be used if approved by the Engineer. The use of such plants shall not increase the contract price. If larger plants are used, the ball of earth shall be increased in proportion to the size of the plant. All plants shall be measured when the branches are in their normal position. Height and spread dimensions specified refer to the main body of the plant and not from branch tip to root base or from branch tip to branch tip. Where trees are measured by caliper (cal.), reference is made to the diameter of the trunk measured 300 mm above ground as the tree stands in the nursery.

.10 Native plants shall be propagated in nurseries and not harvested from wild sites, except where salvaged from an area where the native vegetation will be destroyed and authorization for harvest has been obtained. All collected native plants shall be held and maintained in a nursery until new roots have formed through the burlap or other suitable packing material, or in the case of containerized plants, until such time that the roots grow to fill and hold the soil within the container.

.11 Collected plants shall not be used without prior approval in writing by the Engineer.

.12 Balled and burlapped conifers and trees in excess of 3 m height must have been dug with a sufficiently large firm rootball to contain 75% of the fibrous and feeder root system. Rootballs shall be free of invasive weeds.

.13 All nursery grown plant materials shall conform to the most current versions of the Canadian Nursery Landscape Association/Canadian Standards for Nursery Stock and the BCNTA Standard for Container Grown Plants.

.14 A comprehensive pest management system should be developed to protect plants and trees which may have been weakened or stressed and made susceptible to disease and insect pressure due to disturbance during transportation, storage and planting.

.15 Rootballs and soil in containers shall be free of invasive and noxious plants.

14.27 SOD

.1 The quality and source of nursery sod shall comply with standards outlined in 'British Columbia Standard for Turfgrass Sod' published by Canadian Nursery Trades Association, and the B.C. Society of Landscape Architects, latest edition. Quality Grade shall be No. 2 Standard unless shown otherwise on the drawings. The turfgrass sod shall be grown from a seed mixture containing Kentucky Bluegrass (Poa pratense) or Turf-type perennial Ryegrass (Lolium perenne) and not less than 40% by weight of Creeping Red Fescue (Festuca rubra). At time of site delivery, the sod shall contain no more than 2% of other strains or species of grass or clovers, and no visible broadleaf weeds, and shall be of sufficient density that no surface soil is visible when mowed to a height of 38 mm.

.2 The source of the sod shall be pre-approved by the City Engineer. Source substitutions shall not be made without the written approval of the City Engineer.

14.28 GRASS AND WILDFLOWER SEED MIXTURES

.1 Grass seed mixture quality and source to comply with standards for lawns and grass outlined in the ‘British Columbia Landscape Standard’ published by the Canadian Nursery Trades Association, and the B.C. Society of Landscape Architects, latest edition. Seed mixture are to be suited to the climate, terrain, establishment and maintenance conditions under which they are to grow. All seed mixtures are to meet the requirements of:

(a) Seeds Act
(b) The Provincial Weed Control Act

.2 Fine grass seed mixture quality grade shall be Certified Canada No. 1, or as specified No. 2 Standard. Seed mixture shall contain the following: Perennial Turf Type Ryegrass (Lolium perenne) and/or Kentucky Bluegrass (Poa pratense), and not less than 40% by weight of Creeping Red Fescue (Festuca rubra) and/or Chewings Fescue (Festuba rubra commutata).

.3 Rough grass seed mix shall contain the following: less than 10% by weight Kentucky Blue (Poa pratense) grass and/or Turf-type perennial Ryegrass Ryegrass (Lolium perenne), and not less than 50% by weight of Creeping Red Fescue (Festuca rubra) and/or Chewings Fescue (Festuca rubra commutata)

.4 The wildflower seed mix shall be such that it meets the requirements of the Seeds Act and be free of any invasive plant species or potentially invasive species.

.5 Nurse crop – Annual Rye grass (Lolium multiflorum).

.6 The following invasive species must be removed from all sites:

- Bamboo – (Bambusa sp.)
- Morning Glory – (Convolvulus arvensis)
- Scotch Broom – (Cytisus scoparius)
- English Ivy – (Hedera helix)
- Giant Hogweed – (Heracleum mantegazzianum)
- English Holly – (Ilex aquafolium)
- Policemen’s Helmet/Himalayan Balsam – (Impatiens glandulifera)
- Dead-nettle Lamium – (Lamiastrum gleubdolon)
- Purple Loosestrife – (Lythrum salicaria)
- Himalayan Blackberry – (Rubus armeniacus) (discolour)
- Evergreen Blackberry – (Rubus laciniatus)
- Tansy – (Tanacetum vulgare)
- Periwinkle Species – (Vinca major, Vinca minor)
- Butterfly bush – (Buddleja davidii)
- Carpet Burweed – (Soliva sessilis)
- Daphne/Spurge-Laurel – (Daphne laureola)
- Eurasian Water-milfoil – (Myriophyllum spicatum)
- Garden/Yellow Loosestrife – (Lysimachia vulgaris)

- Lamium – (Aegopodium podagraria)
- Burdock Species – (Arctium lappa, A. minus)
- Common Tansy – (Tanacetum vulgare)
- English Hawthorne – (Crataegus monogyna)
- Hairy Cat's Ear – (Hypochaeris radicata)
- Orchardgrass – (Dactylis glomerata)
- St. John's Wort – (Hypercium perforatum)

.7 The following noxious species must be removed from all sites:

- Annual Sowthistle – (Sonchus oleraceus)
- Bohemian Knotweed – (*Fallopia x bohemica*)
- Bur Chervil – (*Anthriscus caucalis*)
- Canada Thistle – (Cirsium arvense)
- Common Reed – (*Phragmites australis subsp. australis*)
- Crupina – (*Crupina vularis*)
- Dalmation Toadflax – (*Linaria dalmatica*)
- Dense-flowered Cordgrass – (*Spartina densiflora*)
- Diffuse Knapweed – (Centaurea diffusa)
- Dodder – (Cuscuta spp.)
- English Cordgrass – (Spartina anglica)
- Flowering Rush – (Butomus umbellatus)
- Garlic Mustard – (Alliaria petiolata)
- Giant Hogweed – (Heracleum mantegazzianum)
- Giant Knotweed – (Fallopia sachalinensis)
- Giant Mannagrass / Reed Sweetgrass – (Glyceria maxima)
- Gorse – (Ulex europaeus)
- Himilayan Knotweed – (Polygonum polystachyum)
- Hound's-tongue – (Cynoglossum officinale)
- Japanese Knotweed – (Fallopia japonica)
- Jointed Goatgrass – (Aegilops cylindrica)
- Leafy Spurge – (Euphorbia esula)
- Milk Thistle – (Silybum marianum)
- North Africa Grass – (Ventenata dubia)
- Perennial Sowthistle – (Sonchus arvensis)
- Purple Loosestrife – (Lythrum salicaria)
- Purple Nutsedge – (Cyperus rotundus)
- Rush Skeletonweed – (Chondrilla juncea)
- Saltmeadow Cordgrass – (Spartina patens)
- Scentless Chamomile – (Matricaria maritima)
- Smooth Cordgrass – (Spartina alterniflora)
- Spotted Knapweed – (Centaurea maculosa)
- Tansy Ragwort – (Senecio jacobaea)
- Velvetleaf – (Abutilon theophrasti)
- Wild Oats – (Avena fatua)

- Yellow Flag Iris – (Iris pseudacorus)
- Yellow Nutsedge – (Cyperus esculentus)
- Yellow Starthistle – (Centaurea solstitialis)
- Yellow Toadflax – (Linaria vulgaris)
- Common Crupina – (Crupina vulgaris)
- Giant Reed – (Arundo donax)
- Kudzu – (Pueraria Montana)
- Poison Hemlock – (Conium Maculatum)
- Russian Knapweed – (Acroptilon repens)
- Jimsonweed/Devil’s Apple – (Datura stramonium)
- Orange Hawkweed – (Hieracium aurantiacum)
- Saltwater Cordgrass – (Spartina patens)
- Wild Chervil – (Anthriscus sylvestris)

14.29 MULCH

.1 Bark mulch shall be 50 mm and minus Douglas Fir/ Hemlock bark chips, dark brown in colour and shall be virtually free of invasive and noxious seeds and reproductive parts, soil, stones, salts or other harmful chemicals, or other extraneous matter that would prohibit seed germination or the healthy development of plant material.

.2 Other mulch materials shall only be used when indicated in the drawings.

.3 Do not store bark mulch on paved sidewalks.

.4 Mulch is not intended to replace vegetation as a sole ground cover, nor is it to be used as a growing medium in landscape applications.

14.30 PLANTING ACCESSORIES

.1 The following products shall only be installed when indicated in the construction drawings.

(a) TREE STAKES – shall be nominal 50 mm by 50 mm wood or 75 mm round pressure-treated wood, or equivalent to be pre-approved by the City Engineer.
(b) TENSIONING DEVICE – 19 mm wide flat woven polypropylene or nylon webbing.
(c) ROOT DEFLECTING BARRIER – 61 cm by 61 cm copolymer polypropylene of 2.16 mm thickness, 50% post consumer recycled plastic, with 12.7 mm raised moulded root directing ribs c/w anti lift tabs.
(d) TREE GRATES – must be cast iron, aluminum or bronze and the safety standards of the castings are to meet the requirements as per ASTM A48. Tree grates shall be square or round in shape. Tree grates must be installed in a proper perimeter frame with non-tamper attachments and must allow for incremental enlargement to accommodate the tree growth and to protect the tree from injury. Patterns can vary to pertain to the project or neighbourhood aesthetics, however the opening dimensions of the decorative designs shall be less than 12 mm in width or diameter.

14.31 REPLACEMENTS

.1 All plant materials damaged or found not in a healthy satisfactory growing condition during the maintenance and guarantee period, or which, in any other way, do not meet the requirements of the specifications, shall be replaced at the Contractor's expense.

.2 All required plant material replacements shall be by identical species/cultivar and size to the original, as indicated in the drawings.

.3 Where identical replacements are not available, submit a written proposal to the City Engineer. Gain approval from the City Engineer prior to installation of the replacement plan materials.

.4 Replacement shall be made at the next appropriate season to a maximum of four (4) months from identification of the requirement for plant replacement.

.5 Replacement plants shall be maintained and guaranteed by the Contractor to the completion of the next full growing season, or the completion of the original maintenance and guarantee period whichever is later.

14.31A STRUCTURAL SOILS COMPOSITES ***(REVISED MAY 2020)***

.1 Structural soils shall be used with the approval of the City Engineer.

.2 Structural soils composites shall be composed of growing medium and clear crush granular components in accordance with the following recommended base ratio of materials. Ensure sufficient moisture (25% to 75% of field capacity) to provide a homogeneous mixture with consistent properties throughout the composite soil. Peat moss shall not be used in the preparation of structural soil. ***(REVISED MAY 2020)***

.3 Soil Component Proportion By Weight: ***(REVISED MAY 2020)***

Growing Medium	15% to 20% Dry Weight
Clear Crush	25 mm to 75 mm Clear Crush 80% to 85% Dry Weight
Hydrogel/Stabilizer*	0.01% to 0.02%

(REVISED MAY 2020)

*Hydrogel/Stabilizer is applied as a soil tackifier to ensure even distribution and blending of the component materials. Refer to manufacturer specifications for appropriate mixing proportions. ***(REVISED MAY 2020)***

.4 Growing medium properties for use as a component in structural soils shall conform to MoESS Section 14.18 ‘A Horizon’ Soil Mix. ***(REVISED MAY 2020)***

.5 Clear crush gravel properties for use as a component in structural soils shall conform to Section 8 – Aggregates and Granular Material specifications. Gravel gradation shall consist of 25 mm to 75 mm clear crush washed rock free of any foreign elements or materials. ***(REVISED MAY 2020)***

IRRIGATION

14.32 SCOPE

.1 Irrigation work required includes supply of all materials, labor and equipment to install a complete and operation irrigation system as specified herein and as shown on the construction drawings including:

(a) Excavation, piping, valves, heads, drip emitters and devices, controller, and complete installation, testing maintenance, adjustment and guarantee of the system.
(b) Water supply connection and backflow prevention assembly including supply, excavation, installation, and testing in accordance to the B.C. Plumbing Code. ***(REVISED MAY 2020)***
(c) Backflow prevention assembly installation and testing in accordance to CSA B64.10 and CSA B64.10.1. ***(REVISED MAY 2020)***
(d) 110 VAC and low voltage electrical wiring including supply, excavation and installation.
(e) Restoration of all existing landscape areas to condition prior to commencement of work on site, to the satisfaction of the Engineer.
(f) Inspection must be completed by the City Engineer during and after installation, and before the bond is released.

.2 Only those products approved by the City Engineer and listed on the City of Nanaimo Approved Product List will be accepted for installation.

14.33 PERMITS AND FEES

.1 Obtain all permits and pay required fees to any governmental agency having jurisdiction over the work. Inspections required by local ordinances during the course of construction shall be arranged as required. On completion of the work, satisfactory evidence shall be furnished to the City Engineer to show that all work has been installed in accordance with the ordinances and code requirements, including certificates from the Electrical Inspector.

14.34 STANDARDS

.1 Work shall be in accordance with mechanical (plumbing) and electrical standards, codes and regulations including the following:

(a) The National Building Code of Canada and its supplements.
(b) Current C.S.A. and A.S.T.M. Specifications for assemblies, pipes and fittings, including: ***(REVISED MAY 2020)***

(i)	copper pipe:	ASTM B42
(ii)	PVC water pipe:	CSA B137.3 or ASTM D2241.
(iii)	PVC fittings:	ASTM D2466 or ASTM D2467
(iv)	PVC solvent cement:	ASTM D2564
(v)	Backflow Prevention Assemblies: ***(REVISED MAY 2020)***	CSA B64.10 & B64.10.1.

(c) The B.C. Plumbing Code.

.2 Irrigation installers shall have the following qualifications:

(a) Irrigation Technicians Level 2 Certification,
(b) Low Voltage Electrical Certification and
(c) Active BCWWA Cross Connection Control Tester Certification. ***(REVISED MAY 2020)***

.3 All irrigation systems shall plan for future expansion. Sufficient wires, as requested by the City Engineer, shall be supplied at the time of installation from the controller to end of system where the potential for future expansion may exist.

14.35 ACCEPTABLE PRODUCTS

.1 Acceptable products shall be in new condition with the size, manufacturer and features shown in the design.

.2 If irrigation systems with products other than shown in the design are proposed, the Contractor shall undertake the following prior to commencing construction:

(a) Produce complete shop drawings showing the type and location of all heads and nozzle numbers, pipe location and sizes, and all part model numbers and specifications;
(b) Submit hydraulic calculation work sheets for the re-designed system to demonstrate that all parameters have been calculated;
(c) Submit the shop drawings in triplicate and gain the written approval of the Engineer.

14.36 IRRIGATION PLASTIC PIPING

.1 Plastic pipe shall be semi-rigid, extruded from PVC resin type 1 grade 2 normal impact in accordance with applicable codes and standards.

.2 All polyvinyl chloride (PVC) plastic pipe and fittings must be marked as to size and class and their pressure and strength rating must exceed that of one and one half times the working pressure of the system.

.3 All PVC pipe shall be schedule 40 PVC.

.4 Flow volumes and velocities shall always be considered to minimize head loss.

.5 Flow velocities shall not be permitted to exceed 1.52 m per second.

.6 Specified pipes shall be rated at 1.5 times maximum operating pressure.

14.37 IRRIGATION PLASTIC FITTINGS

.1 All plastic fittings shall be a minimum of schedule 40 PVC molded fittings.

14.38 SWING JOINT ASSEMBLIES

.1 Triple joint assemblies for all sprinklers shall consist of:

(a) 3 schedule 40 PVC street elbows (MIPT x FIPT)
(b) 1 schedule 80 PVC threaded nipple, length to suit (MIPT x MIPT)
(c) 1 schedule 40 PVC threaded tee (slip x slip x FIPT)

.2 Triple swing joint assemblies for quick coupler valves shall consist of:

(a) 1 schedule 40 PVC threaded tee
(b) 2 brass threaded nipples, length to suit (MIPT x MIPT)
(c) 2 brass threaded elbows (FIPT x FIPT)
(d) 1 brass threaded street elbow (MIPT x FIPT)
(e) 1 brass threaded riser, 100 mm (4”) length, (MIPT x MIPT)

14.39 IRRIGATION METAL PIPE & FITTINGS

.1 All metal pipe shall be copper except in quick couple swing joint assemblies. All metal fittings shall be copper, brass, or bronze as shown in the Standard Drawings.

14.40 SOLVENT CEMENT

.1 Solvent cement and primer shall be of a type recommended for the PVC pipe class, schedule, and maximum size.

.2 The Contractor shall ensure that the shelf life of the cement, as labeled by the manufacturer on the container, has not been exceeded.

14.41 SPRINKLER HEAD RISERS

.1 Where risers are not of the pop-up type, sprinkler head risers shall be schedule 80 PVC pipe. Pipe shall be cut in a standard pipe cutting tool with sharp cutters. Ream only to full diameter of pipe and clean all rough edges or burrs. Cut all threads accurately with sharp dies. Not more than three (3) full threads shall show beyond fittings when pipe is made up. Use Teflon tape on all PVC threaded connections.

14.42 IRRIGATION BEDDING MATERIAL

.1 Bedding within the pipe zone shall be in accordance with Section 4.17 – Bedding Within Pipe Zone, except that bedding material shall be well graded sand, with a minimum of 75 mm on all sides of the irrigation pipe.

14.43 SPRINKLER HEADS

.1 Sprinkler heads shall be as shown on irrigation construction plans. See legend and notes for correct model numbers and operating pressures.

.2 Sprinklers shall perform to manufacturer's specifications including diameter of throw and gallonage at specified pressures.

14.44 IRRIGATION VALVES

.1 Valves are to be as shown on irrigation construction plans and shall have the same size isolation gate valve. See legend and notes for correct model numbers.

14.45 IRRIGATION WATER SERVICE CONNECTIONS

.1 All materials for water service connection including saddle, pipe, valves, water meter and chamber to be in accordance with Section 5- Water Distribution System.

14.46 IRRIGATION CASING SLEEVES

.1 Irrigation casing sleeves under sidewalks, driveways and road paving and/or through walls, shall be installed prior to the construction of the paved surfaces and/or walls. Sleeves to be SDR 35 PVC pipe, size as indicated on the drawings, with ends capped and staked until such time as irrigation pipe is installed.

.2 The Contractor shall be responsible for locating all sleeves.

.3 Irrigation sleeving to be between 300 mm – 450 mm below finished grade.

14.47 CONTROLLERS

.1 Controller model numbers shall be as noted on the irrigation construction plans.

.2 Automatic controllers shall provide all necessary features for programming as is shown on the irrigation design plan. Controllers shall be encased in a sturdy metal, lockable, weatherproof mounting box and must be easily accessible for maintenance. All electrical controllers shall be CSA approved or be of a type approved by local electrical authorities.

.3 Refer to the City of Nanaimo Approved Product List for the controllers that are acceptable for installation.

14.48 <u>MOUNTING LOCATION</u>

.1 Controller mounting shall be as noted on the irrigation construction plan.

14.49 <u>VALVE BOXES</u>

.1 All in-line valves shall be grouped wherever possible and installed in plastic irrigation boxes with a solid lid marked “irrigation”. Plastic shall have a minimum tensile strength of 45kPa as measured according to ASTM D 638 and shall be unaffected by moisture, light, corrosion and extreme temperatures. The valve box shall be sized to accommodate the number of valves grouped in the manifold with allowance for room to service the valves, minimum 75 mm clearance. The valve boxes are to be bolted. Quantity as required; see irrigation construction plan.

14.50 <u>BACKFLOW PREVENTION ASSEMBLY</u> ***(REVISED MAY 2020)***

.1 A Backflow prevention assembly shall be supplied and installed where noted on the irrigation construction drawing. Such devices shall meet or exceed all local ordinances and requirements governing such a cross connection. ***(REVISED MAY 2020)***

.2 A backflow prevention assembly shall be successfully tested in accordance with CSA B64.10.1 after: ***(REVISED MAY 2020)***

(a) installation, ***(REVISED MAY 2020)***
(b) backflow incident, ***(REVISED MAY 2020)***
(c) alteration of the irrigation system, ***(REVISED MAY 2020)***
(d) cleaned, repaired or overhauled, ***(REVISED MAY 2020)***
(e) relocated, ***(REVISED MAY 2020)***
(f) annually, or ***(REVISED MAY 2020)***
(g) as required by the City Engineer. ***(REVISED MAY 2020)***

.3 Testing and certification shall be by a certified BCWWA backflow assembly tester with an active certificate. ***(REVISED MAY 2020)***

.4 Reports on all testing, maintenance and repairs shall be documented on the specified forms and tags by the backflow assembly tester. Tags shall be affixed to the assembly and form submitted to the City Engineer. ***(REVISED MAY 2020)***

.5 Refer to the City of Nanaimo Approved Product List for the backflow prevention assemblies that are acceptable for installation. ***(REVISED MAY 2020)***

14.51 <u>24 VOLT CONTROL WIRING</u>

.1 24-volt electric control lines from controller to automatic valves shall be CSA approved direct burial minimum (#14 AWG TWU-40) wire of a different colour than the 110-volt power to controllers.

.2 Splicing shall be made with water-proof wiring kits.

.3 (a) All wiring to be installed and tested in accordance to the most current B.C. Electrical Code.
(b) All wiring shall be protected by being bundled and taped at 3 m intervals and installed beneath the irrigation line.
(c) All wire splices must be contained in a valve box.
(d) Sufficient extra wire shall be left in each valve box such that the splice may be lifted above grade. Wires shall be neatly coiled.
(e) White wire is only be used as the common wire and all other colours used shall be consistent from valve to controller.

14.52 POWER WIRING

.1 All 110-volt AC wiring shall be installed in accordance Section 10 Roadway Lighting and Traffic Signals.

14.53 GATE VALVES

.1 Gate valves 50 mm or larger shall be in accordance with Section 5.24 – Water Main Valves. Gate valves smaller than 50 mm in size shall be bronze conforming to ASTM B62.

.2 Gate valves or approved quarter turn ball valves shall also be used in any case where a manual drain valve is required.

14.54 QUICK COUPLING VALVES

.1 Quick coupling valves, keys and valve boxes shall be as noted in the irrigation construction drawings.

.2 Internal parts to be removable and with adjustable flow control.

PLANTING

14.55 SCHEDULING AND CO-ORDINATION

.1 Topsoil shall not be handled in a wet or frozen condition or in any manner in which the soil structure is adversely affected.

