Corporation of the City of
NEW WESTMINSTER

CITY OF NEW WESTMINSTER

DESIGN CRITERIA

#369461

July 8, 2019

AMENDMENT REGISTER				
Amendment No.	**Date**	**Amended Section**	**Amended Page**	**Description of Amendment**
Bylaw 7908	March 6, 2017	Section 6	6-1 to 6-10	Street Lighting and Traffic Signals
Bylaw 8128	July 8, 2019	Sections 1, 3, 4, 5 and Table 8.2	Full sections and p. 8-6	Completely replace sections Replace Table 8.2
Bylaw 8369	June 26, 2023	Section 1.1	1-1	Delete the definitions in Section 1.1
Bylaw 8369	June 26, 2023	Section 7 and 8	7-1 to 8-3	Delete most of Section 8 and insert revised (from S8) new sections in Section 7
Bylaw 8412	Sept. 11, 2023	Section 8 and 9	8-1 to 8-3	Delete Section 8 in its entirety and renumber Section 9 to Section 8

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BYLAW 8128, 2019

1. DESIGN CRITERIA – GENERAL REQUIREMENTS

BYLAW NO. 8369, 2023

1.1 Deleted

1.2 General

Use of Design Criteria Mandatory
All works and services to be provided and constructed under this Bylaw shall be designed by a professional engineer in accordance with the Design Criteria and Specifications and Standard Detail Drawings set out in this Bylaw. Where conditions arise which are not covered by the Design Criteria, Specifications or Standard Detail Drawings, it shall be the responsibility of the Consulting Engineer to consult with the Director of Engineering for direction prior to completing the design.

Minimum Standards and Consulting Engineer's Responsibilities
The Design Criteria specified in this Bylaw shall be considered minimum standards and shall not relieve the Consulting Engineer from his or her professional responsibilities to ensure the adequacy of the design in accordance with good engineering practice, as determined in consultation with the City.

Where sub-consultants are employed by the Consulting Engineer in the design process, the City will expect the Consulting Engineer to represent the sub-consultant's work for administrative and procedural purposes.

The Consulting Engineer is encouraged to seek innovative and superior solutions where appropriate. A Consulting Engineer who wishes to adopt criteria not specifically included in or variant from those within this design specification shall justify the proposed change in a letter/report prepared, signed and sealed by a professional engineer. Submissions must demonstrate that the proposed change is equivalent to or better than these guidelines. The letter/report shall be submitted to the Director of Engineering for review and approval, prior to acceptance of the proposed change.

In spite of using these standards and specifications, the Developers and their Consulting Engineers remain fully responsible for the design and construction of City infrastructure utilities according to good engineering standards adequate to address the specific needs and site conditions of their project.

The Consulting Engineer must be satisfied that the design criteria contained herein are applicable to the project at hand, and must apply more stringent criteria where appropriate. The Consulting Engineer is fully responsible for designing to standards which exceed these standards when specific site conditions dictate that more stringent performance measures are required.

This document is to be used in conjunction with the City of New Westminster approved edition of the Master Municipal Construction Documents (MMCD) and the City of New Westminster Supplementary Specifications and Detail Drawings.

The City of New Westminster Supplementary Specifications and Detail Drawings for City services include:

Item 1	Supplementary Specifications – Additions, amendments and deletions to the Specifications in the MMCD
Item 2	List of Approved Materials and Products
Item 3	Supplementary Detail Drawings

Existing Works and Services

Existing (as-constructed) services information may be available from the City. This information is made available on the understanding that the City accepts no responsibility for their accuracy or completeness. Verification of this information must be made by the Consulting Engineer responsible for the design. Variations must be referred to Director of Engineering before completion of design drawings

1.3 Approval of Services

Approval of the proposed design and construction of services, as applicable, must be given by several authorities in addition to the City. These authorities are:

Governing Authorities	Areas of Jurisdiction
Ministry of Environment	• pollution, sanitary sewer systems • fisheries and wildlife
Greater Vancouver Sewerage and Drainage District (G.V.S. & D.D.)	• GVS&DD sanitary sewer systems • Brunette River Drainage Channel
Greater Vancouver Water District (G.V.W.D.)	• G.V.W.D. water mains
Canadian Transportation Authority	• crossing of existing railway at grade associated with roadway widening • construction of new road crossing existing Railway track at grade • replacing existing Railway trestles
Canadian National Railway, Canadian Pacific Railway, Burlington Northern Santa Fe, Southern Railway	• as per Canadian Transportation Agency • all underground services crossing existing Railway rights-of-way • installation of overhead transmission lines crossing existing Railway rights-of-way
Fortis	• as per Fortis regulations and the Pipeline Act • all work in the vicinity of intermediate pressure (IP) and transmission pressure (TP) gas mains and rights-of-way
BC Hydro	• as per BC Hydro regulations • all work in the vicinity of any underground plant as well as any transmission lines and rights-of-way