.2 Plant trees, shrubs, and ground covers only during periods that are normal for such work as determined by local weather conditions, and when seasonal conditions are conductive to successful adaptation of plants to their new location.

14.56 SHIPPING, STORAGE AND ON-SITE HANDLING OF PLANT MATERIALS

.1 Co-ordinate shipping of plants and pre-planting preparation to minimize the time lapse between shipping and planting to ensure a maximum of (36) hours storage of plant material on-site.

.2 Cover any plants not in a state of dormancy to prevent desiccation during transit.

.3 During loading, transportation, off-loading, and planting, protect all trees against damage to stems and branches. Protect bark against chafing from chains, cables, equipment, or other trees by a wrapping of cardboard or burlap. Separate entangled tree branches without damage to branches.

.4 Plants with broken or abraded trunks or major branches will not be accepted. Prune damaged twigs to ISA pruning guidelines using secateurs.

.5 Unload and check all plants immediately upon arrival and water if necessary. Condition of plants should be documented by the contractor.

.6 Immediately cover and protect bare root stock from damage to roots by frost, sun, and wind.

.7 Handle material supplied in pots and containers by the container only to reduce breakage of branches and leaves.

.8 Handle balled and burlapped plant materials with caution to maintain the firmness of the balls. No plants shall be used when the ball of earth surrounding the roots has been cracked or broken preparatory to or during the process of planting, or when the burlap, staves, and ropes required in connection with their transplanting have been removed.

.9 Do not lift trees supplied in wire baskets by the trunk.

.10 Keep plants in a moist condition at all times. Protect all plants against damage and/or drying out until they are planted on the site.

.11 During the growing season, store all plants in containers, balled & burlapped or wire basket in an upright position if not planted immediately and take care to provide enough space between plants such that light reaches all portions of the plant in order to avoid burning when planted out.

.12 Protect rootballs of balled and burlapped material by heeling in with material suitable to protect them from drying out (i.e., sawdust, peat moss, topsoil). Do not store containerized or balled & burlapped plants intended to be planted in the open in a building or in an area of low light intensity for a period exceeding 7 days. Keep all plants well-watered and protected from heat and frost.

.13 Plants shall be acclimatized or "hardened off" against the environmental conditions of their final planting location and shall not be taken directly from shade houses or greenhouses and planted in drastically different environment. Preparation for the new environment should include an appropriate period of storage in an intermediate environment, managing fertilizer applications to avoid excessively lush growth and provision of a graduated watering regime.

14.57 PRE-PLANTING INSPECTIONS

.1 Give 72 hours' notice to the City Engineer for an inspection of plant material at a single plant material assembly point. The City Engineer must give approval of plant material in advance of commencement of planting work.

.2 Acceptance of plant material by the City Engineer at its assembly point does not prevent rejection on-site prior to or after planting operation if, in the opinion of the City Engineer, the plant material has been damaged by the act or omission of the Contractor.

.3 Give 24 hours' prior notice to the City Engineer for each following required inspections:

(a) Prior to commencement of landscape work, give notice to the City Engineer and make the project landscape supervisor available for an on-site inspection of marked locations for planting and as-built conditions and site work by others. The City Engineer may alter the locations of plant materials in the field.

(b) After excavation of plant locations, but prior to placement of sub-soil and installation of plant material, give notice to the City Engineer for inspection of the subgrades.

.4 The City Engineer, at his discretion, may waive one or more of the pre-planting inspections, but this shall not impair the right to reject work or materials which have been damaged or in any way do not conform to the specifications.

14.58 EXCAVATION

.1 The location of all planting pits shall be staked by the Contractor and approved by the City Engineer prior to excavation.

.2 Tree pits, plantation beds and turf areas shall be tested for drainage by the following means: Dig a 250 mm deep by 250 mm wide hole at bottom of pit. Fill with water and allow to drain. Refill hole with water and time rate of fall of water. A rate of fall less than 25 mm (1”) per hour indicates inadequate drainage for plant survival and shall be reported to the Engineer, prior to planting. No claim for poor drainage will be accepted after planted has taken place.

.3 Tree planting pits shall be excavated to the dimensions indicated in the drawings. Pit sides wherever possible shall be dug with sloping sides at a preferred angle of 45°, scarified to remove glazing and provide a roughened soil interface. A minimum of 300 mm depth scarified layer of native soil shall be created in the bottom of the tree pit by such means that the layer remains uncompacted prior to the subgrade inspection by the Engineer. Remove all stones larger than 75 mm.

.4 Stockpile excavated soil near tree pit for use, if deemed suitable by testing of the soil testing laboratory.

.5 Shrub beds shall be excavated to allow for a total of:

(a) 300 mm layer of un-amended topsoil
(b) 150 mm layer of ‘A’ horizon soil mix or as listed within Section 14.58.8, whichever is the greater depth.
(c) 50 mm layer of bark mulch.

.6 Areas of ground covers shall be excavated to allow for a total of:

(a) 150 mm layer of un-amended topsoil.
(b) 150 mm layer of ‘A’ horizon soil mix or as listed within Section 14.58.8, whichever is the greater depth.
(c) 50 mm layer of bark mulch.

.7 A minimum 150 mm depth scarified layer of native soil shall be created in the bottoms of shrub or groundcover planting pits by such means that the layer remains uncompacted prior to the subgrade inspection by the City Engineer.

.8 Minimum depths of growing medium shall be in accordance to the British Columbia Landscaping Standards as followed:

	A	B	C
Application	Over prepared subgrade which retains some existing topsoil (which retains the "A" horizon)*	Over prepared subgrade where the subsoil drains rapidly	Over structures or where the subsoil drains poorly
Low Traffic Lawn Areas:			
Irrigated	100 mm (4 in)	150 mm (6 in)	150 mm (6 in)
Not Irrigated	100 mm (4 in)	150 mm (6 in)	230 mm (9 in)
High Traffic Lawn Areas	100 mm (4 in)	150 mm (6 in)	
Planting Areas and Planters:			
Ground cover areas	150 mm (6 in)	300 mm (12 in)	230 mm (9 in)
Shall shrubs	300 mm (12 in)	450 mm (18 in)	300-500 mm (12-20 in)
Large shrubs	450 mm (18 in)	600 mm (24 in)	500-900 mm (20-36 in)
Tree Planting Areas:			
At each tree	1000 mm (40 in) deep for as large an area as 500-900 mm (20-36 in) possible around each tree. Recommended area 10 m^2 (108ft^2) or greater. The soil volume should reflect the severity of compaction and grading at the planting site.		
*The combined depth of the existing topsoil and the new growing medium shall meet the minimum depth requirements shown in column B and C.			

14.59 TREE PLANTING

.1 The Contract shall examine the sub-grade before planting, and shall report any conditions of defects on-site which may adversely affect the performance of this section of the work to the Engineer prior to placing topsoil mix.

.2 Root deflecting barrier shall only be installed when and as indicated on the construction drawings.

.3 Soils to be placed in dry weather over relatively dry, approved, free-draining subgrade.

.4 Roughen bottom and sloping side surfaces of tree pit to remove glazing and provide a roughened soil interface prior to placement of tree and subsoil. Adjust elevation under where tree is to be placed so that the nursery soil line on the tree trunk will be 50 mm above finish grade to allow for settlement.

.5 Remove the wire basket before placement in planting pit. With the tree in the planting pit untie and remove burlap and cord from top 1/3 portion of a balled & burlapped rootball. Completely remove, with care, imperishable containers from container-grown or bag –grown trees. ***(REVISED MAY 2020)***

.6 Prior to backfilling, the Contractor shall inspect the root system. Trees with the following defects shall be replaced at the Contractor’s expense:

(a) Lack of root ball integrity,
(b) Broken or abraded structural or main roots,
(c) Presence of fungal mass or fruiting bodies and root discolouration,
(d) Poor root development with few fibrous roots, or
(e) Any other evidence of pathogenic or accidental injury.

.7 Unwrap and spread out encircling roots and tease out roots growing at the outside of the rootball.

.8 The tree shall be installed plumb and face to provide the best appearance toward the primary viewing location, as determined by the City Engineer.

.9 Place 2/3 depth of the sub-soil and water to remove air voids.

.10 If indicated in the construction drawings, and prior to completion of backfilling, place tree stakes, avoiding penetration of the root system. Stakes shall be driven plumb and to a sufficient depth in the subgrade that the portion exposed above finish grade equals 1 m height.

.11 Place remaining 1/3 of sub-soil lightly boot tamping to remove air voids. Roughen surface prior to placement of ‘A’ horizon soil mix.

.12 Place 150 mm depth unamended topsoil then thoroughly till in all amendments specified in the soil analysis report to form the ‘A’ horizon. The Contractor shall not machine cultivate the soil above the root zone of the tree.

.13 Ensure soil level does not exceed original nursery soil line. Form earth saucer to retain water over rootball and water in the tree.

.14 Secure tree to stakes with counter-tensioned, non-twisted loops of 19 mm polypropylene webbing stapled to the stakes, if required.

.15 Unless otherwise indicated in the construction drawings, place 75 mm bark mulch over soil surface.

.16 Tree grate installation shall be as per the manufacturer's specifications. Refer to Standard Drawing P-6.

14.60 <u>RIPARIAN AND RESTORATION PLANTING</u> ***(REVISED MAY 2020)***

.1 Shrub beds shall be a total of:

(a) 300 mm layer of un-amended topsoil as specified in Section 14.16
(b) 150 mm layer of 'A' horizon soil mix as specified in Section 14.18 or as listed within Section 14.58.8, whichever is the greater depth.
(c) 50 mm layer of bark mulch.

.2 Areas of ground covers shall be a total of:

(a) 150 mm layer of un-amended topsoil as specified in Section 14.16
(b) 150 mm layer of 'A' horizon soil mix as specified in Section 14.18 or as listed within Section 14.58.8, whichever is the greater depth.
(c) 50 mm layer of bark mulch.

.3 Compact unamended topsoil in shrub and groundcover beds to no greater than 80% of corrected maximum dry density. Roughen surface prior to placement or 'A horizon' soil mix.

.4 For the 'A' horizon mix, place an additional 150 mm lift of unamended topsoil over soil depths indicated in Section 14.60.1 or .2, then thoroughly till in all amendments specified in the soil analysis report. Lime, if required, may be added to the topsoil mix at the time of topsoil spreading. All other required fertilizers shall be added to the topsoil mix after it is in place. There should be at least one week between the time of applications of lime and other types of fertilizer. Fertilizer shall be spread with a suitable mechanical spreader and be fully incorporated into the topsoil mix to a minimum depth of 150 mm.

.5 Excavate individual pits in the placed topsoil mix for shrubs, to the same depth, and 1.5 times the width, of the container. Place shrubs to show the best side towards the primary viewpoint. Water shrubs in the pits prior to backfilling with the planting medium.

.6 Rake shrub and ground cover beds to a smooth surface prior to placement of 50 mm depth bark mulch layer.

.7 Plant ground covers through bark mulch layer into the 'A' horizon layer below. The Contractor shall not plant ground covers into the mulch layer without full root burial in the soil.

.8 Rake mulch layer to a smooth finish grade and water bed.

14.61 PRUNING

.1 Trees which, at the time of planting, require the removal of damaged or diseased branches larger than 12 mm diameter, that have broken leaders, or that have a damaged trunk, will be rejected by the City Engineer.

.2 Pruning shall be limited to the minimum necessary to remove dead or damaged secondary branches or twigs, or to provide safe headroom adjacent to streets and sidewalks. Pruning shall be done in such a manner as to preserve the natural character of the plant.

.3 For pruning cuts 12 mm diameter and smaller use clean sharp secateurs. The cut shall be perpendicular to the branch angle and located at the outside edge of the branch collar only, leaving no stub or bark tears.

.4 Pruning cuts larger than 12 mm shall be undertaken according to the current ISA Pruning Guidelines by a qualified person. The 3-cut method shall be employed using a clean sharp pruning saw.

14.62 CUTTING, SHIPPING, AND ON-SITE HANDLING OF SOD

.1 Sod shall be in pieces approximately 0.84 sq. m. in area with the soil portion having a minimum depth of 19 mm.

.2 Co-ordinate shipping of sod to minimize the time lapse between shipping and laying. Co-ordinate with soil placement accordingly.

.3 During transportation protect sod against drying.

.4 Sod shall be installed 24 hours after delivery and within 36 hours of harvesting. Keep sod moist and cool if in the event of any delay in laying. The supplier shall provide, upon request, a label or statement certifying the quality grade, location of sod source and species of grass in the sod and that the sod meets the specifications for the stated grade.

.5 During dry weather, water sod as necessary to ensure its vitality and prevent soil and root loss during handling.

.6 During wet weather allow sod to dry sufficiently to prevent tearing during lifted and handling.

.7 Roll or fold all sod prior to handling to avoid tearing or breakage.

.8 Sod shall have a fibrous root system strong enough that a standard sized section can support its own weight without damage or tearing when suspended vertically by holding up the upper two corners.

.9 Turfgrass sod shall not be harvested or transplanted when excessive moisture or dryness will result in damage to, or failure of the sod.

.10 The height of the grass in the sod at the time of harvesting shall be between 40 mm (1.15 in) and 60 mm (2.5 in), except where otherwise specified.

.11 Turfgrass sod shall be reasonable free from thatch. Up to 13 mm (0.5 in) of thatch (uncompressed) is acceptable. Commercial grade is exempt.

.12 Turfgrass sod shall be free from visible diseases, detrimental fungi and damaging nematodes and soil-born insects, to the extent that with proper installation methods and initial maintenance, new turf will not deteriorate due to such causes.

.13 All turfgrass sod shall be absolutely free from plants designated as noxious weeds, as per Section 14.28.7. Nursery turfgrass sod shall be free of broadleaf weeds, invasive species and undesirable grasses to the extent required for each quality grade. Field turfgrass sod shall not contain more than ten (10) weeds per 10 m^2 (100 ft^2).

.14 Sod shall not be dropped or dumped from vehicles.

.15 Sodded areas shall be protected with warning signs during rooting and the initial maintenance period.

14.63 <u>SOD SCHEDULING AND WORKMANSHIP</u>

.1 Keep site well drained.

.2 Do not lay sod during freezing temperatures or when the ground is frozen.

.3 Sod placed between May 15 and September 15 shall require installation of any automatic irrigation system.

.4 Clean up immediately soil or debris spilled onto pavement and dispose of deleterious materials.

14.64 <u>LAYING OF SOD</u>

.1 Excavate and/or fill and prepare subgrade to a sufficient depth below finish grade to accommodate 150 min. topsoil plus the thickness of the sod.

.2 Scarify top 75 mm surface of subgrade to produce an even loose-textured surface free of stones larger than 75 mm. Remove and dispose of all roots and branches, and all plant parts of blackberry, horsetail, morning glory, Canada thistle or other noxious weeds. Remove and dispose of all paving materials, tar, building materials or other deleterious substances.

.3 The Contractor shall inform the City Engineer of any existing sub-grade conditions which will adversely affect the work in this section.

.4 The finished sub-grade shall be approved by the City Engineer prior to placement of topsoil.

.5 Topsoil shall not be placed when in a wet or frozen condition.

.6 Spread topsoil evenly over the approved sub-grade to a minimum depth of 150 mm and compacted to maximum 85% modified dry density.

.7 Where the soil analysis indicates the addition of granulated lime it shall be incorporated into the soil at the depth and rate specified by the soil testing laboratory at least 3 week prior to the application of the fertilizer.

.8 A turf starter fertilizer, as specified by the soil testing laboratory, shall be incorporated into the soil, at the depth and rate specified, a minimum of 48 hours prior to the laying of sod.

.9 Immediately prior to sod placement, the finished topsoil grade shall be smooth, firm against footprints, with a fine loose-texture.

.10 Lay sod in rows, perpendicular to slope, smooth and even with adjacent areas and surfaces, and with joints staggered. Butt sections closely without overlapping or leaving open joints between pieces.

.11 Water immediately after sod laying to obtain moisture penetration through sod into top 100 mm (4 in) of topsoil mix.

.12 When sod and soil has dried sufficiently to prevent damage, provide close contact between sod and soil by means of a 150 kg roller. Heavy rolling to correct irregularities in grade is not acceptable.

.13 Provide adequate marking of sodded areas with warning signs, to be removed by the Contractor when sodding work has given a Notice of Acceptance.

14.65 SODDING INSPECTIONS

.1 Give 24 hours prior notice to the City Engineer for each following required inspection:

(a) After excavation and preparation of the subgrade but prior to placement of topsoil give notice to the City Engineer for inspection of the subgrades.
(b) Notify the City Engineer when the sod is established for an inspection for acceptance.

14.66 SHIPPING, AND ON-SITE HANDLING OF SEED

.1 Deliver and store grass seed in original container showing:

(a) Analysis of seed mixture and % of pure seed.
(b) Year of production and date and location when tagged.
(c) Net Mass.
(d) Percentage germination.
(e) Name and address of distributor.

.2 All seeds to be stored in dry, weatherproof storage places and are to be protected from damage by heat, moisture, rodents or other causes until time of seeding.

14.67 SEEDING SCHEDULE AND WORKMANSHIP

.1 Seed grass and/or wildflower mix during early spring or after the 15^{th} of August to within two weeks of freeze-up.

.2 Keep site well drained.

.3 Perform work under optimum field conditions. Do not undertake seeding operation under adverse conditions including moisture, temperature, wind or scheduling related work.

.4 Clean up immediately soil or debris spilled onto pavement and dispose of deleterious materials.

14.68 SEEDING

.1 Apply seed by Mechanical Dry Seeding method or Hydraulic Seeding method unless otherwise specified. Hand seeding shall only be carried out when site conditions preclude the above methods and must be approved by the City Engineer.

.2 Base application rates of fertilizers, seed mix, mulch and tackifier on analysis of season, climate, terrain, soil, and establishment and maintenance conditions affecting project.

14.69 MECHANICAL DRY SEEDING

.1 Excavate or fill and grade smooth subgrade to within 150 mm of finish grade in areas to be seeded with fine grass. Removed all deleterious and refuse materials. Place 150 mm depth topsoil and fine grade removing humps and hollows. Rough grass/wildflower areas shall be seeded on the native sub-soil graded for drainage, and free of surface rocks and all deleterious materials.

.2 Obtain Engineer's approval of topsoil grade and depth before starting seeding.

.3 Sow during calm weather (winds less than 6 mph) using equipment suitable for the area involved to the approval of the City Engineer. Sow half of the required seed in one direction and the remainder at right angles. Incorporate the seed into the soil a minimum depth of 6 mm simultaneously or within one half hour after seeding operation. Mix carefully with light chain harrow or wire rake and roll area immediately afterward with water ballast type lawn or agricultural type roller.

.4 Water with fine spray, avoiding washing out seed. Apply enough water to ensure penetration to a minimum of 50 mm (2").

.5 Re-seed at 2 week intervals where germination has failed.

14.70 HYDROSEEDING

.1 Do not hydroseed fine grass areas without pre-approval from the City Engineer.

.2 Thoroughly mix seed, fertilizer and hydraulic mulch in water slurry and distribute normally over surface area with approved hydraulic mulcher.

.3 Measure quantities of each material to be charged into hydraulic seeder/mulch tank accurately either by mass or by common accepted system of mass-calibrated volume measurements. Add materials to tank while it is being filled with water and in following sequence: seed, fertilizer, and where applicable, mulch. Thoroughly mix materials into homogeneous water slurry and distribute uniformly over surface area with hydraulic seeder/mulcher.

.4 Keep seeds for legumes in separate containers prior to seeding. If required, add legume seeds with standard product humus culture before mixing with grass/wildflower seed. Protect inoculated seed from exposure to sunlight for periods of over one-half hour. Use seed within eight hours from inoculation or to be re-inoculated.

.5 After charging, do not add water or other materials to mixture in hydraulic mulcher.

.6 Do not leave seed, fertilizer, mulch and water slurry in tank for more than 4 hours. Slurry left in tank over maximum time to not be used for seeding, dispose off-site.

14.71 HYDROSEEDING WITH MULCH

.1 Prepare area to be seeded. Seed wildflower/grasses and 25% of fibre mulch on the first pass, then seed the balance of mulch on the second pass.

14.72 EROSION CONTROL BLANKET

.1 Prepare area and seed.

.2 Apply blanket over designated areas in accordance with manufacturer’s instructions.

.3 Anchor blanket in accordance with manufacturer’s recommendations which are to be used as minimum standard to ensure that blanket is held down to maintain firm contact.

14.72A STRUCTURAL SOILS COMPOSITES ***(REVISED MAY 2020)***

.1 Structural soils shall be used with the approval of the City Engineer.

IRRIGATION

14.73 EXISTING CONDITIONS

.1 Ensure that existing site features and improvement areas are disturbed as little as possible. Protect existing vegetation throughout installation and do not damage root systems. Return all areas to prior conditions immediately after irrigation installation and testing.

.2 Prior to excavation, the Contractor shall satisfy himself as to the finished grade elevations and density of compaction in existing lawn and planting areas, to ensure restoration of disturbed areas to grades and compaction matching existing.

.3 Existing sod removed to accommodate irrigation installation shall be preserved in a healthy condition and replace subsequent to installation and backfilling, or replaced with new sod.

.4 Notify Engineer if trenching is required through paved areas. The Contractor shall saw-cut and remove paving to the width of the trench. Removal and replacement of paving to match existing shall be the responsibility of the Contractor.

.5 Where trenching for piping or wiring is required through paved roadway areas, provide 150 mm ID SDR 35 sleeve with minimum 600 mm depth cover. Extend sleeve minimum 300 mm into soft landscape areas.

14.74 DELIVERY AND STORAGE

.1 Shipping and handling and installation of materials shall be to manufacturer's recommended instructions, and best workmanship. Particular care shall be taken to avoid scratches and nicks on the plastic pipe. Pipe must be properly stacked and stored in a clean place on the site, keeping dirt out of the pipe at all times.

14.75 WORKMANSHIP

.1 Lay out work as accurately as possible to the construction drawings. Install swing joints, offsets and all fittings to bring the pipe and heads to the locations shown.

.2 If shop drawings or field adjustments to the design are made, the Contractor shall be responsible for full and complete irrigation distribution, and coverage of all irrigated areas and to add any changes made to the as-built drawings.

14.76 EXCAVATION AND TRENCHING

.1 All trenching and backfilling to be in accordance with Section 4 – Trench Excavation, Trenching, and Backfill, and in addition:

(a) Excavated materials shall be carefully place adjacent to the trench in separate piles to avoid contamination of topsoil and excavated materials.