City of New Westminster Electrical Utility	a) all work in the vicinity of any underground plant as well as any transmission lines and rights-of-way
Telus, Shaw, Rogers, AT&T, Bell Canada, and other telecommunications providers	• all telephone underground and overhead services
Ministry of Transportation and Infrastructure	• all construction (underground and/or surface work) on Ministry of Transportation and Infrastructure rights-of-way • subdivision, road improvements within radius of 0.5 km of the intersection of a controlled access Highway with any other Highway (see Controlled Access Highway Act)
Vancouver Port Authority Fraser Basin Council (FBC)	• works on or about river and foreshore • dredging proposals • stormwater discharge points
Inspector of Dykes	• reconstruction of dykes, fill and excavations adjacent to dykes • any structure on or across dykes
Vancouver Port Authority	• dredging proposals in Fraser River • crossing of dykes – temporary or permanent works

For City projects, the Consulting Engineer will make all applications to the Authorities concerned on behalf of the City, unless otherwise advised. In case of subdivisions, applications will be made by the Developer, with any costs incurred from the application being assessed to the Developer. The final agreement for such application will be drawn between the Authority concerned and the City, provided the proposed services, upon satisfactory completion, revert to and form part of the City services system.

No construction may proceed without the approval of the Authority having jurisdiction.

In all cases, the Authority having jurisdiction has specific requirements of its own, such as

- specific application forms
- utility clearance from the proposed services
- protection of services, carrier pipes, depth of cover
- methods of construction (Ministry of Transportation and Infrastructure and railway companies may not permit open trenching on major Highways and freeways.)

These requirements will be obtained directly from the Authority involved.

1.4 Subdivision and Development Servicing Procedures

Unless otherwise specified, the Developer shall design and install complete City services for the land being subdivided or developed, including provision of services to facilitate further development.

The City services shall include but not limited to:

1. Roads, lanes and walkways
2. Concrete sidewalks, extruded curbs, combined curb and gutter or alternative street edge
3. Sanitary Sewer systems
4. Storm Sewers systems
5. Water mains
6. Ornamental Street Lights
7. Trees and Landscaping
8. Underground Hydro power
9. Underground Telephone
10. Underground Cablevision
11. Natural Gas
12. Lot Grading

1.5 Drafting Requirements

Engineering drawings, details sketches and digital files prepared for submission to the City must conform to the City of New Westminster drawing and digital information standards.

1.6 Rights of Way and Easements

Where specifically approved by the Director of Engineering to locate a City service within a utility right-of-way, the minimum widths of rights-of-way shall be:

a) for single service

R.O.W. width = 3 metres minimum width

b) for two or more services

R.O.W. width = 6 metres minimum width

c) When the service is within a City road allowance but the distance from the property line to the centre of the main is less than one half of the width necessary for a single service, the difference shall be provided as right-of-way on the adjacent property.

In all cases the width of rights-of-way shall be sufficient to permit an open excavation with side slopes in accordance with the Workers' Compensation Board (WCB) regulations, without impacting on or endangering adjacent structures.

Sanitary trunk and interceptor sewers shall have rights-of-way wide enough for future widening and/or twinning. The width of the right-of-way shall be the required separation between pipe centrelines plus 2 times the depth to the crown of the deeper sewer.

The Consulting Engineer shall provide cross sections on the design drawings, indicating the minimum safe distances to adjacent building footings based on a safe angle of repose from the limits of the excavation.

1.7 Certification by the Consulting Engineer

Consulting Engineers offering their services, directly to the City or through Developers, accept the responsibility for their designs by completing and attaching the following statement to their design notes and design drawings:

"I ..... Professional Engineer, in good standing in and for the Province of British Columbia, hereby certify that the works as herein set out on the attached drawings have been designed to good engineering standards and in accordance with the latest edition of the City of New Westminster Design Criteria, the Master Municipal Construction Documents (MMCD), and the City of New Westminster Supplementary Specifications and Supplementary Standard Drawings, adopted by the City of New Westminster.

.....……
(Signature)

1.8 Design Populations by Land Use

The following equivalent population should be utilized for water and sanitary sewer design purpose:

Land Use (each unit)	ppdu	ppha
Single Family Detached	3.0	
Secondary Suite/Laneway Home	2.5	
Row Houses, Townhouses, Duplexes, Triplexes	2.6	
Apartments	1.8	
Commercial	-	90
Industrial	-	45
Institutional	-	50

NOTE:
ppdu - population per dwelling unit
ppha - population per hectare

Where development is expected to exceed the density of the above table, the actual development parameters shall govern.

1.9 Revisions to the Design Criteria

The criteria and design parameters contained in this document are subject to constant review and re-evaluation and the Director of Engineering reserves the right to initiate revisions or additions to these criteria as and when he deems it is necessary to make such revisions.

2. FIELD SURVEY REQUIREMENTS

All field survey information should follow the requirements outlined in the City of New Westminster Drafting and Drawing Submission Standards,

BYLAW 8128, 2019

3. STORM DRAINAGE SYSTEM

3.1 General

All storm drainage works including rainwater collection, management and conveyance facilities shall be designed with considerations for public safety, regulatory requirements, economic benefits and protection of the natural environment. Rainwater is a valuable resource that supports the protection, enhancement, maintenance of:

- Aquatic and terrestrial habitat;
- Surface water supply and groundwater resources;
- Recreational opportunities; and
- Community aesthetics and urban life.