(b) Perform all excavations as required for the installation of the work included under this section, including shoring or earth banks to prevent cave-ins. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of the excavations to their original condition and in a manner approved by the City Engineer.

(c) Excavations through existing landscape areas shall be carried out such that adjacent areas are not contaminated with excavated materials. Backfilling and replacement of topsoil shall be performed in accordance with the specifications such that all existing planting areas are restored to their original condition.

(d) Trenches shall be made wide enough to allow a minimum of 50 mm between parallel pipelines. Trenches for pipelines shall be made of sufficient depths to provide the minimum cover from finish grade as follows:

(i) 45 mm minimum cover over main lines
(ii) 300 mm minimum cover over lateral lines to heads.
(iii) 100 mm minimum over drip lines

.2 Maintain all warning signs, barricades and other safety devices in accordance with the Section 3 – General Requirements.

14.77 WATER AND ELECTRICAL SERVICE CONNECTION

.1 Water Service Connection shall be in accordance with Section 5 – Water Distribution System, and as shown on the construction drawings.

.2 Contractor shall have a qualified Electrician connect the controllers to the electrical supply.

14.78 PIPELINE ASSEMBLY AND INSTALLATION

.1 Do not drag pipe along ground whether single lengths of assembled sections. Damaged pipe shall be rejected and replaced by new pipe and couplings.

.2 Keep pipes clean at all times, blow out with compressed air or water on completion of assembly.

.3 Plastic pipe shall be laid on sand to a compacted depth of 75 mm. A further 75 mm depth of sand shall be placed over plastic pipe prior to backfilling.

.4 Plastic pipe and fittings shall be solvent welded using solvents and methods as recommended by manufacturer of the pipe, except where threaded connections are required. Pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before applying solvent with a non-synthetic bristle brush. All PVC pipe shall be installed in accordance to Section 5.0 – Water Distribution System.

.5 Pip may be assembled and welded on the surface. Snake pipe slightly from side to side to allow for expansion and contraction.

.6 No irrigation line shall be installed so that it runs parallel and directly over another such line or utility.

.7 Leave minimum clearance 50 mm between irrigation lines laid in a common trench.

.8 Make all connections between plastic pipe and metal valves with threaded fittings using plastic male adapters.

(a) Screw fittings shall be carefully tightened with strap wrenches or by other means that do not mark the plastic pipe or plastic fittings.
(b) Pipe wrenches shall not be used on plastic fittings, unless the fittings are a type designed for use with a pipe wrench. Use teflon tape on all threaded fittings.

14.79 VALVES AND CONTROL WIRING

.1 Install valve boxes such that top of structure is at finished grade, accessible for maintenance, in accordance with Section 5 – Water Distribution System.

.2 24-volt wiring of valves to controller shall be undertaken by a certified low energy systems tradesman.

.3 All 24-volt wiring shall be a different colour than the 110-volt power to controller and shall be buried a minimum of 300 mm as per the amended B.C. Electrical Code.

.4 Coil additional 600 mm length of each electrical wire within valve box as extra material.

.5 Splicing shall be minimized. Splices are to be made waterproof with the use of water-proof wiring kits and installed in a valve box as per Standard Drawing No. I-1.

14.80 SPRINKLER HEADS

.1 Install all sprinklers according to manufacturer's specifications.

14.81 CLOSING OF PIPE AND FLUSHING LINES

.1 Cap or plug all openings as soon as lines have been installed to prevent the entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.

.2 Thoroughly flush out all water lines before installing heads, valves and other hydrants.

.3 Test in accordance with Section 14.83 – Backfill and Compacting.

.4 Upon completion of the testing, the Contractor shall complete assembly and adjust sprinkler heads for proper distribution.

14.82 HYDROSTATIC TESTS

.1 Request the presence of the City Engineer at least 48 hours in advance of testing.

.2 Testing to be accomplished at the expense of the Contractor and in the presence of the City Engineer.

.3 Center load piping with small amount of backfill to prevent arching or slipping under pressure.

.4 After welded plastic joints have cured at least 24 hours, fill test section with water and expel all air and cap risers for an additional 24 hours prior to testing. Contractor shall pre-test the circuits, and call the City Engineer for a supervised test once the circuits to be demonstrated meet the test requirements. Contractor shall supply and temporarily install, until tests are approved, a pressure gauge and hose bib to each main and circuit to be tested. Tests to be conducted at 1.5 times the maximum operating pressure (continuous and static water pressure) in the presence of the City Engineer as follows:

(a) Main lines and sub-mains to be tested for 1 hour.
(b) Lateral lines to be tested for 15 minutes.
(c) Pressure loss on the pressure gauge shall not exceed 10% of the test pressure in the time period of the test.

.5 Repair leaks resulting from tests by cutting out and replacing pipe or fittings. Leaks shall not be repaired by patching. Maintain test pressure for a minimum of one hour after replacement of defective parts and re-inspect as per Section 14.83 – Backfill and Compacting, clause 14.83.4.

.6 After approval by the City Engineer, backfill excavations, maintaining pressure in the lines. If there is any indication of a leak, the defective section shall be located and replaced. Flush out the system to remove dirt and then attach the sprinklers using a thread seal tape (PTFE tape).

14.83 BACKFILL COMPACTING

.1 After system is operating and required tests and inspection have been made, backfill excavations and trenches.

.2 All sprinkler head excavations shall be backfilled with sand or topsoil up to within 50 mm of finish grade.

.3 Trenches to be backfilled in accordance with Section 4 – Trench Excavation, Bedding, and Backfill.

.4 Ensure that existing lawn and planting areas are disturbed as little as possible.

.5 Dress off all areas to finish grades.

14.84 CLEAN-UP

.1 Remove from the site all debris and surplus material resulting from work of this section.

14.85 BALANCING AND ADJUSTMENTS

.1 Balance and adjust all components of the system to achieve the most efficient system operation. Balancing and adjustment to include synchronization of controllers and soil moisture sensors, adjustments to pressure regulators, pressure relief valves, sprinkler heads and individual station adjustments on controllers.

.2 Lawn sprinkler heads shall be set flush with the final turf grade by shortening or lengthening the riser as required. During the maintenance period, return and adjust the heads as required to be flush with the final turf grade.

14.86 DRIP COMPONENTS

.1 Install according to the manufacturers' specifications.

.2 Keep pipe ends and components absolutely clean during installation.

.3 Check and clean filter one week after system start-up. Check and clean filter monthly thereafter during the operating season of the maintenance period.

SECTION 14 – LANDSCAPE
LANDSCAPE MAINTENANCE

LANDSCAPE MAINTENANCE

14.87 SCOPE

.1 The area of maintenance operations will be all constructed or altered landscape areas in this Contract.

.2 Landscape maintenance operations shall meet the "Moderate" Maintenance Level in accordance with the BC Landscape Standard, 2008 Edition, unless otherwise specified herein or subject to a separate agreement.

Moderate Maintenance Level Definition (from BC Landscape Standard, 2008 Edition)	
Objectives	Main objective is a generally neat, moderately groomed appearance, with some tolerance for the effects of "wear and tear," moderate traffic and natural processes.
Appearance Standard	Plants and lawns are healthy, lawns kept within accepted height range for type; invasive plants, with the exception of listed noxious weeks and debris are acceptable within limits between regular visits. Invasive and noxious weeds shall be eradicated. Seasonal plantings in good condition and attractive at appropriate seasons.
Typical Locations	• Most residential, commercial and institutional sites, especially those of medium to large size • Publicly visible portions of industrial sites • Areas for occasional recreational use • Areas viewed from a medium distance
Plant Characteristics	Areas may include some native or naturalized planting; this may be modified for appearance or moderately intensive use.
Traffic Activity Levels	Moderate traffic tolerated; minor deterioration due to traffic is acceptable. Maintenance may include adjustments in response to such "wear and tear".
Maintenance Practices	Routine maintenance of moderate frequency and intensity, with regular monitoring to avoid serious deterioration.

.3 Litter control and garbage pick-up, other than construction clean-up during and after work performed in this Contract, will be supplied by others, or will be subject to a separate agreement.

.4 The maintenance period shall be from the time of planting until the end of the specified maintenance period (minimum two years) from the date of Notice of Acceptance of the landscape works or at the discretion of the City Engineer, or will be subject to a separate agreement. ***(REVISED MAY 2020)***

.5 Maintenance operations for trees, shrubs and ground covers shall occur once per month from April to October, throughout the specified maintenance period and shall include: ***(REVISED MAY 2020)***

(a) Watering, weeding, pest and disease control, remedial pruning;
(b) Plant replacements as required;
(c) Supplemental fertilization as specified by the soil testing laboratory;
(d) Spring and fall clean-up;
(e) Planting beds shall be maintained to be weed-free.

.6 Maintenance operations for sodded and seeded lawn/fine grass areas shall include: watering, mowing, weeding, topdressing and reseeding as required to meet conditions set out in 14.99, throughout the maintenance and guarantee period.

.7 Maintenance operations for rough grass, nurse crop, and wildflower areas shall include: mowing, weeding, topdressing and reseeding as required to meet conditions set out in 14.100 and 14.101, throughout the maintenance and guarantee period.

.8 Maintenance operations for irrigation system shall include: monitoring and adjustment of system, repair as necessary, and winterization and spring startup of the system.

.9 Maintenance operations should, where possible, follow ecologically sound practices such as:

(a) Integrated Pest Management (IPM)
(b) Plant Health Care (PHC)
(c) Composting
(d) Application of Organic Mulches

14.88 <u>REFERENCE STANDARDS</u>

.1 Refer to Section 14.12 for reference standards for landscape maintenance.

14.89 <u>QUALIFICATIONS AND WORKMANSHIP</u>

.1 A qualified professional, for this Section, refers to any individual who is trained as and is certified and recognized, such as:

(a) Diploma in Horticulture
(b) Landscape Horticultural Journeyperson with a Certificate of Qualification by the Industry Training Authority of BC
(c) ISA Certified Arborist

.2 All landscape maintenance personnel shall be skilled in the tasks assigned to them.

.3 Supervisors for landscape crews shall be qualified professionals.

.4 Pesticide handling and application shall be done only be applicators holding current certification within the comprehensive pest management system.

14.90 PROTECTION

.1 All existing and new plants, site services, curbs, paving, structures, finishes and all other features shall be protected against damage during the work, refer to Section 3.0 of these specifications.

.2 Appropriate measures shall be taken to ensure that no spillage of fuels, fertilizers, toxic construction materials, or other toxic wastes occurs, and where use of such materials is necessary, to ensure that adequate containment facilities and clean-up equipment are utilized.

.3 No toxic or waste materials, fuels and fertilizers shall be stored adjacent to or dumped into water courses or any other water body either on or off the job site, or in a location where spillage could result in seepage into a watercourse.

.4 All toxic wastes and other material shall be disposed of in a manner acceptable to the Owner and in accordance with municipal, provincial and federal regulations.

.5 Appropriate measures shall be taken to ensure that wildlife protection is achieved in accordance with municipal, provincial and federal regulations. ***(REVISED MAY 2020)***

14.91 HANDLING AND STORAGE OF CHEMICALS

.1 Chemicals used during the course of maintenance procedures shall be limited to those that are registered and meet all federal, provincial and regional/municipal regulations and bylaws.

.2 Application, disposal and handling of all chemicals including, but not limited to, herbicides, pesticides, fungicides, and insecticides shall comply to all applicable legislation and regulations, including, but not limited to, the federal Pest Control Products Act, Fisheries Act and Food and Drugs Act; and the provincial Integrated Pest Management Act, Wildlife Act, Weed Control Act, Plant Protection Act and Waste Management Act, the City of Nanaimo Pesticide Use Bylaw 7102 as well as any municipal or regional district legislation.

14.92 VANDALISM

.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.

14.93 END OF MAINTENANCE PERIOD

.1 Notify the City Engineer, 30 days in advance of the end of the maintenance period.

14.94 PRODUCTS AND MATERIALS

.1 Products and materials used in landscape maintenance operations shall meet the requirements of the specifications and referenced standards.

14.95 EQUIPMENT

.1 The Contractor shall supply all equipment, materials, and all other supplies necessary to maintain the Contract landscape area.

.2 Equipment shall be suited to the work at hand, and shall be in good condition. Mowers shall have clean, sharp blades. Safety devices shall be in place and functioning to Workers' Compensation Board requirements.

.3 Pruning equipment shall be kept sharp and sterile to prevent the spread of plant diseases.

.4 Equipment shall be such that the risk of spillage, inadvertent spraying or miss-direction of oil, gasoline, fertilizer or other chemicals is minimized.

.5 Spray equipment shall be of a type which can be adjusted with respect to spray pattern and application rate. Do not use air blast, mist, or fog sprayers. Hose mounted sprayers shall be equipped with a check valve rated for the prevention of backflow, to be located within 1 m of the water source shut off valve.

14.96 WATER

.1 Water supply other than irrigation system will be the responsibility of the Contractor or subject to separate agreement.

.2 Base cost of this work on hand watering as required, and supplemental to the irrigation system if one is supplied, or in cases of breakdown.

.3 Supply all equipment such as pumps, hose, portable sprinklers, tank trucks, etc. if required for watering operations.

.4 Water used for landscape maintenance shall be free from organic or chemical contaminants detrimental to healthy plant growth.

14.97 SCHEDULING

.1 Schedule operations to the type of plant materials being maintained, the intensity and pattern of use of the site, and the seasonal weather patterns.

.2 Adjust maintenance frequency and intensity to the weather patterns of the particular year.

.3 Schedule watering operations to meet the following criteria:

(a) To provide water just prior to, or during, early daylight hours for maximum plant uptake,
(b) To not impede the use of sidewalks or other paved areas during daylight hours, and
(c) In accordance with any watering restrictions in effect at the time.

14.98 TREES, SHRUBS AND GROUND COVERS

.1 The Contractor shall undertake the following maintenance operations, once per month, from April to October, for trees shrubs and ground covers for the duration of the maintenance period: ***(REVISED MAY 2020)***

(a) Monitor all plants at least once per month during the growing season for pest and disease signs: to ensure prompt treatment, minimum damage, and to minimize treatment intensity. Where the application of a pesticide is warranted, notify the City Engineer prior to treatment.

(b) The Contractor shall be required to compensate the Owner for damage caused to non-target plants from the misapplication of herbicides.

(c) The Contractor shall immediately notify the City Engineer, of any major insect, fungal or other pathogenic infestation or disease which will adversely affect the health of the plant materials. If, in the opinion of the Engineer and the City Engineer, the condition cannot be remedied prior to Acceptance, the affected plant materials shall be replaced by the Contractor, at no cost to the Owner.

(d) Provide adequate water during the growing season to ensure healthy turgid growth. During the period from April 15 to September 15, the combined weekly total of natural precipitation and irrigation or water supplied by the Contractor shall be not less than the equivalent of 38 mm of precipitation.

(e) Maintain the mulched areas of shrub and ground cover beds, and at the bases of trees, in a clean, uncompacted, weed-free and grass-free condition. Ensure the total removal of all root parts of weeds. Do not mechanically cultivate over the root zone of any plant material.

(f) Maintain areas to be free of invasive and noxious species. ***(REVISED MAY 2020)***

(g) Remove fallen leaves, twigs and trimmings in a timely fashion to prevent rot, damage to the surrounding landscape, impeded area drainage, or public inconvenience.

(h) Pruning shall only be undertaken in accordance with 14.61. Except as indicated below, or as recommended for a particular species in the technical horticultural literature, prune plant materials during the late autumn after leaf drop or in early spring prior to bud break. Prune trees of the following genus’ in autumn only: Betula, Cladastris, Laburnum, Liriodendron, Magnolia. Prune shrubs which bloom on the previous year’s grown, shortly after blooming.

(i) Do not fertilize trees planted in the spring until the following spring. Do not fertilize trees planted in the summer or fall until the following spring. Apply only a controlled release complete fertilizer, at the rate recommended by the soil testing laboratory.

(j) Fertilize shrub and ground cover beds with a complete slow release fertilizer in accordance with the recommendations of the soil testing laboratory.

(k) Trees which are staked shall be inspected periodically for state of repair, correct tensioning and for signs of stem abrasion or constriction. Unless otherwise instructed by the City Engineer, the stake shall be removed by the Contractor prior to, and as a condition of, final payment at the end of the maintenance period.

14.99 FINE GRASS AREAS

.1 Maintain fine grass areas to the 'Moderate' standard set out in the BC Landscape Standard 2008 Edition.

.2 Provide sufficient water to keep the sod root zone moist until firmly rooted.

.3 If area was seeded, keep soil moist during germination period and adequately water grassed areas until accepted by the City Engineer. Apply water to ensure moisture penetration 75 mm to 100 mm. Control water to prevent washouts. Seeded areas to be adequately protected with warning signs, temporary wire or twine fences, or other necessary means.

.4 Subsequent to rooting, program irrigation to provide alternate day watering for a total weekly precipitation rate of 38 mm during the growing season.

.5 Topdress and reseed areas which are dead or bare and keep moist until fully established. Use a seed mix that matched the varieties found in the sod or original seed mix.

.6 Weeding must be done when isolated small weed patches (no greater than 4 patches per 5 sq. m) have a width of 150 mm. Weeding (mechanical or chemical) shall kill or remove 90% of weeds or the process shall be repeated within the next two site visits.

.7 Mow at a time and frequency required to maintain the lawn at a height between 62 mm and 38 mm.

.8 Remove and dispose of clippings at each mowing.

.9 At each mowing, trim grass at interface with all non-turf elements such as curbs, pavement surfaces, walls, mulched areas beneath trees, and shrub beds. Do not allow the line of a string trimmer to come into contact with any plant material other than the sod.

.10 Using a sharp edging tool, vertically cut an edge at the perimeter of all shrub beds and mulched areas under trees, three times during the growing season.

.11 Fertilize sod in accordance with the recommendations of the soil testing laboratory at the prescribed interval and rate, and with the type of fertilizer appropriate to the stage of the growing season. Fertilize a minimum of twice during the growing season.

.12 Fertilizer shall be spread with a mechanical spreader that can be calibrated for an even application of fertilizer at a controlled rate.

14.100 ROUGH GRASS AND WILDFLOWER

.1 Mow rough grass once every thirty days. Mow to maximum height of 100 mm. Wildflower mixes to be mowed once in the spring to a height of 150 mm.

.2 Maintain areas to be free of invasive and noxious species. ***(REVISED MAY 2020)***

.3 Refer to Section 14.28 for specifications.

14.101 NURSE CROPS

.1 Mow crop once every 30 days. Mow to a maximum height of 150 mm.

.2 Cut crop prior to going to seed to ensure the annual species do not reseed.

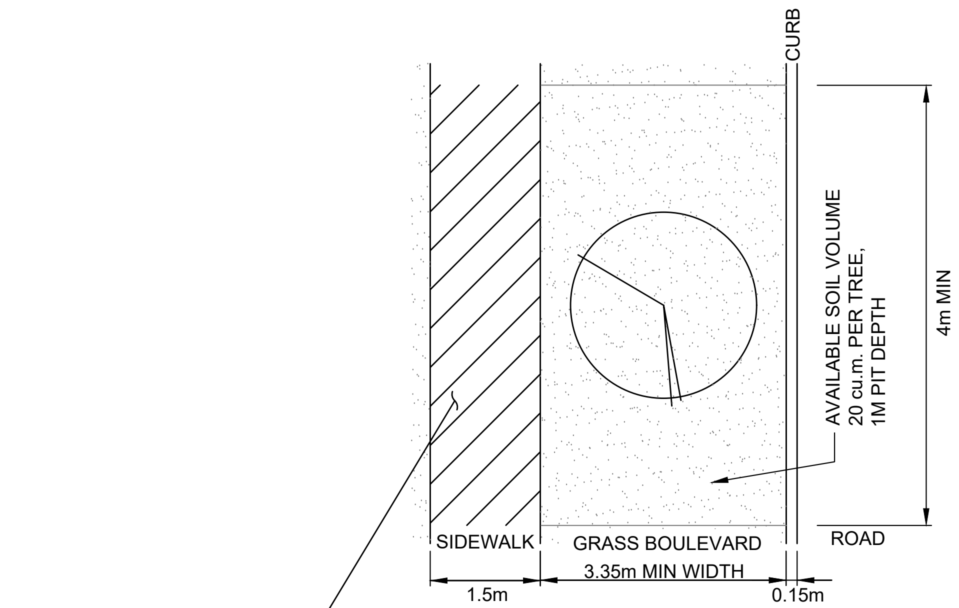
14.102 IRRIGATION SYSTEM

.1 Maintenance of the irrigation system shall include:

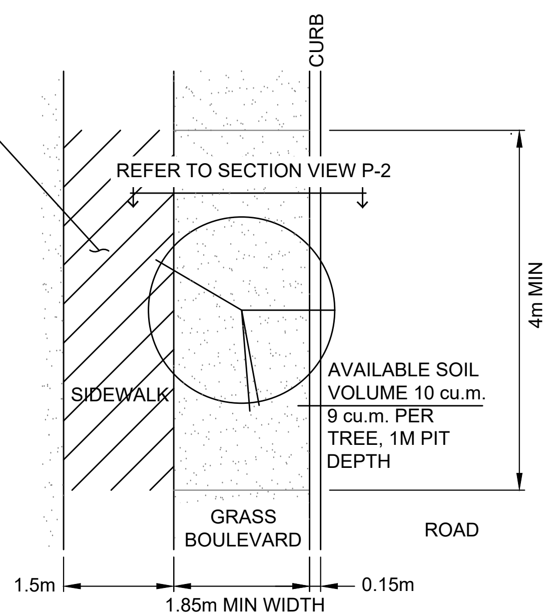
(a) Monitoring of the irrigation controller functioning and scheduling;
(b) Adjustment of risers and nozzles for the designed coverage;
(c) Monitoring and cleaning of drip filters and emitters;
(d) Repair or replacement of defective or damaged components; and
(e) Winterization of the system at the end of the growing season, and spring startup.

.2 Winterization shall include flushing, draining, and shut-off of all system components.

.3 Spring startup shall include backflow prevention assembly device field testing/documentation/tagging and submittal, filter cleaning, system charging, monitoring and adjustments. ***(REVISED MAY 2020)***



TREE PLANTING WITH 20 cu.m ROOT ZONE
PLAN VIEW



TREE PLANTING WITH 13.5± cu.m ROOT ZONE
PLAN VIEW

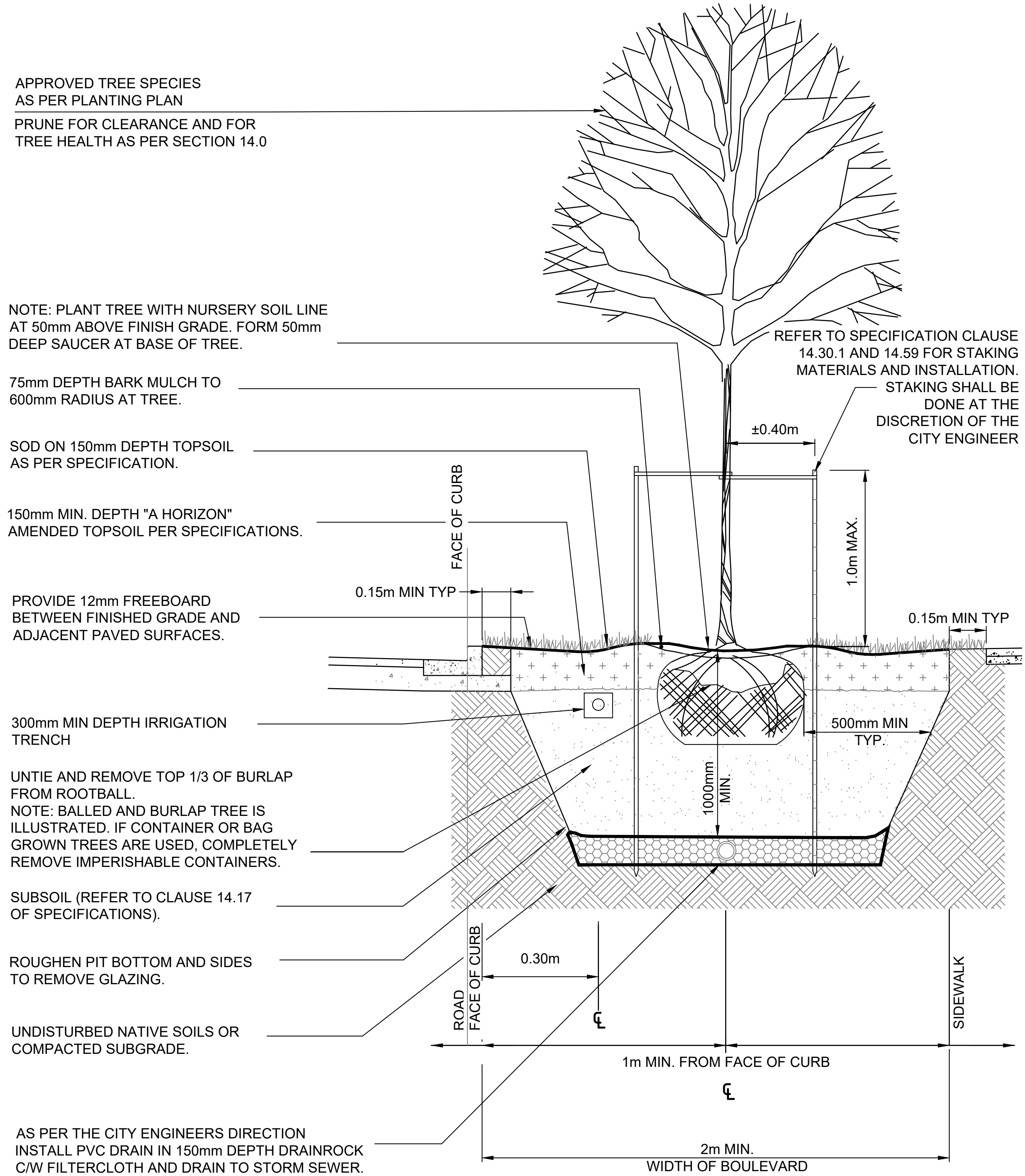
NOTES:

1. REFER TO SPECIFICATIONS CLAUSE 14.06 FOR STREET TREE SPACING, LOCATION, AND SIZE.

CITY OF NANAIMO
THE HARBOUR CITY

TREE PLANTING ROOT ZONE VOLUME

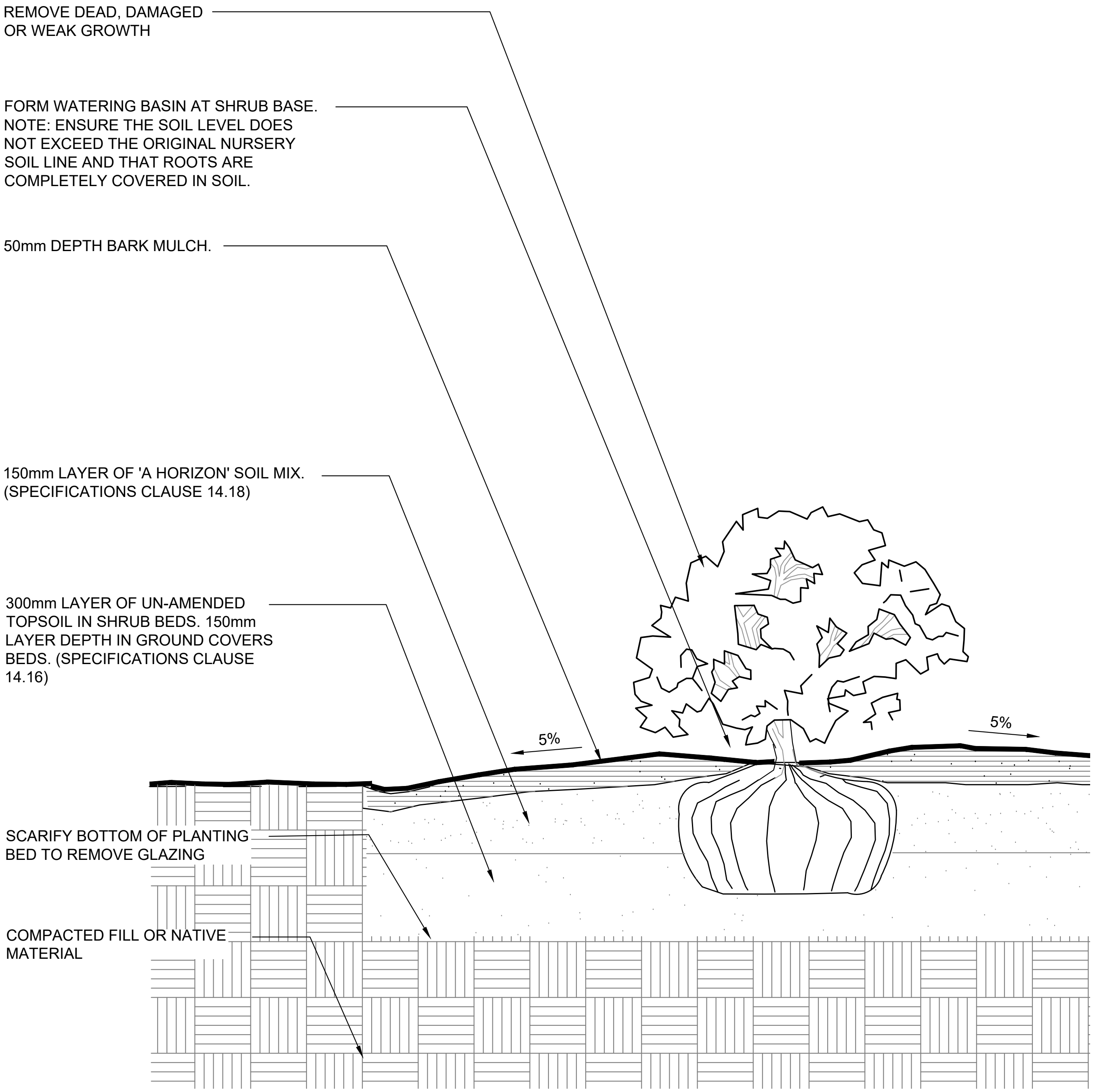
Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	P-1



CITY OF NANAIMO
THE HARBOUR CITY

TREE PLANTING IN GRASS
BOULEVARD OR MEDIAN

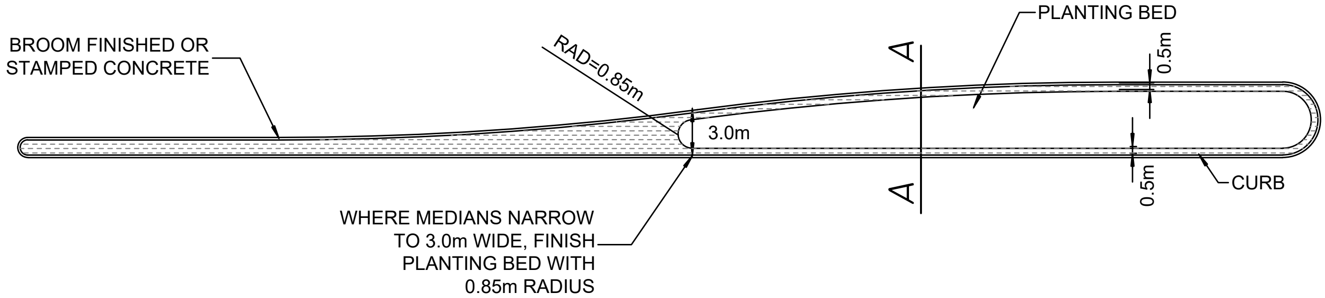
Scale:	NTS
Created:	MAY 2013
Rev Date:	NOV 2016
Dwg No:	P-2



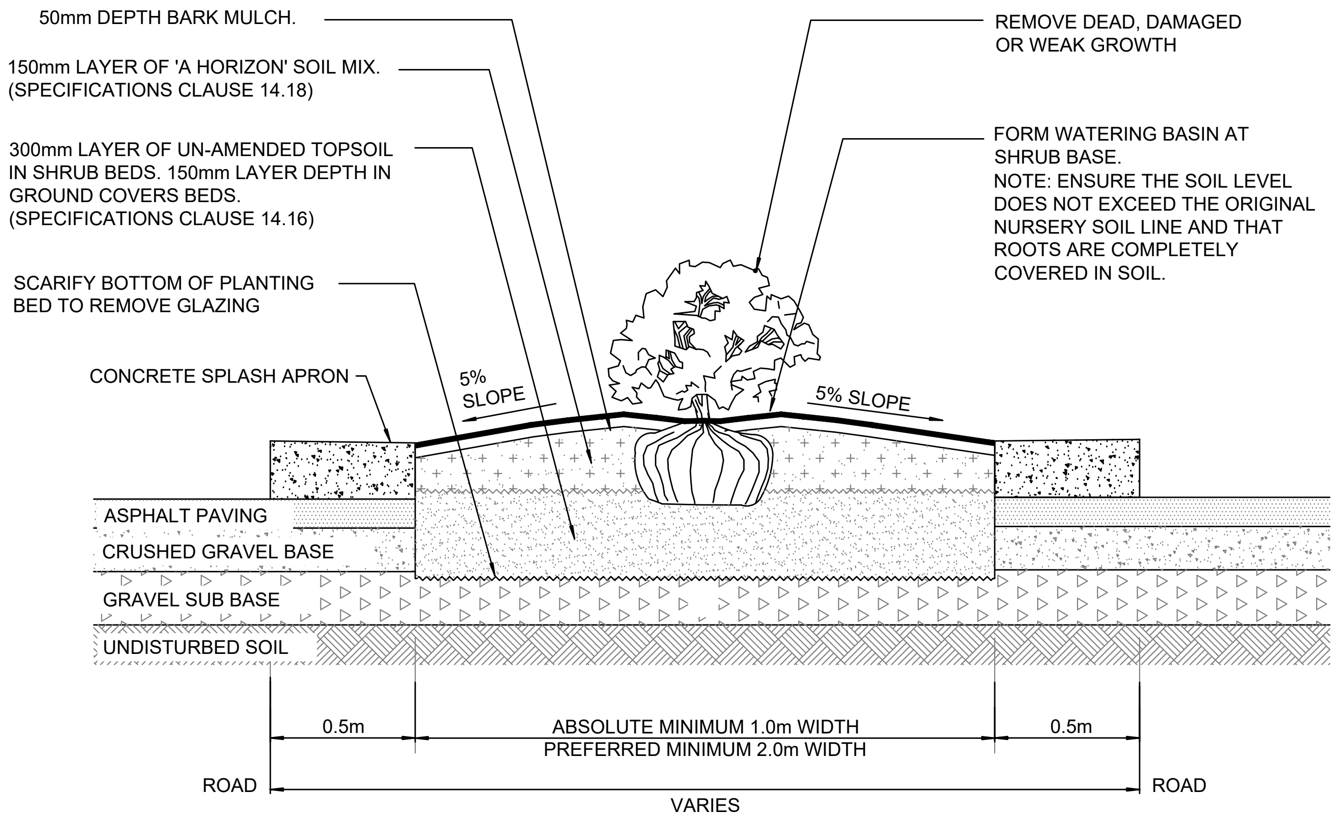
CITY OF NANAIMO
THE HARBOUR CITY

SHRUB PLANTING IN BED

Scale:	NTS
Created:	JAN 1998
Rev Date:	JAN 1998
Dwg No:	P-3



PLAN VIEW



SECTION VIEW A

NOTES:

1. FOR CENTER MEDIAN DETAILS SEE SECTION 8, STD DWG CS-7.

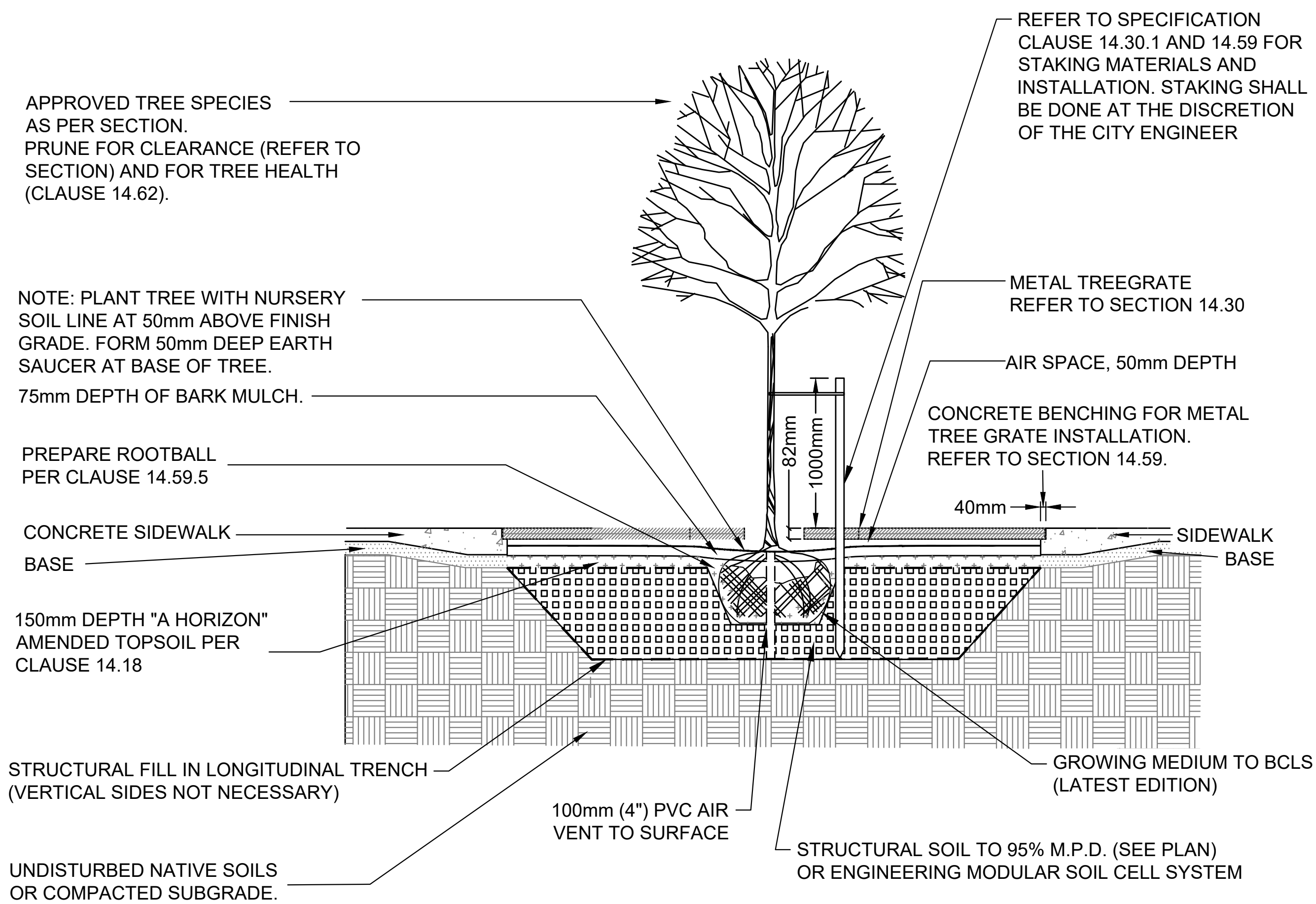
G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 14 DWGS\P-4

3.18.2020

CITY OF NANAIMO
THE HARBOUR CITY

SHRUB PLANTING IN MEDIAN

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	P-4



SECTION VIEW

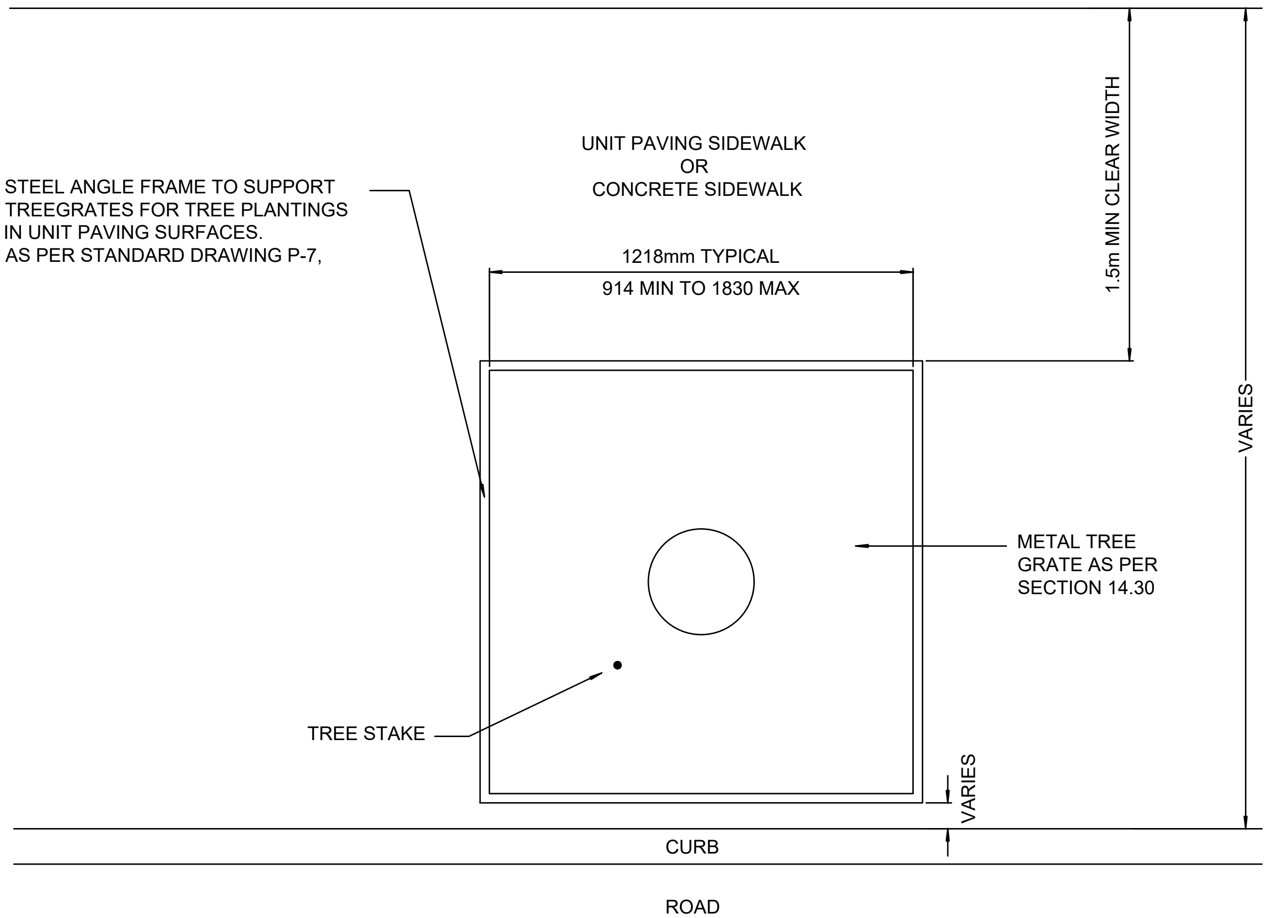
NOTES:

1. ALL WORK AND MATERIALS ARE TO BE AS DESCRIBED IN THE CITY OF NANAIMO MANUAL OF ENGINEERING STANDARDS & SPECIFICATIONS LATEST EDITION OR AS OTHERWISE APPROVED BY THE CITY ENGINEER.
2. REQUIRED VOLUME OF GROWING MEDIUM IS 10m³, TO A DEPTH OF 800mm FOR EACH TREE.
3. FINAL TREE LOCATIONS MAY BE VARIED IF CERTIFIED BY A LANDSCAPE ARCHITECT AND THE CITY OF NANAIMO.
4. IF POOR DRAINAGE CONDITIONS EXIST, PROVIDE POSITIVE SUB-SURFACE DRAINAGE AWAY FROM PLANTING EXCAVATION.
5. IRRIGATION REQUIRED TO CITY OF NANAIMO STANDARDS WHERE REQUIRED BY CITY ENGINEER.
6. SEE DRAWING P-2 FOR REQUIRED DETAILS AND WORKS.