Storm drainage designs shall be prepared by the Consulting Engineer with qualified expertise in storm water management systems. Design criteria only specify the minimum requirements and the Consulting Engineer shall confirm with the City on the design requirements. Storm drainage designs shall conform to local government bylaws, regulations, guidelines, policies and federal and provincial statutes.

The Consulting Engineer will need to confirm the following:

a) Drainage catchment boundary
b) Planned land uses within the drainage catchment
c) Location of major pumped and gravity facilities
d) Location of the future gravity conveyance systems
e) New Westminster Citywide Integrated Stormwater Management Plan (ISMP)

The presence of an existing municipal storm drainage system does not mean, nor imply that the existing system has adequate capacity to accommodate the proposed design flows either adjacent to the site or further downstream, nor does it indicate that the existing system pattern is acceptable to the City. Undersized or inadequate existing storm drainage facilities must be upgraded at the Developer's expense to accommodate the appropriate flows as specified herein. Alternative stormwater management proposals may be considered.

A Stormwater Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP) are required for all proposed developments within the City.

3.1.1 Stormwater Design Manuals, Guidelines and Plans

The Engineering Design Criteria applies to the analysis, design and construction of storm drainage systems located in City rights-of-way, easements, lots and parks, and which will be eventually owned and operated by the City. In addition to the Engineering Design Criteria, the storm drainage design shall conform to the Citywide ISMP which provides design guidance and required water quality and infiltration targets for on-site storm drainage systems.

3.1.2 Citywide Integrated Stormwater Management Plan

The Citywide Integrated Stormwater Management Plan (ISMP) provides information related to:

- Approved goals and strategies for developments to minimize the effects of flooding, erosion on water quality and ecological health; and
- Remedial and new capital works to be incorporated with developments.

The ISMP is to be used in conjunction with the Official Community Plan (OCP) and relevant Neighbourhood Community Plans (NCP's) for mitigating the impacts of developments on the City storm drainage system.

3.1.3 Stormwater Management Plan

A Stormwater Management Plan (SWMP) details the proposed storm drainage servicing for the development and the impact on the downstream system. Unless otherwise directed by the City, a SWMP must be submitted for City's approval. The submission shall include technical drawings and a report including:

- Development characteristics;
- Existing and proposed tributary catchment area and boundaries along with existing and ultimate land uses;
- The development area within the drainage catchment including all features such as roads, ditches, watercourses with their environmental classification, existing and proposed drainage control structures, storm sewers, culverts, stormwater management facilities, and site grading;
- Method and parameters used for hydrological/hydraulic analysis;
- Tabulated pre and post development hydrologic and hydraulic calculations;
- Major and minor systems flow routing;
- Downstream conveyance capacity limitations;
- Minor and major hydraulic grade lines of all proposed works;
- Design calculations, details and supporting information for all stormwater management facilities to meet *Citywide ISMP Volume 1 (Vision, Principles & Actions)* and *Volume II (BMP Tool Kit)*;

- Proposed service connection locations, Minimum Building Elevations (MBE), and pre and post-development flows entering and leaving the subject site;
- Groundwater management for the protection of municipal and private infrastructure and property;
- External drainage issues and recommended options to address impacts;
- Potential floodplain issues and recommended options to address impacts; and
- Easements required.

The SWMP shall demonstrate how the development and the proposed storm drainage system will be consistent with the Official Community Plan (OCP), Neighbourhood Community Plan (NCP) and the Citywide ISMP. A SWMP design report shall also be prepared if Runoff Hydrograph Method is used for the analysis (see Section 3.3.4).

3.1.4 Erosion and Sediment Control Plan

Erosion and Sediment Control Plan (ESCP) shall be submitted to the City for approval. The plan shall include measures such as siltation basins, channels, sediment basins, cut-off ditches and swales, siltation fencing, soil covers, truck washes, etc. to manage erosion and sedimentation from the construction activities in compliance with City's Erosion and Sediment Control Bylaw 7754, 2016 and Sewerage and Drainage Regulation Bylaw 7746, 2015, as amended.

3.2 Design Objectives and Requirements

3.2.1 Servicing Objectives

Design Frequencies

The design frequency for storm drainage systems will be in accordance to the followings, unless otherwise directed by the Director of Engineering:

Minor System	Storm sewers, driveway culverts and local road ditches	1:10 Year (Mainland) 1:25 Year (Queensborough)
Major System	Watercourses, channels, culvert crossings, overland flood paths, major trunk storm sewers[1] and outfalls	1:100 Year
Flood Control Facilities	Within the Fraser River Floodplain and major watercourse crossings under Provincial Highways	1:200 Year

3.2.2 Climate Change Impact Consideration

The design of the storm drainage infrastructure shall incorporate climate change impacts based on the following principles:

"Do nothing" Approach: for temporary infrastructure or assessment of existing infrastructure near the end of useful life (less than five to ten years of service life). The existing climate rainfall data and ocean boundary condition data shall be used to verify capacity.