CITY OF NANAIMO
THE HARBOUR CITY

TREE PLANTING IN CONCRETE SIDEWALK

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	P-5



NOTE:

1. REFER TO SECTION 14.30 FOR SPECIFICATIONS AND 14.59 FOR INSTALLATIONS.
2. ALLOWABLE TREE GRATE SIZE SHALL BE 1219mm x 1219mm WITH A MINIMUM SIZE OF 914mm AND A MAXIMUM SIZE OF 1830mm.
3. INSTALL TREES TO MINIMIZE CONFLICTS WITH UTILITIES, BUILDING, STRUCTURES, PEDESTRIAN, AND VEHICULAR TRAFFIC.
4. INSTALL TREE STAKES AS PER CITY ENGINEERS DIRECTION. REFER TO SECTIONS 14.30 AND 14.59 FOR MATERIALS AND INSTALLATION SPECIFICATIONS.
5. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

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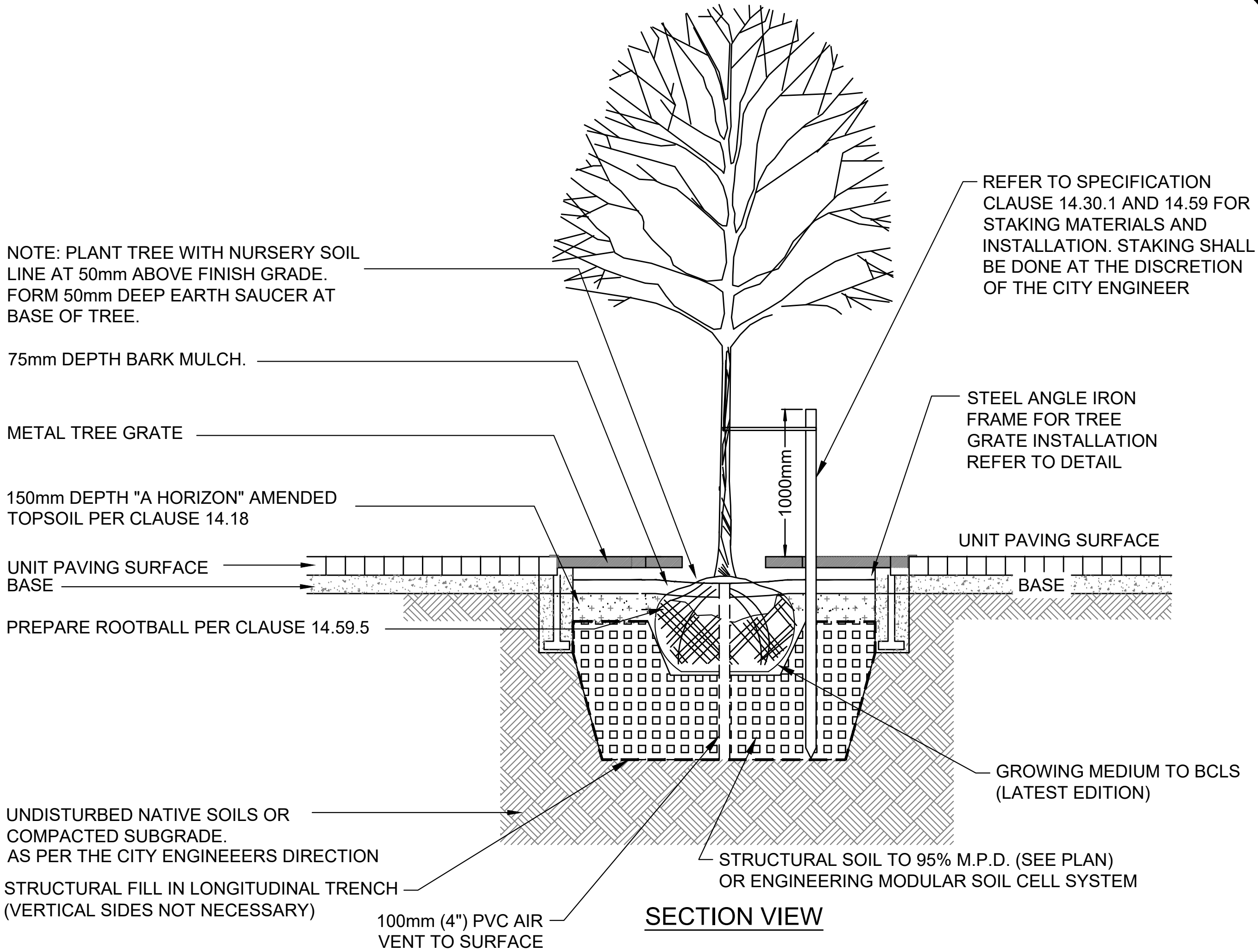
3.3.2020

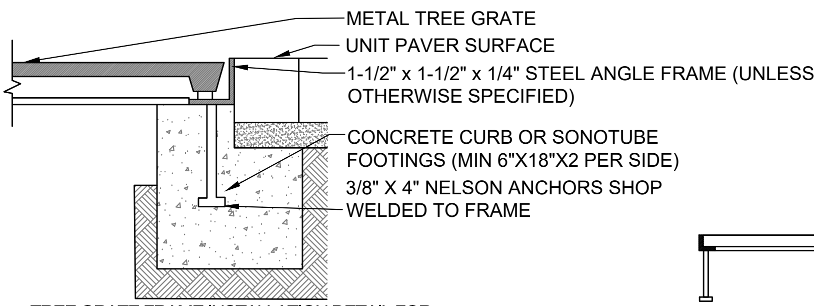
CITY OF NANAIMO
THE HARBOUR CITY

TREE GRATE PLAN VIEW

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2013
Dwg No:	P-6

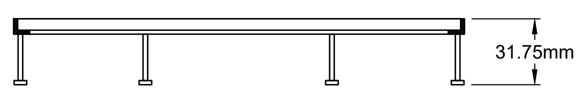


SECTION VIEW



TREE GRATE FRAME INSTALLATION DETAIL FOR PAVERS WITHOUT CONCRETE BASE

PLAN



SECTION

TREE GRATE STEEL ANGLE IRON FRAME DETAIL

NOTES:

1. PRUNE APPROVED TREE SPECIES FOR CLEARANCE AND FOR TREE HEALTH AS PER SECTION 14.
2. TREE GRATE INSTALLATION SHALL BE AS PER THE MANUFACTURERS SPECIFICATION.
3. ALL WORK AND MATERIALS ARE TO BE AS DESCRIBED IN THE CITY OF NANAIMO MANUAL OF ENGINEERING STANDARDS & SPECIFICATIONS LATEST EDITION OR AS OTHERWISE APPROVED BY THE CITY ENGINEER.
4. REQUIRED VOLUME OF GROWING MEDIUM IS $10m^3$, TO A DEPTH OF 800mm FOR EACH TREE.
5. FINAL TREE LOCATIONS MAY BE VARIED IF CERTIFIED BY A LANDSCAPE ARCHITECT AND THE CITY OF NANAIMO.
6. IF POOR DRAINAGE CONDITIONS EXIST, PROVIDE POSITIVE SUB-SURFACE DRAINAGE AWAY FROM PLANTING EXCAVATION.
7. IRRIGATION REQUIRED TO CITY OF NANAIMO STANDARDS WHERE REQUIRED BY CITY ENGINEER.
8. SEE DRAWING P-2 FOR REQUIRED DETAILS AND WORKS.

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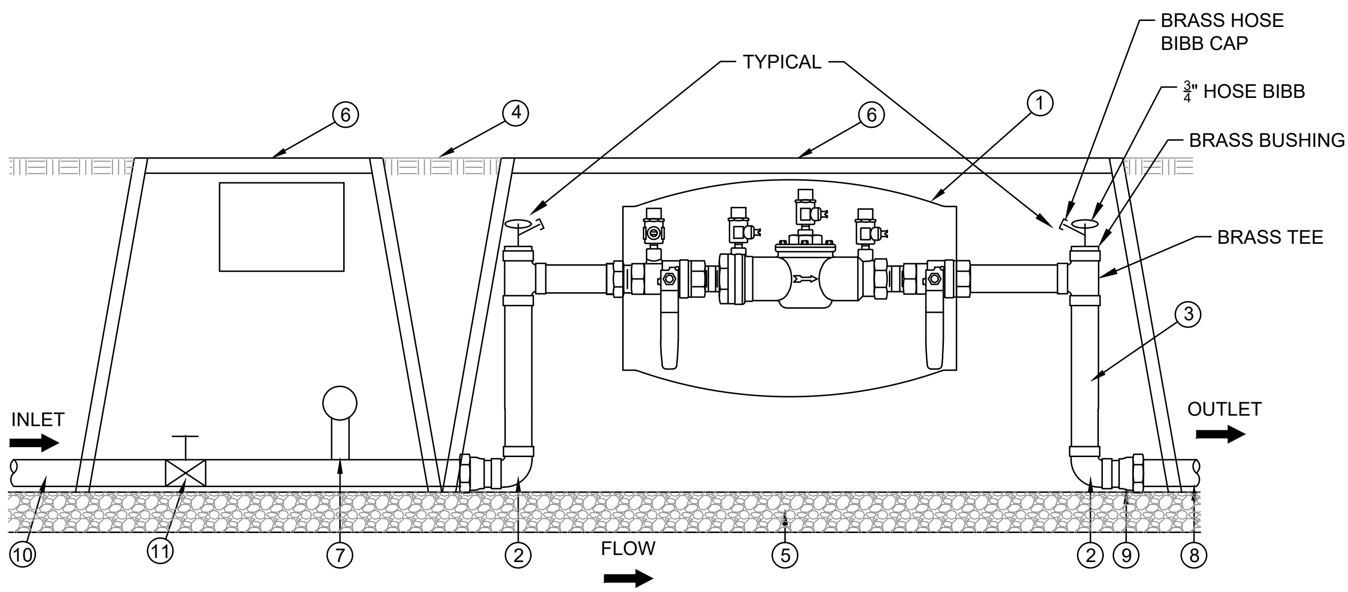
3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

TREE PLANTING IN UNIT PAVING SURFACE

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	P-7

1. DOUBLE CHECK VALVE ASSEMBLY (DCVA) BACK FLOW PREVENTER
2. BRASS 90° ELL (1 OF 2)
3. BRASS NIPPLE
4. FINISH GRADE
5. 50mm DEPTH 19mm MINUS GRAVEL
6. VALVE BOX C/W BOLTED LID
7. LIQUID FILLED PRESSURE GUAGE
8. 19mm - 50mmØ SCHEDULE 40 PVC IRRIGATION MAIN (¾"-2"Ø)
9. SCHEDULE 40 PVC MALE ADAPTER
10. TYPE K ANNEALED COPPER PIPE OR CLASS 200 POLYETHYLENE TUBING FROM CITY OF NANAIMO WATER METER AS PER SECTION 5.30
11. BRONZE GATE VALVE



NOTES:

1. SUPPLY CONNECTION FROM MAIN TO WATER METER TO CITY OF NANAIMO ENGINEERING STANDARDS AND SPECIFICATIONS BY CITY FORCES AT OWNERS EXPENSE.
2. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED ON THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
3. AS PER SECTION 5 WATER SYSTEM CROSS CONNECTION CONTROL.
4. DCVA FOR SYSTEMS WITHOUT INJECTION OF CHEMICALS. IF CHEMICALS ARE USED A RP ASSEMBLY SHALL BE REQUIRED.
5. SUBJECT TO APPROVAL BY THE CITY ENGINEER, AN ASSE 1060 CLASS 2 FROST PROTECTION ENCLOSURE MAY BE USED.

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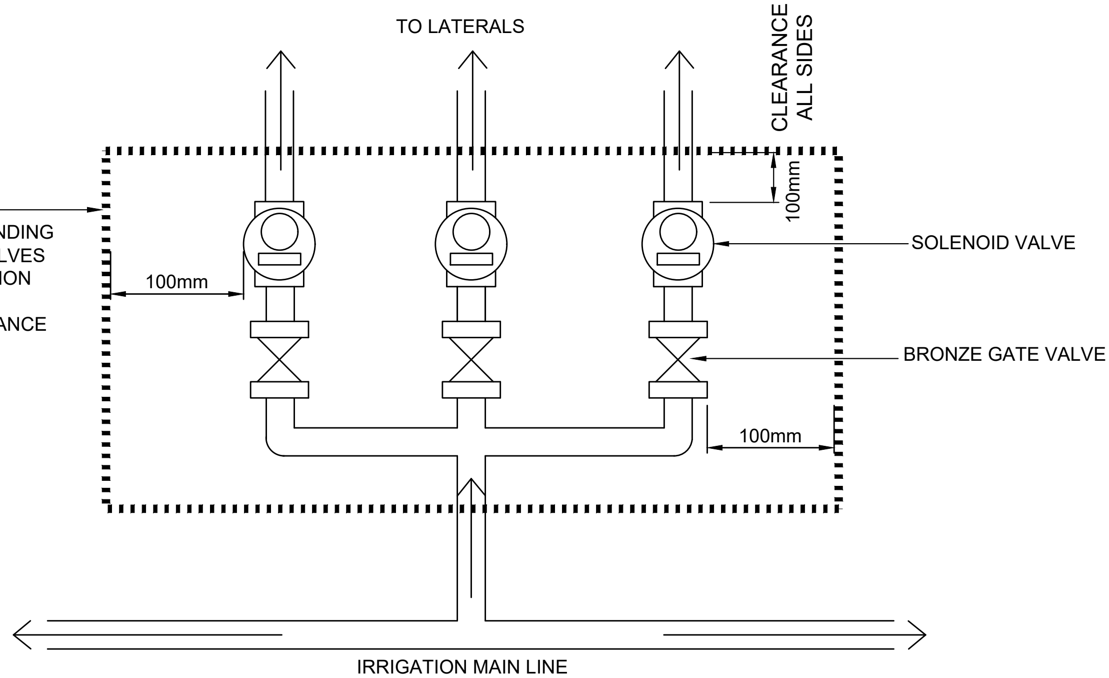
3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

19MM TO 50MM DIAMETER SERVICE
IRRIGATION BACKFLOW PREVENTER
AND POINT OF CONNECTION

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	I-1



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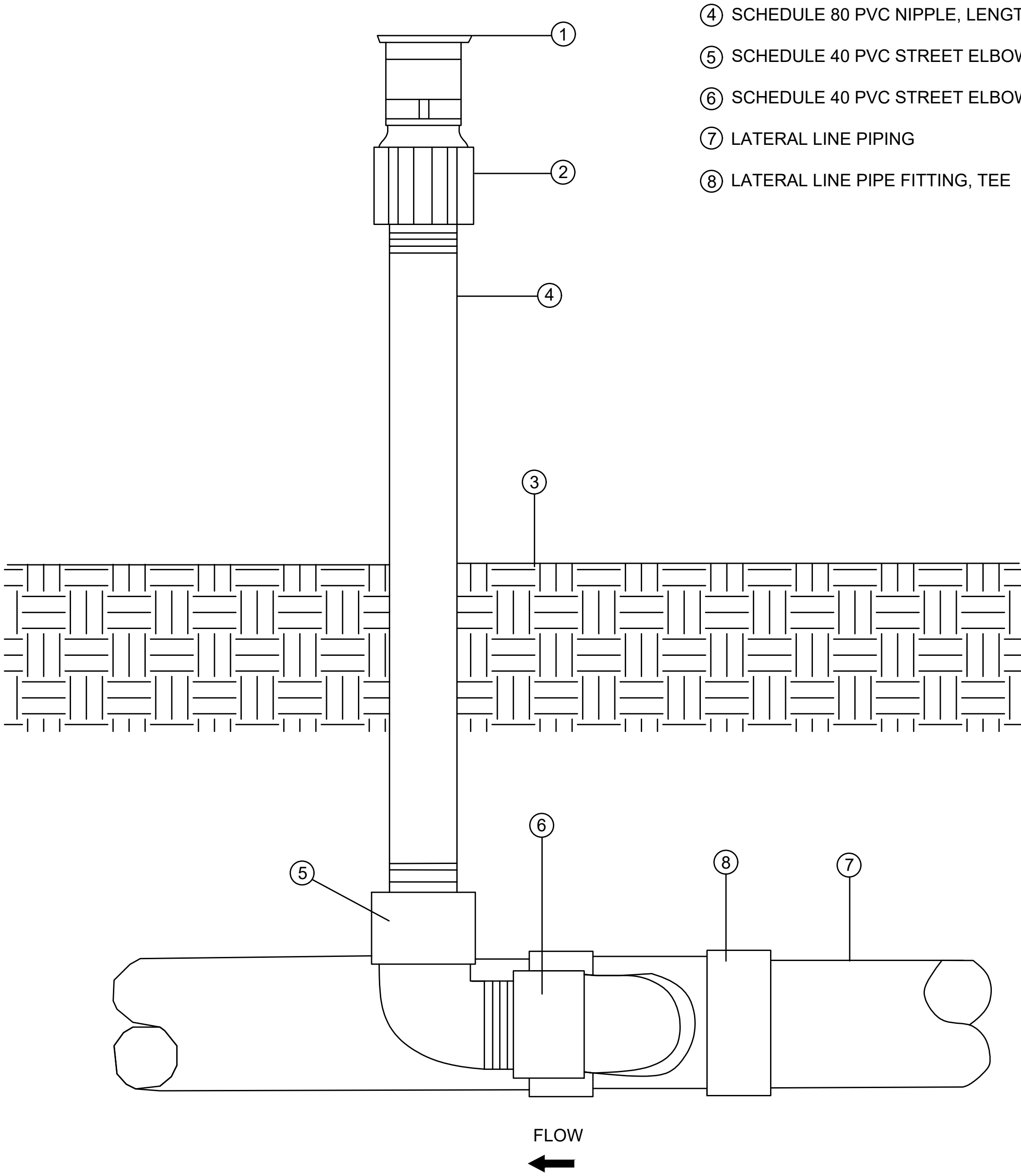
3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

VALVE BOX SCHEMATIC
PIPING CONFIGURATION
AT VALVE CLUSTER

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	I-3



1. SPRAY NOZZLE
2. SHRUB ADAPTER
3. FINISH GRADE
4. SCHEDULE 80 PVC NIPPLE, LENGTH TO SUIT, 300mm.
5. SCHEDULE 40 PVC STREET ELBOW
6. SCHEDULE 40 PVC STREET ELBOW
7. LATERAL LINE PIPING
8. LATERAL LINE PIPE FITTING, TEE

NOTES:

1. THREAD SEAL TAPE (PTFE TAPE) ALL THREADED JOINTS.
2. FOR DESIGN CRITERIA, SPECIFICATION AND INSTALLATION REFER TO SECTION 14.0 WRITTEN SPECIFICATIONS.
3. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED ON THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.

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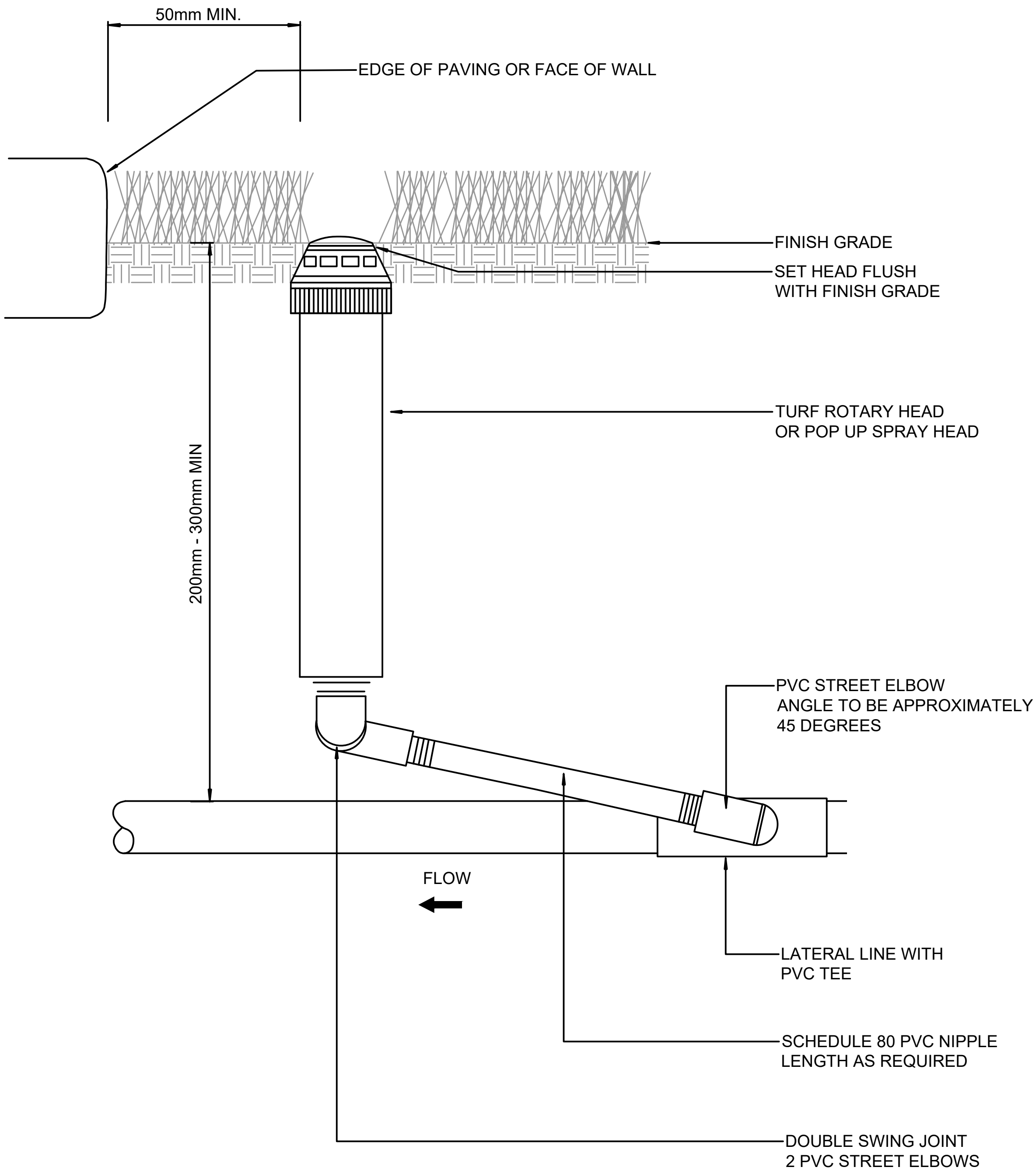
3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

SHRUB RISER
SPRAY HEAD

Scale:	NTS
Created:	MAY 2013
Rev Date:	NOV 2016
Dwg No:	I-4



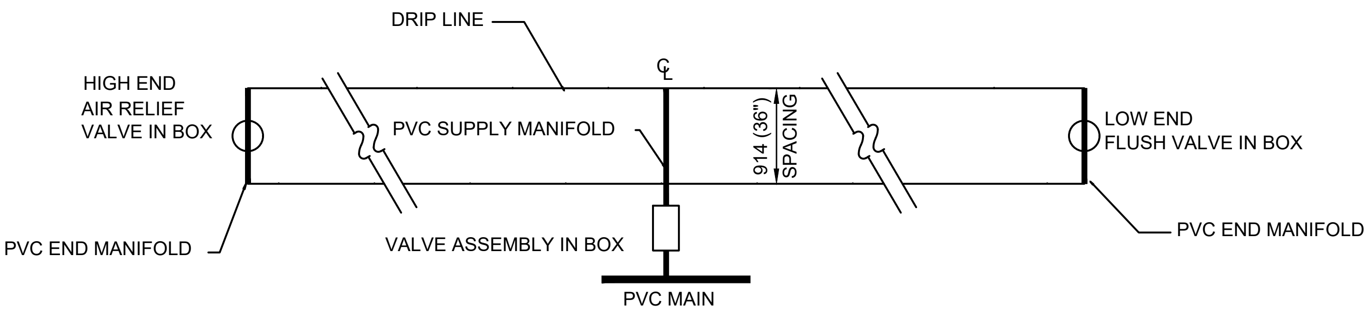
NOTES:

1. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED ON THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
2. FOR DESIGN CRITERIA SPECIFICATIONS AND INSTALLATIONS REFER TO SECTION 14.0 WRITTEN SPECIFICATIONS.