"Middle of the road" Approach: for new infrastructure (i.e. storm sewers, culverts, floodboxes and flow control facilities). Use a moderate climate change forecast for Year 2050 as discussed in Section 3.3.2.

"Worse-case" Approach: for high-risk infrastructure (i.e. with catastrophic or high consequences of failure such as dikes and drainage pump stations). Use a moderate climate change forecast for Year 2100 as discussed in Section 3.3.2.

3.2.3 Combined Sewer System

A significant area of the City is currently serviced by combined sewer systems. The City is committed to separate all combined sewer systems under the Regional Liquid Waste Management Plan.

Separate sanitary and storm sewer systems shall be designed and installed for new subdivisions and rezoning applications along the entire site frontage. The development may be required to separate the combined sewer system immediate downstream from the site as determined by the Director of Engineering.

[1] at the discretion of the Director of Engineering

Flows in the combined sewers shall be calculated to account for both stormwater flows and sanitary flows as per the City's Sanitary and Stormwater design criteria.

3.2.4 Design Requirements & Procedures

The design shall show in plan and profile the proposed storm sewer mains, service connections, existing underground services, overland flow details and ditch drainage patterns as applicable. The following considerations shall be incorporated into the design:

a) A topographic field survey of the site with sufficient details to determine drainage patterns will be required including elevations of surrounding properties, existing drainage systems and the crown of the roadway. Proposed ground elevations for the final development should also be given.

b) Provision must be made for house drains from each lot, either to storm sewer, open ditches in the road or lane, underground storm sewers elsewhere or natural watercourses. Onsite storm drainage works shall be consolidated into a single service connection into the City drainage system.

c) Catch basin type shall be chosen according to Supplementary Specifications and Detail Drawings. Lead size shall be not less than that shown on Detail Drawings. Type of catch basin and lead size shall be marked on construction drawings.

d) When establishing inverts in a manhole at the junction of two or more pipes, the crowns of pipes shall be coincident. In built up areas where there is not sufficient cover available at the ultimate upstream terminal, the design pipe profile may be invert to invert with the hydraulic grade line shown.

3.2.5 Site and Lot Grading Requirements

Site grading around the building(s) shall be graded away from the foundation in accordance with BC Building Code and drain into a municipal drainage system, natural drainage path or roadway. Surface runoff across the parcel to adjacent lots is to be avoided. If cross-lot drainage is unavoidable, a swale shall be provided to divert runoff away from the lower lots. Lots lower than the adjacent roadways shall have road runoff directed away from buildings and driveways and into an appropriate municipal drainage system.

a) Lot grades and swales shall have a minimum slope of 1% and a maximum slope of 6%.

b) Where grade changes in excess of the above are required, the maximum slope should be 3:1. Where these occur between dwellings, the slope is to be located on the lower lot.

c) Grade changes in excess of 1 m are to be accomplished by the use of a retaining wall.

d) The maximum depth of rear yard swales shall be 0.3 m.

e) The maximum depth of side yard swales shall be 0.2 m. The grade adjacent to the house shall follow the grade of the swale to maintain constant depth.

f) At least one side yard of all dwelling units shall have a minimum (2% slope) level area of 0.6 m.

g) The crossfall at the back of all units shall not exceed 2%.

h) For all lots with detached and semi-detached dwellings having conventional rear yard setbacks and reverse frontage on arterial roads, the rear area shall be graded at 2% for at least 7.5 m of the total rear yard depth.

i) The maximum flow allowed into a swale between two houses is that from 4 rear yards.

j) The maximum flow allowed into a rear yard swale shall be that from 6 rear yards and in no case will the swale lengths be greater than 3 lot widths for single and semi-detach houses. For townhouse units, 8 rear yards and a maximum swale length of 4 lot widths will be permitted.

k) The ponding depth over rear yard catch basins shall not exceed 0.3 m.

l) Grade differences between housing units shall be minimized, especially where new developments abut existing developments. The vertical distance between the ground level at the rear wall of houses which back on to each other shall not be greater than that achieved by striking a 3% grade between the units.

3.2.6 Minimum Building Elevation (MBE)

The MBE is defined as the elevation of the lowest floor slab in a building or the underside of the floor joists where the lowest floor is constructed over the crawl space. Crawl space is the space between a floor and the underlying ground having a maximum height of 1.2 m to the underside of the joists and not used for storage of goods or equipment damageable by floodwater.

The MBE shall be established at least 0.6 m above the storm service connection invert at the property line or 0.3 m above the 1:100 year hydraulic grade line whichever is greater.

For sites located within the Fraser River Floodplain, the MBE shall be established above the designated Flood Construction Level (FCL). The FCL is 0.6 m above the Fraser River Flood Design Level established by the Province of British Columbia.

For sites adjacent to major watercourses other than the Fraser River, the FCL is 0.3 m above the 1:200 year return period hydraulic grade line of the subject watercourse. In addition, the MBE shall be 1.5 m above the natural boundary of any watercourse, lake, marsh or pond.

The rationale used to establish the MBE for a site shall be presented in the SWMP or a separate report.