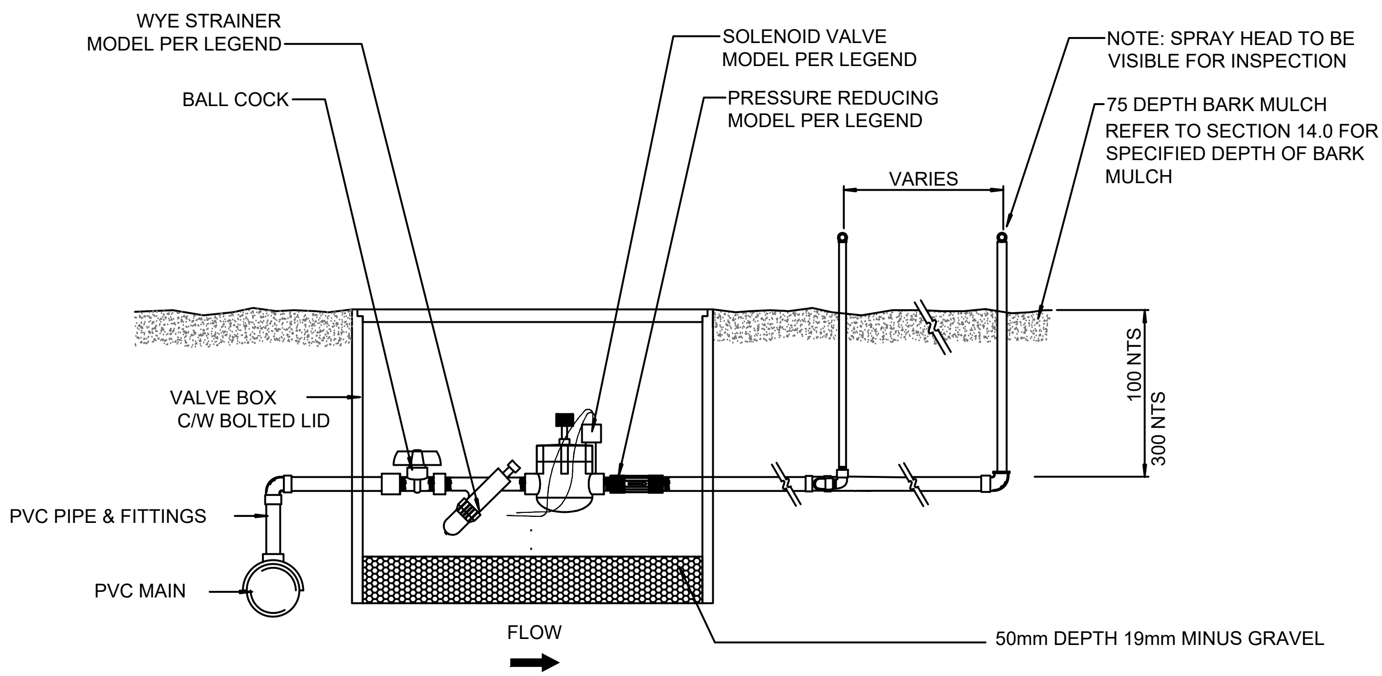
CITY OF NANAIMO
THE HARBOUR CITY

POPUP SPRAY HEAD
TURF ROTARY HEAD

Scale:	N.T.S.
Created:	SEPT 2012
Rev Date:	MAY 2020
Dwg No:	I-5



DRIP CIRCUIT SCHEMATIC LAYOUT



TYPICAL DRIP VALVE ASSEMBLY AND MANIFOLD

NOTES:

1. FOR DESIGN CRITERIA, SPECIFICATIONS AND INSTALLATIONS REFER TO SECTION 14.0 WRITTEN SPECIFICATIONS.

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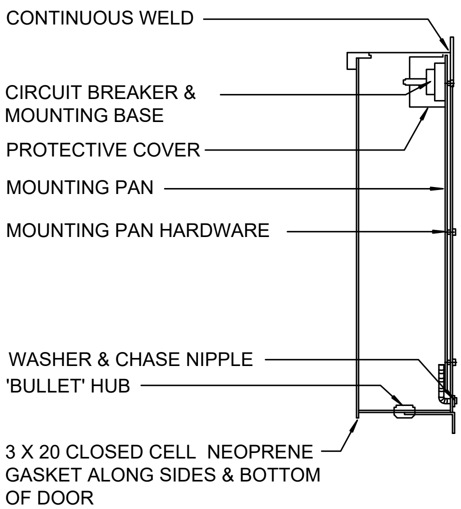
3.3.2020

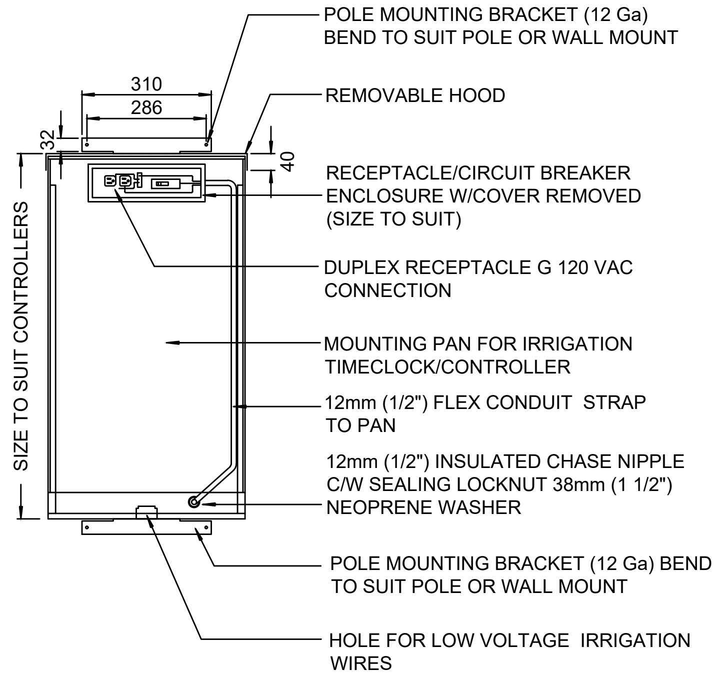
CITY OF NANAIMO
THE HARBOUR CITY

IN-LINE DRIP ASSEMBLY AND LAYOUT

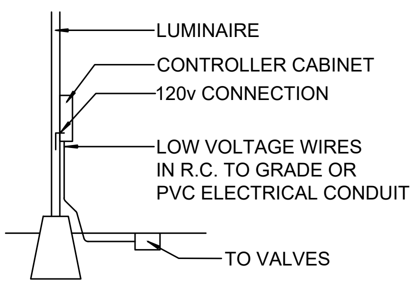
Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2013
Dwg No:	I-6



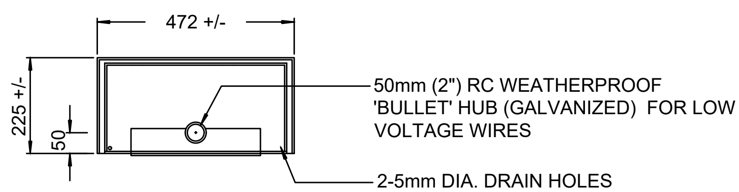
CROSS SECTION



FRONT VIEW WITH DOOR REMOVED



MOUNTING DETAIL



BOTTOM VIEW

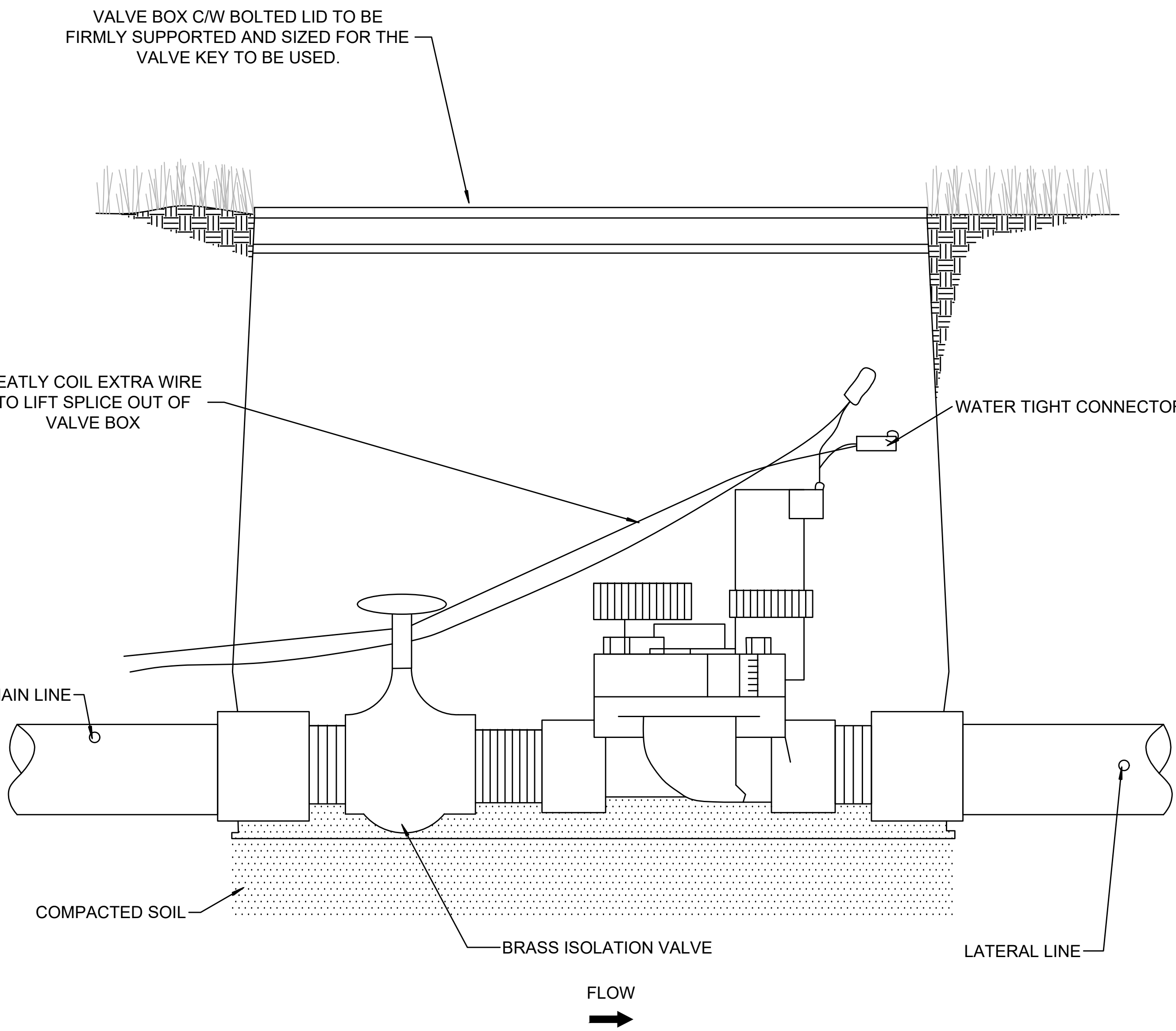
NOTES:

1. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED ON THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
2. ENTIRE ENCLOSURE TO BE 16 GAUGE MILD STEEL OR ALUMINUM WITH THE EXCEPTION OF THE RECEPTACLE ENCLOSURE & MOUNTING PAN WHICH SHALL BE 14 GAUGE. STEEL FINISHED WITH GREY ENAMEL, ALUMINUM CLEAR ANODIZED. ALL SEAMS SHALL BE CONTINUOUSLY WELDED.
3. THE ENCLOSURE SHALL BE MANUFACTURED TO CONFORM TO C.S.A. ENCLOSURE 3 SPECIFICATIONS & SHALL BEAR APPROVAL FROM THE PROVINCIAL SAFETY BRANCH INSPECTOR.
4. ALL HARDWARE (SCREWS, NUTS, ETC.) SHALL BE STAINLESS STEEL.
5. DOOR TO BE FULLY GASKETTED & WITH PADLOCKING FACILITY.
6. THE PANEL SHALL BEAR THE MANUFACTURER & THE PROVINCIAL APPROVAL LABELS INSIDE THE PANEL.
7. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN.

CITY OF NANAIMO
THE HARBOUR CITY

IRRIGATION CONTROLLER CABINET DETAILS

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	I-7



NOTES:

1. VALVE BOX TO BE INSTALLED FLUSH WITH FINISHED GRADE, AND IN A SHRUB AREA WHERE POSSIBLE.
2. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.

G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 14 DWGS\I-9

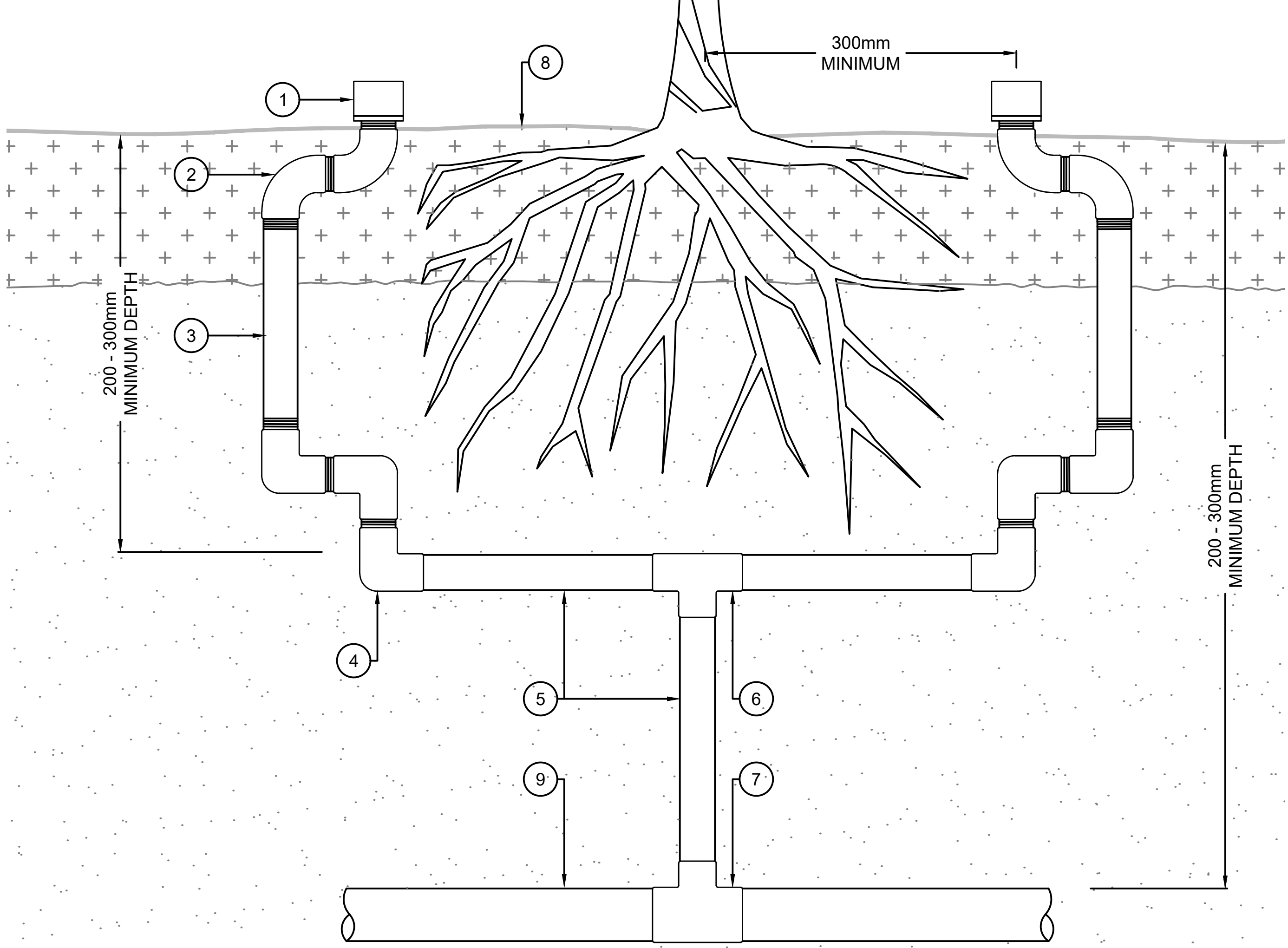
3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

ELECTRIC VALVE DETAIL

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2013
Dwg No:	I-9

1. 1.89 LPM (.5 GPM) BUBBLER
2. 50mm (½") PVC STREET 90° ELBOW
3. 50mm (½") PVC SCH 80 NIPPLE
4. 50mm (½") SLIP X FEMALE PVC 90° BEND
5. 50mm (½") PVC SCH 40 PIPE
6. 50mm (½") SLIP X SLIP PVC TEE
7. PVC TEE, REDUCED TO 50mm (½")
8. FINISHED GRADE
9. PVC LATERAL PIPE



IRRIGATION BUBBLER SECTION

SCALE: 1:10

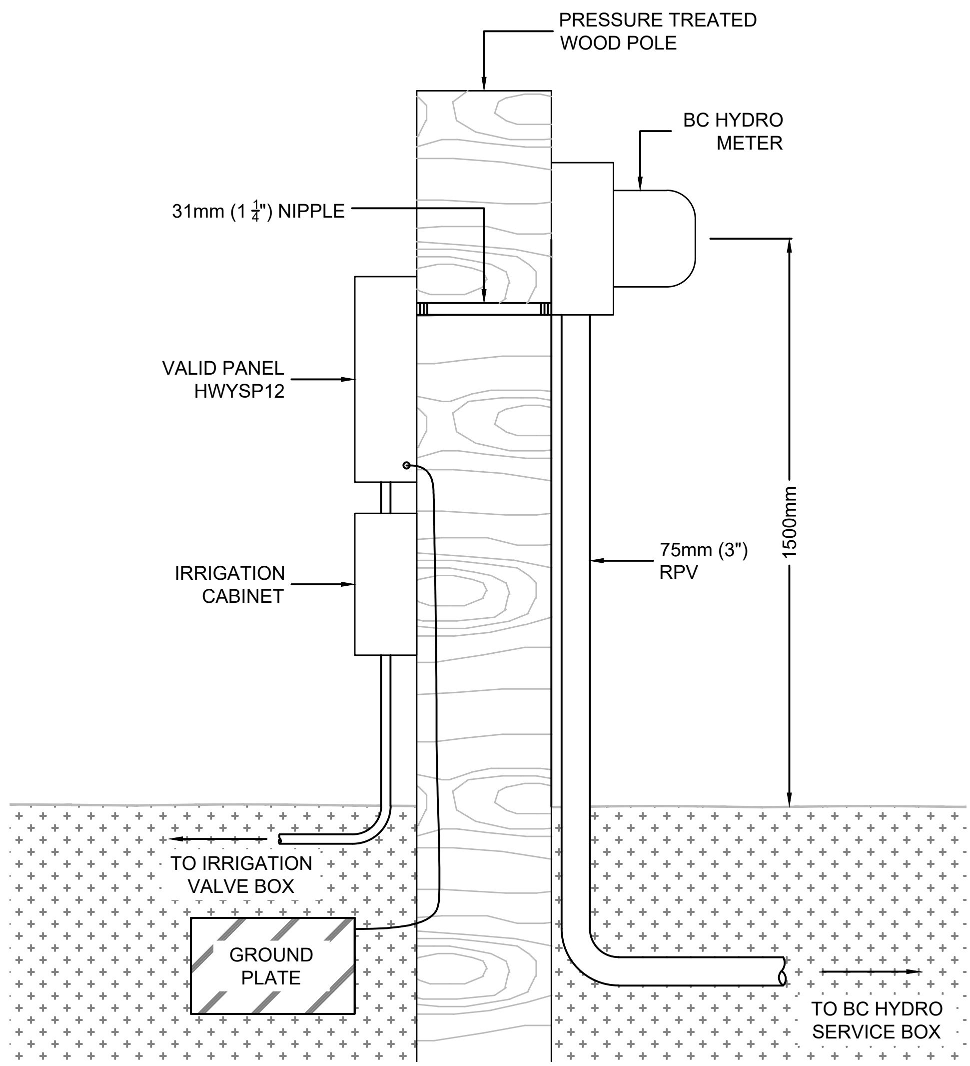
NOTES:

1. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER WILL BE APPROVED FOR INSTALLATION.

CITY OF NANAIMO
THE HARBOUR CITY

IRRIGATION BUBBLER

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	I-10



SECTION

SCALE: 1:20

NOTES:

1. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED ON THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
2. INSTALLATION SHALL BE DONE FOR DESIGNATED PARK LAND.

G:\INFRASTRUCTURE PLANNING\STANDARDS & PRODUCTS\MOESS\EDITION NO13 MAY 2020\2019-09-15 REDLINE INCORPORATION - WORKING\2020 DRAWING SECTIONS\FINAL DRAFT\SECTION 14 DWGS\I-11

3.3.2020

CITY OF NANAIMO
THE HARBOUR CITY

IRRIGATION UNDERGROUND
ELECTRICAL SERVICE WITH POLE

Scale:	NTS
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	I-11

APPENDICES

CONTENTS

(REVISED MAY 2020)

Revision Request Summary Sheet **APPENDIX A**
for the Manual of Engineering Standards and Specifications

Revision Request No.: ____________________
(filed by Engineering Services Technologist)

Date: ____________________

To: Engineering Services Technologist – City of Nanaimo

From: ____________________ **Department**: **(or company name)** ____________________

Phone No.: ____________________

Section Number / Drawing Reference: ____________________

Change Requested: ____________________

____

____

____

____

Reason for Change: ____________________

____

____

____

____

Signature: ____________________ **Date:** ____________________

Action:
(Eng Ser Tech) ____________________ **Date:** ____________________

APPENDIX C

CONDITION SHEET

REFERENCE: ________________ DATE:__________________________

NAME:____

ADDRESS:____

The undersigned agrees to grant access to the property as mentioned herein for the purpose of a ____, subject to the following conditions for restoration.

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

CITY OF NANAIMO
455 Wallace Street, Nanaimo, B.C., V9R 5J6

EASEMENT RELEASE AND INSPECTION FOLLOWING INSTALLATION OF UTILITY

Contractor:______________________________ Contract No.:________________________

Owner's Name:______________________________ Easement Reference No.:__________________

Mailing Address:____

____

Location:____

____

Legal Description:____

____

Manhole No.:____________________ to Manhole No.:______________________________

Clean-up of easement is satisfactory and meets the requirements as set out in the easement condition form.

Date:_______________ Property Owner:____

Clean-up of easement is NOT satisfactory until the following work has been carried out:________

____

____

____

____

Date:_______________Property Owner:____

Contractor's Agent:____

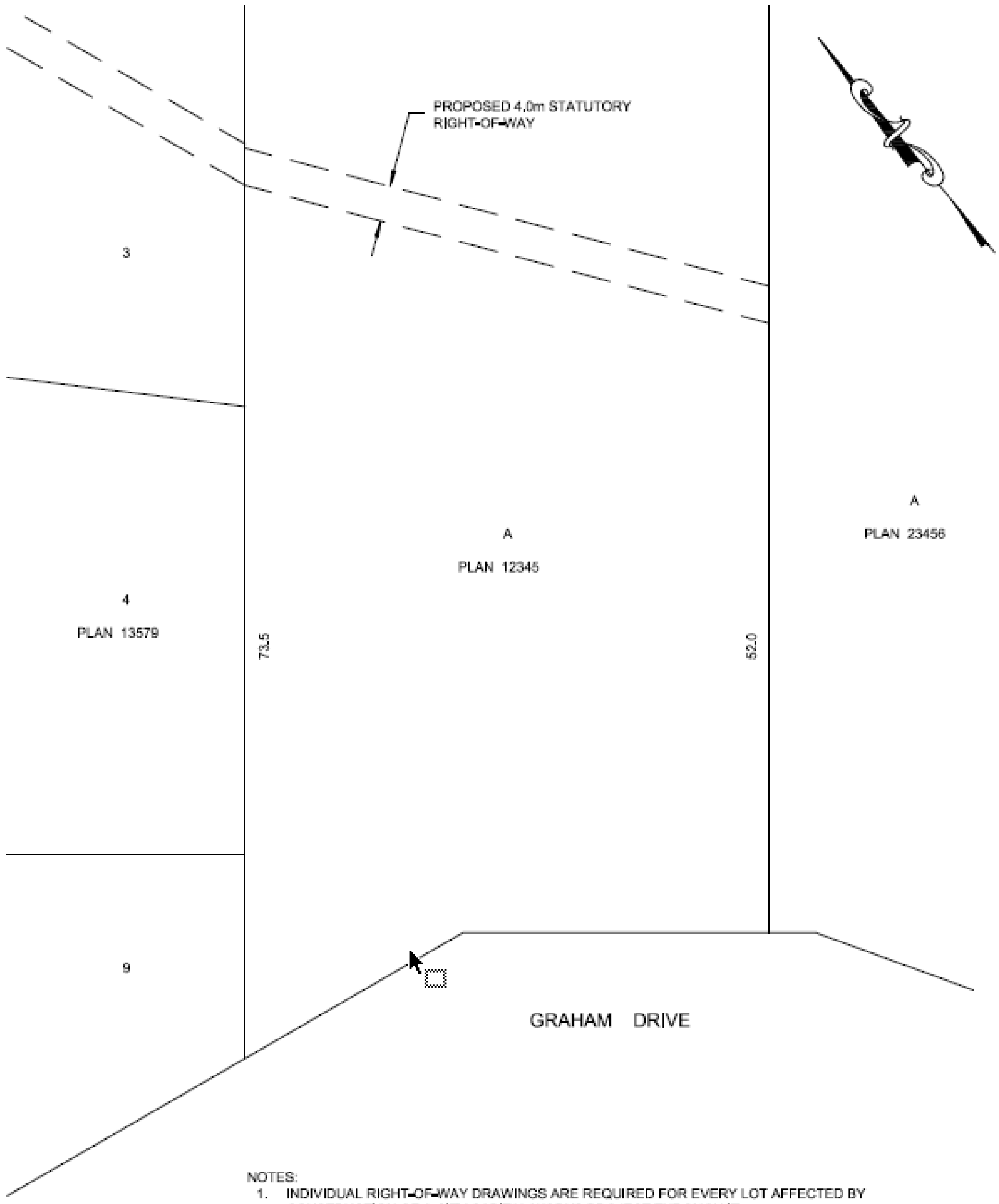
==

Consulting Engineers' Approval and Recommendation:_______________________________

____

____
Consulting Engineer

APPENDIX C



NOTES:
1. INDIVIDUAL RIGHT-OF-WAY DRAWINGS ARE REQUIRED FOR EVERY LOT AFFECTED BY CONSTRUCTION OF A CITY CAPITAL WORKS PROJECT THROUGH IT.
2. THE SKETCH IS AN ATTACHMENT REQUIRED WITH EVERY PERMISSION TO ENTER FORM, AND CONDITION SHEET SIGNED BY THE PROPERTY OWNER.
3. FOR BLANKET WORKING ACCESS AGREEMENTS, REFER TO APPENDIX D, CLAUSE 4.

SAMPLE SKETCH

CITY OF NANAIMO
THE HARBOUR CITY

PROPOSED RIGHT OF WAY

Scale:	N.T.S.
Created:	MAY 2013
Rev Date:	MAY 2020
Dwg No:	RW-2

MINIMUM REQUIRED STATUTORY RIGHT-OF-WAY AND TEMPORARY WORKING EASEMENT WIDTHS FOR UNDERGROUND SERVICES THROUGH PRIVATE PROPERTY

1. Where location of a municipal utility in a statutory right-of-way is permitted by the *City Engineer*, the right-of-way widths shall be as follows:

(a)	Single utility.	R.O.W. width =	Twice the depth from surface to the crown of the pipe rounded up to nearest half meter [4.0 m minimum width]
(b)	Two utilities within the same trench.	R.O.W. width =	Twice the depth from surface to the crown of the deeper pipe rounded up to the nearest half meter [5.0 m minimum width]
(c)	Two or more utilities adjacent to one another but in separate trenches.	R.O.W. width =	Cumulative widths for single services PLUS any difference to provide the required separation rounded up to nearest half meter [6 m minimum width]
(d)	The maximum depth shall be used to determine the R.O.W. width and the width shall be consistent throughout the length of the R.O.W.		
(e)	For pipes 900 mm or larger, add an additional 2.0 m to R.O.W. width.		
(f)	When the utility is within a Road allowance and the distance from the property line to the centre of the utility is less than half of the width indicated above for a single utility, the difference shall be provided as right-of-way on the adjacent property.		
(g)	Modified right-of-ways will be considered where supported by design and/or supplemental report(s).		

2. Rear and side yard utility right-of-ways are acceptable if appropriate access is provided to the utilities for maintenance and replacement by conventional open cut method.

3. In all cases, the width of rights-of-way shall be sufficient to permit an open excavation with side slopes and access for construction equipment in accordance with the WorkSafeBC regulations, without impacting on or endangering adjacent structures. The *Consultant* shall provide cross sections indicating the minimum safe distances to adjacent building footings based on a safe angle of repose from the limits of the excavation.

4. Blanket access agreements are required on private property for the purpose of moving construction equipment and materials onto the utility right-of-way.

5. Right-of-way locations shall be selected to avoid environmentally sensitive areas such as watercourses and wetlands.

SUBSTANTIAL COMPLETION STATISTICS RECORD
ASSETS FOR (FROM) DEVELOPMENT

DATE OF SUBMISSION: ____________________

FILE NO: ____________________

ASBUILT NO.: ____________________

ENG. CO: ____________________

LOCATION: ____________________

DATE OF CERTIFICATION: ____________________
(Same date as G2 Certification of Installed Works)

WATER ASSETS

ITEM	TYPE	DR	UNIT	QUANTITY	COST PER UNIT ($)	VALUE ($)
PIPE			L.M.			
FIRE HYDRANT			EACH			
FLUSHOUT			EACH			
PRESSURE REDUCING VALVE			EACH			
METER			EACH			
FITTINGS			EACH			
					WATER ASSETS TOTAL	

SANITARY SEWER ASSETS

ITEM	TYPE	DR	UNIT	QUANTITY	COST PER UNIT ($)	VALUE ($)
PIPE			L.M.			
MANHOLE			EACH			
TEMPORARY CLEANOUT			EACH			
DROP MANHOLE			EACH			
					SANITARY SEWER ASSETS TOTAL	

STORM SEWER ASSETS

ITEM	TYPE	DR	UNIT	QUANTITY	COST PER UNIT ($)	VALUE ($)
PIPE			L.M.			
MANHOLE			EACH			
TEMPORARY CLEANOUT			EACH			
CATCH BASIN			EACH			
STORM DETENTION			EACH			
					STORM SEWER ASSETS TOTAL	

TRANSPORTATION ASSETS

ITEM	UNIT	QUANTITY	COST PER UNIT ($)	VALUE ($)
50 mm Asphalt Road/Lane	L.M.			
75mm Asphalt Road	L.M.			
Asphalt Widening & Patching	S.M.			
Mountable Curb and Gutter	L.M.			
Non-mountable Curb or Curb and Gutter	L.M.			
Roundabouts	EACH			
Medians	EACH			
Traffic Calming – Circle	EACH			
Traffic Calming – Curb Extension	EACH			
Traffic Calming – Speed Hump	EACH			
Pedestrian Crossings	EACH			
Pedestrian Islands	EACH			
Pedestrian Sidewalk - Concrete	L.M.			
Pedestrian Sidewalk - Asphalt	L.M.			
Pedestrian 1.8m Wide Sidewalk - Asphalt	L.M.			
Walkway - Asphalt	L.M.			
Trail*	L.M.			
Trail*	L.M.			
Transit – Bus Shelters	EACH			
Transit – Pads	EACH			
Cycling Marked Bike Lane – Same as Road	L.M.			
Cycling Buffered Lane – Concrete Separator	L.M.			
Cycle Track Bike Lane	L.M.			
Streetlights**	EACH			
Traffic Signal	EACH			
			TRANSPORTATION ASSETS TOTAL	

Note the width of the trail and the material type.
*****The cost per unit for streetlights or traffic signal includes supply of all materials and installation of electrical service equipment, concrete pole base, conduit, wiring, pole and lamp for each streetlight or traffic signal.***
(REVISED MAY 2020)

LANDSCAPING & IRRIGATION ASSETS

ITEM	UNIT	QUANTITY	COST PER UNIT ($)	VALUE ($)
Street Trees	EACH			
∅Irrigation Piping	L.M.			
Irrigation Controller	EACH			
Top Soil	S.M.			
Sod/Seeding	S.M.			
Rock/Block Wall	L.M.			
Bio Swale	L.M.			
		LANDSCAPING AND IRRIGATION ASSETS TOTAL		

STATISTIC SUMMARY

DATE OF SUBMISSION: ______________________________

FILE NO: ______________________________

ASBUILT NO.: ______________________________

ENG. CO: ______________________________

LOCATION: ______________________________

DATE OF CERTIFICATION: ______________________________
(Same date as G2 Certification of Installed Works)

ITEM	UNITS	QUANTITY	TOTAL VALUE ($)
WATERMAINS	L.M.		
SANITARY SEWERS	L.M.		
STORM SEWERS	L.M.		
STORM DETENTION	EACH		
ROADS/LANES	L.M.		
SIDEWALKS	L.M.		
WALKWAYS/TRAILWAYS	L.M.		
BIKE LANES	L.M.		
CURB AND GUTTER	L.M.		
FIRE HYDRANTS	EACH		
STREETLIGHTS	EACH		
LANDSCAPING/IRRIGATION	L.S.		
TRANSIT FACILITY	EACH		
		GRAND TOTAL VALUE OF ALL ASSETS	

CITY OF NANAIMO SERVICE SHEET

APPENDIX F1

SINGLE FAMILY RESIDENTIAL LOT

HOUSE NO:	STREET NAME:	
PLAN NO:	LOT NO:	FILE NO:

SHOW: 1) LOT. 2) STREET R/W NAME. 3) RIGHT OF WAYS IF ANY. 4) NORTH ARROW. 5) LOCATION OF ALL UTILITIES – IDENTIFIED & DIMENSIONED.

NOTE: "FROM LPL" = FROM LEFT PROPERTY LINE & "FROM RPL" = FROM RIGHT PROPERTY LINE

VACANT LOT		DEVELOPED LOT		CAPITAL PROJECT		L.I.P.		D.C.C.	

LOCATION	CONNECTED		SIZE / MATERIAL
	YES	NO	
WATER:			
FIRE LINE:			
SANITARY SEWER:			
			INVERT EL.
STORM SEWER:			
			INVERT EL.

MINIMUM BASEMENT ELEVATION:
CERTIFIED ACCURATE BY:

COMMENTS:

SEAL / ENGINEER'S STAMP

CITY OF NANAIMO SERVICE SHEET
FOR ALL LOTS EXCLUDING SINGLE FAMILY

HOUSE NO:	STREET:		CARD NO:
PLAN NO:	LOT NO:	PERMIT NO:	FILE NO:

B.P.L.

L.P.L.

R.P.L.

F.P.L.

SHOW THE FOLLOWING:
1) LOT 2) STREET NAME 3) R.O.W.(S) IF ANY 4)NORTH ARROW
5) LOCATION OF ALL UTILITIES (DIMENSIONED FROM CIVIC ADDRESS)

☐ NEW INSTALL
☐ CHANGE/UPDATE
☐ METER REMOVAL
☐ SERVICE CONNECTION
☐ SERVICE DISCONNECT
☐ METER REPLACEMENT

COMMENTS:

NOTE: "FROM LPL" = FROM LEFT PROPERTY LINE; "FROM R.P.L." = FROM RIGHT PROPERTY LINE;
"FROM FPL" = FROM FRONT PROPERTY LINE; "FROM B.P.L." = FROM BACK PROPERTY LINE;

☐VACANT LOT ☐DEVELOPED LOT ☐CAPITAL PROJECT ☐LOCAL IMPROVEMENT PROJECT ☐D.C.C.

SERVICE		LOCATION	NEW	EXIST	CONNECTED YES	CONNECTED NO	SIZE (mm)	MATERIAL
WATER	DOMESTIC		☐	☐	☐	☐		
WATER	FIRE LINE		☐	☐	☐	☐		
WATER	COMBINATION		☐	☐	☐	☐		
SANITARY			☐	☐	☐	☐		
SANITARY		M.B.F.E.:	INVERT ELEVATION:					
STORM			☐	☐	☐	☐		
STORM		M.B.F.E.:	INVERT ELEVATION:					

M.B.F.E. = Minimum Basement Floor Elevation NOTE: Inverts to Geodedic Datum

METERS		
NEW	REGISTER NO.	
NEW	READING	
OLD	REGISTER NO.	
OLD	READING	

COMPLETED BY: ____________________

DATE: ____________________

PLACE METER STICKER/STAMP IN BOX

SEAL / ENGINEER'S STAMP

TO: Finance Department
City of Nanaimo
411 Dunsmuir Street
Nanaimo, BC V9R 5E4

Building Permit or File #____________________________

Civic Address ___________________________________

BUILDING DEVELOPMENT WATER METER INFORMATION SHEET

TO BE USED ON BUILDING DEVELOPMENTS WHERE THE DETECTOR CHECK/METER CHAMBER IS DEVELOPER INSTALLED. COMPLETE FORM FOR EACH METER.

TO BE SUBMITTED UPON INSTALLATION OF WATER METER/DETECTOR CHECK.

1. Type of Water Meter: ❑ Domestic Meter ❑ Detector Check ❑ Combination Meter

2.(a) Date of Installation of Water Meter: ____

(b) Date of Installation of Detector Check, if applicable: ______________________________

OR:

(c) Date of Installation of Combination Meter, if applicable: ___________________________

3. Make and Model of meter installed:

Domestic ______________ Register No. ______________

Detector Check ________ Register No. ______________

Combination __________ Register No. ______________

4. Size of meter installed: Domestic: ___________

Detector Check: ___________

Combination: ______________

5. Meter reading at date of installation: Domestic: _________________

Detector Check: _____________

Combination: _______________

6. Reading type: Metric ___________

7. Does reading contain decimal places: Yes _______ No _________

8. If reading contains decimal places, how many decimal places are there? __________

9. Location of meter/service: ____

(must be stated on this sheet)

________________________________ P.Eng.

____
(Please Print Name)

____
(Company Name

____
(Address)

cc: Manager, Utilities, Public Works
Manager, Revenue Services, Finance

(REVISED MAY 2020)

CERTIFICATION OF DESIGN

I, ____, a Professional Engineer registered in the Province of British Columbia, hereby certify that the works, as herein set out on the attached drawings entitled

____

____

____

have been designed in accordance with the City of Nanaimo's Engineering Standards and Specifications, and in accordance with good engineering practice where such design is not covered by the City's Engineering Standards and Specifications.

____

I have been retained to provide design, supervision, inspection, as-built drawings, and final certification for this project by:____

(Name of Client)

Phone:____________________________ Fax:____________________________________

Address:____

____

I am satisfied that in the contractual mandate which exists between myself and my client, the terms of reference will permit me to render a level of supervision of the construction work which will allow me to put my name and seal to the "Certification of Works" required by the City of Nanaimo, a sample copy of which is attached to this document and initialed by me.

In the event that my client releases me from this project, or in the event that I find the terms of reference do not permit me to render a level of supervision of the construction work which will allow me to put my name and seal to the form of certification required by the City of Nanaimo, I will notify the City of Nanaimo within twenty-four (24) hours verbally and follow it up with written confirmation and clarification.

Signed this _______________ day of _____________ 20 ________.

____ P. Eng.

(Signature)

I understand that the "CERTIFICATION OF WORKS" is to be completed in this format and submitted with the "AS-BUILT" drawings. ____

Engineer

SEAL / ENGINEER'S STAMP

____

Engineer (Signature)

____

Engineering Firm

Effective January 1995

CERTIFICATION OF INSTALLED WORKS

NOTE: To be completed in this format and submitted with the "As-Built" drawings

Location of the Construction Site and Works: (Legal Description)

____

____

all within the City of Nanaimo, British Columbia.

I, ______________________________________, a Registered Professional Engineer (Reg. No. ___________) in the Province of British Columbia, hereby certify:

1. THAT the following construction tests were carried out to confirm that construction met the specifications required:

   (a) ____

   (b) ____

   etc.

2. THAT I was able to monitor the construction and provide a level of supervision of the construction work sufficient to be able to confirm that: specifications in force and effect by the City of Nanaimo and in the applicable design drawings for the said Works were generally met during the Construction Period and that all materials incorporated into the Works that are regulated by the City's Approved Product List are materials noted at the time of installation, and

3. THAT the accompanying plans labeled:

   (i) ____

   (ii) ____

   (iii) ____

   accurately record the materials, grades, inverts, offsets and dimensions of the constructed work.

DATED this ____________________ day of ___________________ 20 _____.
(DATE OF CERTIFICATION)

SEAL / ENGINEER'S STAMP

____
Engineer (Signature)

____
Engineering Firm

Effective January 1995

CERTIFICATION OF STREET LIGHT INSTALLATION

Location of the Construction site and Works (Legal Description)

____

____

all within the City of Nanaimo, British Columbia.

I, ___________________________, a Registered Professional Engineer (Reg. No. ___________), in the Province of British Columbia, hereby certify that:

1. I have received the final electrical inspection request and declaration for the street lighting installation from the electrical Field Safety Representative (copy attached).

2. All of the street lighting system is installed in accordance with all the specifications in force and effect by the Provincial Government and the City of Nanaimo as shown on the drawings and specifications authorized by me and submitted to the City of Nanaimo, Engineering Division. The system has been energized and tested. The system is in working order and will be ready for use once it is connected to the B.C. Hydro and Power Authority's system.

3. The accompanying plans labeled:

____

____

____

____

are certified "as-builts" and truly record the construction of all the street lighting required for the subject project.

DATED this ___________ day of _____________________ 20 _____.

SEAL / ENGINEER'S STAMP

____
Engineer (Signature)

____
Engineering Firm

APPENDIX G4

CERTIFICATION OF LANDSCAPE INSTALLATION
NOTE: To be completed in this format and submitted with the "As-Built" drawings

Location of the Construction Site and Works: (Legal Description)

____

____

____

____

all within the City of Nanaimo, British Columbia.

I, ____________________________________, a Landscape Architect, and member in good standing of British Columbia Society of Landscape Architects, hereby certify

1. THAT the following construction tests were carried out to confirm that construction met the specifications required:

1. THAT I was able to monitor the construction and provide a level of supervision of the construction work sufficient to be able to confirm that the specifications in force and effect by the City of Nanaimo and in the applicable design drawings for the said Works were generally met during the Construction Period and

2. THAT the accompanying plans labeled:

(i) ____

(ii) ____

(iii) ____

accurately record the materials, species, as-built locations, offsets and dimensions of the constructed work.

DATED this ____________________ day of _____________________________ 20________.