3.3 Runoff Analysis

Storm drainage systems shall be designed to accommodate post-development flows using the Rational Method or the Runoff Hydrograph Method. For developments where the total tributary area is 10 hectares or less, the Rational Method will be used to compute the peak runoffs. For systems where the total tributary areas is greater than 10 hectares or where stormwater management systems require more than basic flow conveyance, the Runoff Hydrograph Method will be used to compute the peak flows and to design the runoff control facilities. All calculations pertinent to the design of the drainage system shall be signed and sealed by the Consulting Engineer and submitted to the Director of Engineering for approval.

In areas serviced solely by combined sewers, pre and post development flows for both storm and sanitary contributions shall be determined. Where post-development flows exceed pre-development flows, onsite storage or equivalent best management practices will be required to limit peak discharge rates to pre-development levels. Existing conditions will be considered 'pre-development' for non-greenfield sites unless historical site design documentation is submitted.

3.3.1 Catchment Area

The extent of the tributary areas of the storm drainage system under design shall be in accordance with the natural contours of the land, subject to any overall drainage plans established by the City. The Consulting Engineer is responsible to confirm the extent of the drainage area with the City prior to detailed design.

Although minor changes in the catchment boundaries may be necessary for development, the post-development tributary area should not deviate from the total natural drainage area, unless otherwise approved by the Director of Engineering. The Consulting Engineer is responsible for obtaining true and accurate surface elevations and drainage system information under the existing and proposed future development conditions. The analysis must include all lands tributary to the drainage system, whether considered on-site or off-site to the Developer's parcels.

3.3.2 Rainfall Data

Rainfall Intensity Frequency (IDF) curves for 5 minutes to 24-hour durations are based on the 2018 report: *"Study of the Impacts of Climate Change on Precipitation and Stormwater Management"* prepared by GHD for the Greater Vancouver Sewage and Drainage District. The

recorded rainfall data in the regional rain stations up to 2016 were used to derive the updated IDF data.

Climate Change Adaptation

The City of New Westminster is located within Zone 4 of the Homogeneous Rainfall Zones developed for the entire Metro Vancouver area in the GHD study. The existing climate condition IDF curves are based on the dimensionless IDF curves for Zone 4 using index rain values selected for New Westminster for durations from 5 minutes to 24 hours. The moderate change future climate scenarios for time horizons of 2050 and 2100 were developed by scaling up the existing climate condition IDF curves with Delta Changes for Zone 4. Current 2016, future 2050 and future 2100 IDF curves for the City are provided on Figures 3.1, 3.2 and 3.3. Rainfall intensity taken from these curves can be used with the Rational Method to calculate design flows under the required time horizon specified in Section 3.2.2.

Design storms shall be used for the Runoff Hydrograph Method computation. Tables 3.4 to 3.8 provide design storm hyetographs under current climatic condition (2016) for different return frequencies. To adjust for climate change impacts specified in Section 3.2.2, IDF curve values for future 2050 and 2100 conditions shall be used with the appropriate return period and duration to pro-rate the current (2016) design hyetographs.

3.3.3 Rational Method

The Rational Method calculates the peak flow using the formula:

$$Q = RAIN$$

Where R = Runoff Coefficient
A = Drainage Area (ha)
I = Rainfall Intensity at the Time of Concentration (mm/hr)
N = 0.00278
Q = Flow (m^3/s)

a) Runoff Coefficients

The following runoff coefficients based on the highest and best land use in the City's Official Community Plan (OCP) shall be used to compute the design flow:

Table 3.1 Runoff Coefficients

Type of Area	Percent Impervious	Runoff Coefficient	
		10 Year Storm	25/100 Year Storm
Wood Lands	5	0.10	0.30
Cultivated Lands	30	0.30	0.40
Park and Green Open Space	10	0.15	0.25
Single Family Residential	45	0.50	0.55
Single family with laneway/coach house	60	0.55	0.60
Low Density Multi-Family Residential	65	0.60	0.65
Apartment	80	0.75	0.80
Commercial	90	0.80	0.85
Industrial	90	0.80	0.85
Institutional	80	0.75	0.80
Roofs or Pavement	100	0.95	0.95

The values in Table 3.1 are for general applications. The Consulting Engineer should verify the coefficient applicable for the area involved. The Director of Engineering shall have the final authority on the coefficient to be utilized.

b) Rainfall Intensity

The rainfall intensity used in the Rational Method should be determined using the appropriate rainfall Intensity-Duration-Frequency (IDF) curve with the duration equal to the Time of Concentration (T_c) calculated as indicated in the later section.

c) Time of Concentration (T_c)

T_c is the time required for water to flow from the most remote part of the catchment area under consideration to the design node. T_c can be calculated using the following formula:

$$T_c = T_i + T_t$$

Where T_c = time of concentration (minutes)
T_i = inlet or overland flow time (minutes)
Tt = travel time in sewers, ditches, channels or watercourses (minutes)

Inlet or Overland Flow Time (T_i)

Two methods can be used to estimate T_i as follows:

i) This method is typically used for direct runoff from small urban development areas ($\leq$ 2000 m²) with runoff coefficients greater than 0.4 under the assumption that BMP's are not applied. These values assume direct runoff.

Land Use Type	T_i (Min)
Single Family Lot	10
Multi-Family Lot	8
Commercial/Industrial/ Institutional	5

ii) This method is used for relatively flat and larger areas and is calculated using the following formula (referred to as the Airport Method):

$$T_i = \frac{3.26(1.1 - C)\, L^{0.5}}{S^{0.33}}$$

Where T_i = Inlet time (minutes), minimum time = 15 minutes
C = Runoff coefficient
L = Travel distance (m), maximum length = 300m
S = Slope of travel path (%)

Travel Time (T_t)

The travel time in sewers, ditches, channels or watercourses can be estimated using the following formula:

$$T_t = \frac{C_t\, Ln}{12\, s^{0.5}}$$

Where, C_t = Concentration coefficient
= 0.5 for natural watercourses or ditches, storm sewer flow
L = Length of watercourse or conduit flow (m), along the drainage path from the furthest point in the basin to the outlet.
n = Roughness coefficient
= 0.050 Natural channels
= 0.030 Excavated ditches
= 0.013 Concrete pipe
= 0.011 PVC Pipe
= 0.024 Corrugated Steel Pipe (CSP or CMP)
s = Basin slope (m/m)

d) Manning's Formula

The hydraulic analysis of sewers and open channels shall be carried out assuming steady state flow conditions and using the Manning equation, with the pipe flowing full:

$$Q = \frac{AR^{2/3}S^{1/2}}{n}$$

Where, Q = Pipe Design flow (m^3/s)
A = Pipe cross section area (m^2)
R = Hydraulic radius (m) = diameter/4 for pipes
S = Slope of energy grade line (m/m)
n = Manning coefficient of roughness
= 0.013 Concrete Pipe
= 0.011 PVC Pipe
= 0.024 Corrugated Steel Pipe (CSP or CMP)
= 0.030 to 0.10 for open channels.

e) Presentation of Rational Method Design Calculations

The Consulting Engineer will be required to tabulate the Rational Method design calculations on the "Storm Sewer Design - Rational Method" table for submission along with the appropriate plans and other relevant information. Table 3.2 attached shows an example of the "Storm Sewer Design - Rational Method" table. Governing climate conditions for design calculations of the storm sewers shall be clearly noted in the design calculation sheet.

3.3.4 Runoff Hydrograph Method

Hydrologic modelling programs using Runoff Hydrograph Method shall be used for the design of storm drainage systems serving areas greater than 10 hectares and for all erosion and detention retention/detention facilities.

a) Selection of Modeling Program

Prior to commencing any computer modelling, the Consulting Engineer shall obtain approval from the Director of Engineering on the selection of the proposed computer program. City uses SWMM based runoff simulation modelling programs.

b) Modelling Parameters

For design purposes, land use data shall be based on the best available post-development condition as per the Official Community Plan (OCP) and other pertinent land use information. Percent of imperviousness can be selected based on values suggested in Table 3.1 unless more accurate information from air photos or actual site designs are specifically available.

Either the Horton or Green-Ampt methods may be used to estimate the infiltration characteristics based on the best available soil conditions information. The parameters must be reflective of the type of soils, ground cover and typical Antecedent Moisture Condition (AMC) prevalent during the winter season.

c) Modelling Procedures

Efforts shall be made to calibrate/validate the results using the observed rainfall/flow data. Sensitivity to input parameter values shall be tested to ensure that the model predictions are adequate for establishing a proper system design. Conservative parameters shall be selected if calibration data is not available.

Design flows should be calculated at key intervals of the drainage system for all design storms (see Tables 3-4 to 3-8) with various design return periods, storm durations and climate change adjustments as prescribed in this document. This will identify the critical event to be used in designing the system. Note that the storm duration that generates the critical peak flow may be different from the duration that generates the critical storage volume. Systems with a number of interconnected ponds or with restricted outlet flow capacity may require analysis for sequential storm events or modelling with a continuous rainfall record.

d) Presentation of Modeling Results

A design report that documents the design rationale used to develop the hydrologic model and modelling results shall be submitted to the City along with a SWMP drawing. The design report shall include the followings:

- Design criteria used for the hydrologic/hydraulic analysis;
- Name and version of computer model;
- Design storms;
- Schematic diagram of model;
- Drainage map showing the catchment and sub-catchment boundaries and areas, slopes, land uses, soil conditions, etc.;
- Specific simulation assumptions and parameters;
- Description of the proposed stormwater features;
- Flow hydrographs under both pre- and post-development conditions at key locations;

- Flow exceedance curves for the pre-development, post-development without detention and post-development with detention, if a detention facility is proposed and continuous modelling is performed;
- Rationale and calculations for sizing onsite BMPs;
- Operation and maintenance plans and performance monitoring plans for the proposed on-site stormwater management features.

The SWMP drawing attached to the report shall include the following:

- Catchment areas and boundaries and the proposed storm drainage system including storm sewer locations, sizes and slopes, and functional layout of the proposed detention facility, on-site BMPs and other hydraulic control structures. Minimum Building Elevations (MBEs) shall also be presented in the SWMP drawing.
- A table summarizing design information and modelling results on the "Storm Sewer Design – Runoff Hydrograph Method" table.