SEAL / LANDSCAPE ARCHITECT STAMP

____
Landscape Architect (Signature)

____
Landscape Architecture Firm

Effective May 1998

CITY OF NANAIMO SANITARY SEWER FLOW ANALYSIS – CALCULATION SHEET

Project ______________________

ENGINEERING COMPANY ______________________

ADDRESS ______________________

ENGINEER ______________________

Seal/ Engineer's Stamp

Date: ______________________

Design By: ______________________

Sheet ________ **of** ________

Harmon Peaking Factor:
PF = 1 + 14/(4+P^1/2)

Mannings Formula:
V = (R^2/3 * S^½)/n
Q = V*A n = 0.013

										Sewage Flow		Infiltration & Inflow		Total Flow		Pipe Data			
Area No.	MH No. To MH No.	Location	Area (Hectares) A	Units or Lots	Density pp Ha	Equiv. Pop. (ca)	Cum. Equiv. Pop. (ca)	Average Flow (L/day)	Peakin g Factor	Peak Flow (L/day)	Peak Flow (ML/day)	Infilt. (ML/day)	Cum. Infilt (ML/day)	Total Flow (ML/day)	Flow (L/s) Q	Pipe Size (mm) D	Pipe Slope (m/m) S	Pipe Capacity (L/s)	Velocity (m/s) V

CITY OF NANAIMO STORMWATER MANAGEMENT FLOW ANALYSIS – CALCULATION SHEET

PROJECT: ____________________

ENGINEERING COMPANY: ____________________
ADDRESS: ____________________
ENGINEER: ____________________

Rational Formula: $Q = C \times I \times A \times 2.78$

SEAL / ENGINEER'S STAMP

Return Period: ___________ Years

Date: _________________

Design By: ____________

Sheet ______ of ______

Mannings Formula

$V = \frac{(R)^{2/3} \times (S)^{1/2}}{n}$

$Q = V \times A$ $n = 0.013$

MH To MH	Area (Ha) (A)	Coeff. (C)	Area x Coeff. (AC)	Accum. A x C	Time Of Concent (Mins)	Rainfall Intensity (mm/hr) (I)	Q (l/s)	Diam. (mm) (D)	Design Slope (%) (S)	Installed Slope (%)	Cap. (l/s)	Velocity (m/s) (V)	Length M.H. to M.H. (m)	Time of Flow-MH to MH (Mins)

CITY OF NANAIMO
FIRE FLOW CALCULATION SHEET
(Calculations based on "Guide for Determination of Fireflow"
prepared by Fire Underwriter's Survey)

1. Type (s) of Construction: ____________________

   Co-efficient (c) based on type of construction = ____________________

   Ground Floor Area: ____________ ft^2 No. of Stories: ____________

   Total Floor Area: ____________________ ft^2

   Fire Flow From Formula ($F = 14.8 \quad C \sqrt{A}$): ____________________ IGPM (a)

2. Type of Occupancy: ________ Hazard: Low ________ High ________ Other ________

   Hazard Allowance: Add or subtract: ____________ % x (a) = ____________ IGPM

   Sub Total: ____________________ IGPM (b)

3. Automatic Sprinklers: ____________ (yes/no)

   Sprinkler Allowance: Subtract (max. 50%): ____________ % X (b) = ____________ IGPM (c)

   Sub Total: ____________________ IGPM (d)

4. Exposures: Distance/Hazard
   1. Front ________ Add ________%
   2. Left ________ Add ________%
   3. Rear ________ Add ________%
   4. Right ________ Add ________%

   Exposure Allowance: Add: ____________ (e) % X (b) = ____________ IGPM (f)

TOTAL FIRE FLOW REQUIRED: ____________________ IGPM (g)
REQUIRED PRESSURE: ____________________ P.S.I.

SPRINKLER SYSTEM INFORMATION

(a) If building has automatic sprinklers:
Distance from sprinkler fire connections at building to nearest available fire hydrant on an unobstructed route ____________m

Will sprinkler systems be wet or dry: Wet _____ Dry _____

If wet, will system contain anti-freeze or any other chemical additive? Yes _____ No ______

Backflow protection: (describe) ____
____

(b) If building has no automatic sprinklers:
Distance from main building entrance to nearest available fire hydrant on an unobstructed route ____________m

SEAL / ENGINEER'S STAMP

Calculations by: ____________________ P. Eng.

Signature: ____________________

Date:____________________

CITY OF NANAIMO
THE HARBOUR CITY

Water Meter Sizing Calculation Sheet

For Non-Fire Service Meters

AWWA M22 Fixture Value Methodology

Page 1 of 2

General Information

Customer Name: ____________________ File No. ____________

Address / Legal Description: ____________________ Building Permit No. ____________

____

Occupancy Type: Industrial ☐ Commercial ☐ Institutional ☐

Multifamily ☐ Agricultural ☐ Other ☐ ____________

Is this a phased development? Yes ☐ No ☐

Calculations pertain to: Buildout ☐ Phase ☐ Phase No. ____________

Step 1: Calculate Total Domestic Fixture Value

Fixture	Fixture Value (GPM @ 60 psi)		No. of Fixtures		Fixture Value
Bathtub	8	x		=	
Bedpan Washers	10	x		=	
Bidet	2	x		=	
Dental Unit	2	x		=	
Dishwasher	2	x		=	
Drinking Fountain - Public	2	x		=	
Hose Bibs (c/w 50 ft wash down):					
- 1/2 inch	5	x		=	
- 5/8 inch	9	x		=	
- 3/4 inch	12	x		=	
Kitchen Sink	2.2	x		=	
Lavatory	1.5	x		=	
Showerhead (Shower Only)	2.5	x		=	
Service Sink	4	x		=	
Toilet:					
- Flush Valve	35	x		=	
- Tank Type	4	x		=	
Urinal:					
- Pedestal Flush Valve	35	x		=	
- Wall Flush Valve	16	x		=	
Wash Sink (Each Set of Faucets)	4	x		=	
Washing Machine	6	x		=	

For single family residential properties, the meter size shall be 19 mm, unless the Applicant can demonstrate the need for a larger meter.

CITY OF NANAIMO
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Water Meter Sizing Calculation Sheet

Page 2 of 2

Step 1 (cont.)

Fixture	Fixture Value (GPM @ 60 psi)		No. of Fixtures		Fixture Value	
Other:						
______	______	x	______	=	______	
______	______	x	______	=	______	
______	______	x	______	=	______	
			Total Domestic Fixture Value	=	______	**GPM (A)**

Step 2: Calculate Probable Peak Domestic Demand

Refer to AWWA Manual M22, Sizing Water Service Lines and Meters, Figure 4-2 or 4-3

Probable Peak Domestic Demand = ______ **GPM (B)**

Step 3: Apply Pressure Adjustment Factor

City Water System Pressure (not to exceed 80 psi) = ______ psi

Pressure Factor from *Table 4 = ______ (C)

Adjusted Peak Domestic Demand (B x C) = ______ **GPM (D)**

*AWWA Manual M22, Sizing Water Service Lines and Meters

Step 4: Identify Irrigation Demand

Total Irrigation Demand = ______ **GPM (E)**

For irrigation demands greater than 35 GPM, a detailed irrigation plan shall be provided with appropriately designed zones.

Step 5: Calculate Total Peak Demand

Total Peak Demand (D + E) = ______ **GPM (F)**

Step 6: Select Water Meter

Water Meter Make / Model: = ______

Water Meter Size * = ______ inches

Water Service Connection Size = ______ inches

* Total Peak Demand (F) not to exceed 80% of Meter Rated Peak Instantaneous Flow
* Pressure Loss at Total Peak Demand (F) not to exceed 5 psi

Professional Certification

Name: ______

Company: ______

Date: ______

Comments: ______

Seal

For single family residential properties, the meter size shall be 19 mm, unless the Applicant can demonstrate the need for a larger meter.

CITY OF NANAIMO
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Water Meter Sizing Calculation Sheet

For Non-Fire Service Meters

AWWA M22 Fixture Value Methodology

Example

Page 1 of 3

General Information

Customer Name:	Example	File No.	Example
Address / Legal Description:	Example	Building Permit No.	Example
	Example		

Occupancy Type: Industrial [ ] Commercial [ ] Institutional [ ] Multifamily [X] Agricultural [ ] Other [ ] ________

Is this a phased development? Yes [ ] No [X]

Calculations pertain to: Buildout [X] Phase [ ] Phase No. ________

This meter sizing calculation is based on the AWWA M22 Fixture Value Methodology. Applicant's Engineers are expected to purchase and use the *AWWA Manual of Water Supply Practices M22 Sizing Water Service Lines and Meters* when completing this methodology.

This section includes general information about the customer and proposed development.

A 30 unit townhouse complex has been chosen as an example to demonstrate the use of this sizing methodology.

Step 1: Calculate Total Domestic Fixture Value

Fixture	Fixture Value (GPM @ 60 psi)		No. of Fixtures		Fixture Value
Bathtub	8	x	30	=	240
Bedpan Washers	10	x		=	
Bidet	2	x		=	
Dental Unit	2	x		=	
Dishwasher	2	x	30	=	60
Drinking Fountain - Public	2	x		=	
Hose Bibs (c/w 50 ft wash down):					
- 1/2 inch	5	x	30	=	150
- 5/8 inch	9	x		=	
- 3/4 inch	12	x		=	
Kitchen Sink	2.2	x	30	=	66
Lavatory	1.5	x	90	=	135
Showerhead (Shower Only)	2.5	x	30	=	75
Service Sink	4	x		=	
Toilet:					
- Flush Valve	35	x		=	
- Tank Type	4	x	90	=	360
Urinal:					
- Pedestal Flush Valve	35	x		=	
- Wall Flush Valve	16	x		=	
Wash Sink (Each Set of Faucets)	4	x	30	=	120
Washing Machine	6	x	30	=	180
Other:					
		x		=	
		x		=	
		x		=	
			Total Domestic Fixture Value	=	1386 GPM (A)

In this example, the following fixtures are identified for each of the 30 units in the proposed development:

- 1 bathtub
- 1 shower
- 3 toilets (tank type)
- 3 bathroom sinks
- 1 dishwasher
- 1 kitchen sink
- 1 washing machine
- 1 laundry sink
- 1 hose bib (1/2 inch)

These fixtures yield a Total Domestic Fixture Value of 1386 GPM.

Note: If a fixture is proposed that is not on the list then the peak flow value (fixture value) can be included on one of the blank lines under "Other" based on the manufacturer's information.

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Water Meter Sizing Calculation Sheet
For Non-Fire Service Meters
AWWA M22 Fixture Value Methodology

Example

Page 2 of 3

Step 2: Calculate Probable Peak Domestic Demand

Refer to Figure 4-2 or 4-3

Probable Peak Domestic Demand = 65 **GPM (B)**

The AWWA Manual M22 includes two graphs (Figures 4-2 and 4-3) which provide a correlation between the Total Domestic Fixture Value and Probable Peak Domestic Demand for various development types.

For this example, Figure 4-3 applies since the Total Domestic Fixture Value is in the "high range". The "Apartments" curve indicates that a Total Domestic Fixture Value of 1386 GPM corresponds to a Probable Peak Domestic Demand of 65 GPM.

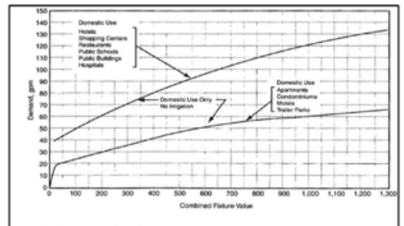


Figure 4-2 Water flow demand per fixture value—low range

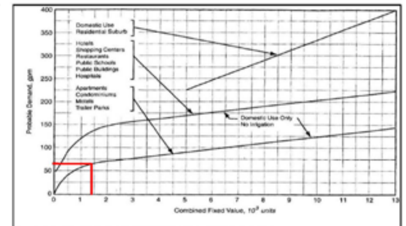


Figure 4-3 Water flow demand per fixture value—high range

Step 3: Apply Pressure Adjustment Factor

City Water System Pressure (not to exceed 80 psi) = 70 psi

Pressure Factor from Table 4-1 = 1.09 (C)

Adjusted Peak Domestic Demand (B x C) = 70.85 **GPM (D)**

The fixture values listed in Step 1 are based on a pressure of 60 psi. This step increases or decreases the peak demand based on the pressure at the outlet of the meter. Table 4-1 in the AWWA M22 Manual provides adjustment factors for various pressures.

For this example, the pressure downstream of the meter is identified as 70 psi. From Table 4-1, the pressure adjustment factor is 1.09 and the Adjusted Peak Domestic Demand is 70.85 GPM.

Note that for the purpose of this sizing methodology, the maximum pressure for which to apply an adjustment is 80 psi.

Table 4-1 Pressure adjustment factors*

Working Pressure at Meter Discharge (psi)	Average Flow from 50 ft of 5/8-in. Hose and Sprinkler (gpm)	Pressure Adjustment Factor
35	6.7	0.74
40	7.2	0.80
50	8.1	0.90
60	9.0	1.00
$\boxed{70}$	9.8	$\boxed{1.09}$
80	10.5	1.17
90	11.2	1.25
100	12.1	1.34

*derived from Table 4-1 and 4-2 of Manual M22 (1975).

NOTE: To convert psi to kPa: psi × 6.89476; to convert gpm to m³/hr: gpm × 0.227.

CITY OF NANAIMO — THE HARBOUR CITY **Water Meter Sizing Calculation Sheet** **For Non-Fire Service Meters** **AWWA M22 Fixture Value Methodology**	Example Page 3 of 3
Step 4: Identify Irrigation Demand **Total Irrigation Demand** = 23.2 **GPM (E)** For irrigation demands greater than 35 GPM, a detailed irrigation plan shall be provided with appropriately designed zones.	The Total Irrigation Demand is identified in this step. The AWWA Manual M22 provides guidance for calculating irrigation demands. However, the Applicant's Engineer may refer to an irrigation system design flow specified by the manufacturer or identified by the irrigation system designer. For this example, an area of 2000 ft^2 is irrigated by a spray irrigation system. The AWWA M22 Manual indicates that for spray irrigation each "section" represents a flow of 1.16 GPM. A "section" is defined as 100 ft^2. So the calculation yields: Total Irrigation Demand = 2000 ft^2 / 100 ft^2 = 20 sections x 1.16 GPM = 23.2 GPM
Step 5: Calculate Total Peak Demand **Total Peak Demand (D + E)** = 94.05 **GPM (F)**	The Adjusted Peak Domestic Demand of 70.85 GPM from Step 3 is combined with the Total Irrigation Demand of 35 GPM from Step 4 to yield a Total Peak Demand of 105.85 GPM.
Step 6: Select Water Meter Water Meter Make / Model: = Sensus OMNI C^2 Water Meter Size * = 1.5 inches Water Service Connection Size = 2 inches * Total Peak Demand (F) not to exceed 80% of Meter Rated Peak Instantaneous Flow * Pressure Loss at Total Peak Demand (F) not to exceed 5 psi	The selected meter is a 1.5" Sensus OMNI C^2. The manufacturer specified maximum intermittent flow rating for this meter is 200 GPM. 80% of 200 GPM = 160 GPM > 94.05 GPM The manufacturer specified pressure loss for this meter (with strainer) at 94.05 GPM is approximately 4 psi (< 5 psi).
Professional Certification Seal Seal Name: Example Company: Example Date: Example Comments:	This section is for the Applicant's Engineer to certify the water meter sizing calculation. The comments space is provided to explain any unique aspects of the development that impact the proposed meter sizing.

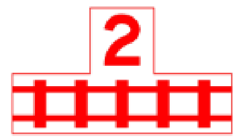
STOP
RA 1
600mm x 600mm

YIELD
RA 2
750mm x 750 x mm 750mm

SCHOOL CROSSWALK
RA 3L/R
600mm x 750mm

PEDESTRIAN CROSSWALK
RA 4L/R
600mm x 750mm

CROSS BUCK
RA 6
CROSS LENGTHS 1200 x 200mm



RAILWAY CROSSING SIGN
RA 6S
700mm X 450mm

ROUNDABOUT YIELD
RA 7
750mm x 750mm x 750mmm

MAXIMUM SPEED
RB 1
600mm x 750mm

NO TURN
RB-11 L/R
600mm X 600mm

TURN ONLY
RB-14 L/R
600mm x 600mm

NOTES:
1. THIS HANDBOOK IS FOR GENERAL REFERENCE ONLY.
2. REFER TO SECTION 9.14 STREET NAME AND TRAFFIC SIGNS.

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10.18.2019

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CITY OF NANAIMO'S FIELD HANDBOOK
OF GENERAL SIGNS

Scale:	N.T.S.
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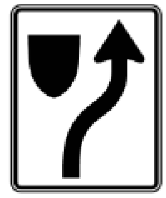
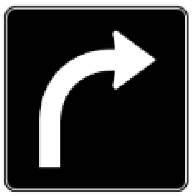
ONE WAY
RB 21
900mm x 300mm

DO NOT ENTER
RB 23
600mm x 600mm

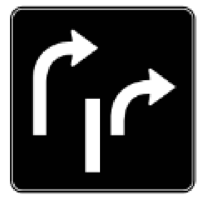


KEEP RIGHT
RB 25
600mm x 750mm

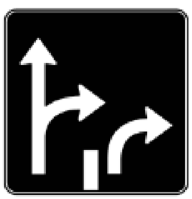


TURN ONLY LANE
RB-41 L/R
600mm x 600mm

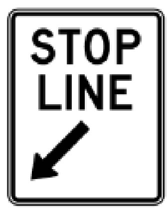
THRU OR TURN LANE
RB-42 L/R
600mm x 600mm



DOUBLE TURN ONLY
RB-46 L/R
600mm x 600mm



STRAIGHT OR DOUBLE TURN LANE
RB-47 L/R
600mm x 600mm



STOP LINE
RC-4 L/R
600mm x 750mm

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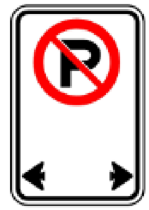
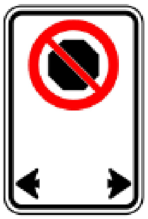
TWO WAY LEFT TURN LANE
RB-48
900mm x 900mm

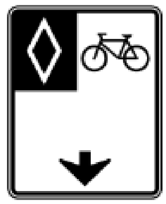
CENTER LANE
RB-48S
600mm x 300mm



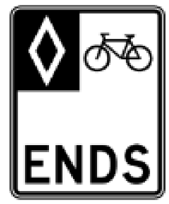
NO PARKING ANYTIME
RB-52
300mm x 450mm



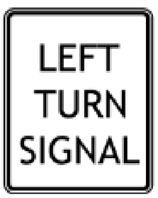
NO STOPPING
RB-57
300mm x 450mm



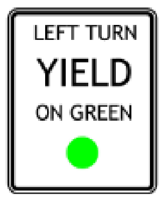
RESERVED BIKE LANE
RB-91
600mm x 750mm



RESERVED BIKE LANE ENDS
RB 92
600mm x 750mm



LEFT TURN SIGNAL
RB-18
600mm x 750mm



YIELD ON GREEN
R-110
450mm X 600mm (MOTI)

CURVE 90°
WA-1 L/R
600mm x 600mm

SHARP CURVE
WA-2 L/R
600mm x 600mm

CURVE
WA-3 L/R
600mm x 600mm

REVERSE TURN
WA-4 L/R
600mm x 600mm

NOTES:
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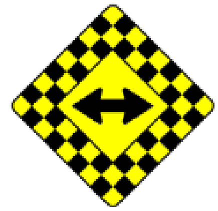
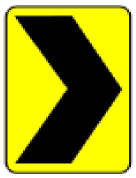
REVERSE CURVE
WA-5L/R
600mm x 600mm

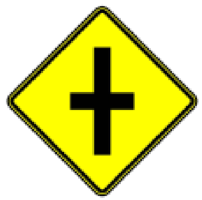
WINDING ROAD
WA-6L/R
600mm x 600mm



CHECKERBOARD
WA-8B
750mm x 750mm

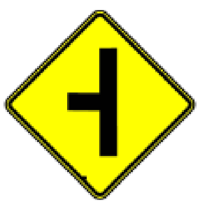


CHEVRON ALIGNMENT
WA-9
450mm x 600mm



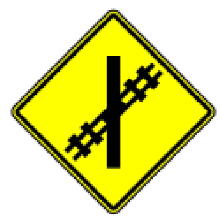
CONCEALED INTERSECTION
WA-11
600mm x 600mm

ACUTE ANGLE CONCEALED INTERSECTION
WA-12L/R
600mm x 600mm



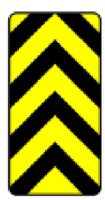
90 ANGLE CONCEALED INTERSECTION
WA-13L/R
600mm x 600mm

RAILWAY CROSSING STRAIGHT
WA-18
750mm x 750mm



RAILWAY CROSSING ANGLED
WA-18L/R
750mm x 750mm

LANE ENDS
WA-33L/R
750mm x 750mm



OBJECT MARKER
WA-36
450mm x 900mm

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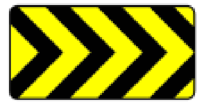
OBJECT MARKER
WA-36L
300mm x 900mm



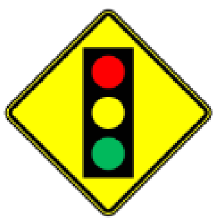
ROUNDABOUT DIRECTION
WA-38
60mm x 1660mm

ROUNDABOUT AHEAD
WA-39
900mm x 900mm

NEIGHBOURHOOD SPEED HUMP
WA-50
600mm x 600mm

STOP AHEAD
WB-1
750mm x 750mm

YIELD AHEAD
WB-2
750mm x 750mm



SIGNAL AHEAD
WB-4
600mm x 600mm

BIKE LANE AHEAD
WB-10
750mm x 750mm

SCHOOL CROSSWALK AHEAD
WB-16L/R
600mm x 600mm

PEDESTRIAN CROSSWALK AHEAD
WC-2L/R
600mm x 600mm

PLAYGROUND AHEAD
WC-3R/L
600mm x 600mm

BICYCLE CROSSING AHEAD
WC-7
600mm x 600mm

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FIRE TRUCK ENTRANCE
WC-17L/R
750mm x 750mm

BIKE PEDESTRIAN CROSSING AHEAD
WC-46L/R
600mm x 600mm

BIKES ON ROADWAY
WC-19
600mm x 600mm

CUL-DE SAC SIGN
ID-31
600mm x 600mm

PEDESTRIAN PUSHBUTTON SIGN
ID-21L/R
130mm x 200mm

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SAMPLE - BC Hydro SLIM Connection Form – Ornamental Lights

Development Title: Date:___________________

Comments:

Request:

Request Type**:**

Reason Type:

Lamp Type:

Wattage:

Lens Type:

Request Details:
(# of lights, wattages, etc.)

Electrician:

Name:

Company:

Phone #:

Permit #:
***provided by electrician*

SLIM ID#:____________________