In addition, the following design details shall also be shown in the SWMP drawing or in the detailed design drawings for the storm drainage system:

- Profiles showing pipe inverts and obverts, ground profiles, predicted Hydraulic Grade Lines (HGL's) under conditions governing the design and lowest MBEs throughout the storm drainage system.
- Design details of the proposed detention facility, BMPs (e.g. rock pit, rain garden, bio-swale, etc.) and hydraulic control structures (e.g. catch basins, manholes, detention pond outlet structures, flow control/diversion structures, oil and grit separators, spillways, etc.).
- Stage-discharge, stage-area and stage-volume curves of the detention facilities.
- Tabulated peak inflows and outflows, design water levels, detention pond areas and storage volumes.

3.4 Storm Sewers and Appurtenances

3.4.1 Flow Velocity

Maximum and minimum design velocities for pipes flowing full or half full:

- Minimum 0.6 m/s;
- Maximum 6.0 m/s.

Where design velocities are supercritical or in excess of 3.0 m/s, special provisions shall be made to protect against sewer displacement.

Where discharge velocities greater than 1.0 m/s enters a channel or sensitive receiving environment, evaluation of the downstream channel is required. Provisions for energy dissipation may be required to prevent scouring and control erosion.

For all outfalls, a rigorous hydraulic analysis is to be completed to ensure that the exit velocities will not produce scour and damage.

3.4.2 Minimum Sewer Diameter and Grade

The minimum diameter of storm sewers shall be 250 mm. The minimum grade shall be 0.25% for pipes less than 525 mm diameter and 0.10% for pipes equal or greater than 525mm diameter. In areas where the minimum grades cannot be achieved, the Consulting Engineer shall confirm with the Director of Engineering that the minimum velocity requirement is met.

For new extensions, no reduction in pipe size will be made for pipes downstream irrespective of grade provided on the pipe unless specifically approved by the Director of Engineering.

Sewers are to be designed with constant grade. Pipes with grades at 15% or greater shall have an anchoring system and scour protection as approved by the Director of Engineering.

Due to the specific topography in Queensborough, minimum grade and velocity may not always be achievable. Site specific designs will be reviewed by the City on a case by case basis. A methodology must be identified to verify that the storm drainage system is designed and constructed with a positive gradient.

3.4.3 Storm Sewer Location

Storm sewers and service connections shall be located within public road right-of-ways. Side or rear yard statutory right-of-ways or easements should be avoided if possible. The location of the storm sewer will be in accordance with the Supplementary Detail Drawings - “Typical Roadway Cross Section”. If the location shown is impractical, the offset may be varied with the approval of the Director of Engineering but in all cases it shall be located under the road pavement and clear of curbs and gutters.

At least 3.0 m horizontal clearance from water mains shall be maintained. Provincial regulatory separation requirements will govern where sewers are adjacent to or crossing existing or proposed water mains.

Sewers must extend across the full width of each lot to the boundary of the development plan; thus allowing future extension and connection beyond the development where such extension is possible.

Where not technically feasible to locate within a road right-of-way, a storm sewer may be located within an open lane or a statutory right-of-way (SROW) if authorized by the Director of Engineering and that:

a) The open lane meets the minimum requirements of 6.0 m width;
b) The open lane is capable of supporting maintenance vehicles and equipment access under all weather conditions;
c) Within a statutory rights-of-way, the Owner must provide unimpeded maintenance vehicles and equipment access under all weather conditions;
d) Within a statutory rights-of-way, the sewer shall be centred within the registered SROW with a minimum width of 3.0 m, unless the sewer depth exceeds 3.0 m or is combined with a sanitary sewer, in which case a greater SROW width shall be provided;
e) There are no service connections or manholes within the SROW; and
f) The sewer alignment in the lane or SROW is straight.

All-weather vehicular access must be provided to all manholes, inlet structures, inspection chambers and flow control structures.

The elevations of all existing underground utilities crossing the proposed storm sewer shall be confirmed in the field and shown on the profile and plan drawings.

Where feasible, all new storm sewers shall interconnect at the high points to provide alternate routing of stormwater in case of blockage and for added subsurface storage capacity.

3.4.4 Sewer Depth

Storm sewers shall be installed at a depth to:

- Provide gravity service to all properties tributary to the sewer;
- Prevent freezing;
- Clear other underground utilities; and
- Prevent damage from surface loading.

The Consulting Engineer shall verify that the pipe material and bedding are suitable for the live and dead loads imposed on the pipe. In no case shall the cover be less than 0.9 m and greater than 6.0 m without the approval of the Director of Engineering.

3.4.5 Pipe Joints

All storm sewers shall have water tight (gasket) joints unless otherwise approved by the Director of Engineering.

3.4.6 Curvilinear Sewers

Pipes are not to be laid on a curve unless approved by the Director of Engineering.

3.4.7 Manholes

Manholes are required:

- every change of grade or direction;
- where sewers intersect;
- when pipe sizes change;
- at pipe intervals of 100 m;
- at the end of each sewer line;
- downstream of curved sewers (if a curvilinear sewer is approved by the City); and
- wherever future extensions are anticipated.

Generally, frames and covers should be located outside the vehicular and bicycle wheel path on the roadway.

Where ditches discharge into a storm sewer system, the initial manhole shall be of a sump type. All other manholes shall be channelled and benched. A detail drawing shall be provided for manholes of special design.

The inside diameter of manholes shall conform to the City approved edition of the MMCD and the City Supplementary Specifications and Detail Drawings.

Manholes are required at service connection tie-ins to mains where the service connection size is greater than ½ the diameter of the sewer main or the service connection is 200mm diameter or greater.

Drop manholes will only be used when a new incoming sewer cannot be steepened or where site conditions do not permit excavation to the base of an existing manhole. Outside drop shall be provided where the difference between the inlet and outlet inverts exceeds 600mm. The minimum manhole diameter for inside drop shall be:

- 1200mm diameter manholes for mains 300mm or smaller;
- 1500mm diameter manholes with an inside drop for mains larger then 300mm.

Temporary cleanouts are required where an extension of the sewer, in the future, will provide a manhole at an appropriate spacing.

Manholes shall be designed to incorporate a minimum pipe invert elevation difference of at least 30 mm in addition to the normal grade of the lateral sewer. For alignment deflections in excess

of 45 degrees, a 60 mm drop shall be provided. The crown elevations of sewers entering a manhole shall not be lower than the crown elevation of the sewer leaving the manhole.

3.4.8 Groundwater Recharge

For groundwater recharge systems in suitable soil conditions as identified by a qualified geotechnical engineer, additional site specific designed exfiltration systems shall be provided. Conversely, seepage collars or clay plugs shall be provided where groundwater may adversely affect deep sewers.

3.4.9 Perforated Pipes

Perforated storm sewers may be used, subject to the approval of the Director of Engineering, to exfiltrate runoff back to the ground or to lower the groundwater table in areas where elevated groundwater levels are problematic for existing buildings and infrastructure. However, it shall not be used as a means to reduce constraints for new development.

Perforated storm sewers used for groundwater recharge shall be flat, generally 1% or less.

Perforated drains located adjacent to road shall be extended well below the road base. The trench for subsurface drains shall be filled with clear round drain rock in an envelope of approved filter material. The minimum size of the perforated pipe is 100 mm.

3.4.10 Catch Basins

Catch basins shall be:

- spaced to drain a maximum area of 500 m² on road grades up to 3% and 350 m² on steeper grades including sidewalks;
- provided at regular intervals along a roadway, upstream of a curb return radius at intersections and at low points;
- located to intercept the water flowing in the gutter in advance of a wheelchair ramp, curb letdown or pedestrian crossing;
- avoided at low points within curb returns and where they interfere with crosswalks;

Catch basins at low points and on steep grades shall include a side inlet for roads with a barrier curb. Double catch basins shall be used at low points and on steep grades for roads with roll-over curb. The Consulting Engineer must ensure that there is sufficient inlet capacity for design runoff to enter the underground pipe system.

Generally, 600 mm diameter reinforced concrete catch basins shall be used for roadway drainage except when installation is restricted by depth. Special offset catch basins shall only be used where approved by the Director of Engineering.

Grates shall have a "fish" symbol.

Lawn basins shall be provided on boulevards and private properties where necessary to prevent ponding or flooding of sidewalks, boulevards, driveways, buildings and yards.

Catch basin leads will have a minimum diameter of:

- 200 mm for single basins
- 250 mm for double basins. Double catch basins shall not be connected directly together but rather one basin will be wyed into the lead of the other.

The maximum length of the lead is 30 m. The minimum grade for the lead is 2%.

3.4.11 Service Connections

Each lot will have:

a) A gravity connection to the frontage storm sewer; or
b) A gravity connection to the storm sewer in an open lane, walkway or service corridor with an access road.

A gravity service connection shall be made to the storm sewer where the habitable portion of a dwelling is above the major system hydraulic grade line (1:100 year return storm). A pumped service connection will be allowed when the habitable area of a dwelling is below the major system hydraulic grade line of the storm sewer. A backflow prevention device shall be installed at the gravity service connection line under such circumstance.

In situations where the frontage storm sewer does not have sufficient depth to accommodate a gravity service connection and an existing combined sewer in an open lane can accommodate the design runoff, a service connection to the combined sewer may be considered if there is an established City plan to separate combined sewer in the open lane in the future, subject to the approval of the Director of Engineering.

Every lot (existing or newly created) capable of being serviced, whether it is vacant or not, shall be provided with a separated service connection. The service connection shall be installed in accordance with the standard drawings.

The minimum diameter of all service connections shall be 150 mm and have a slope not less than 2.0% from the property line to the main. Refer to the Supplementary Specifications and Detail Drawings for the location of storm sewer connections. No service connection shall be installed on sewers greater than 4.5 m depth unless otherwise approved by the Director of Engineering.

Service connections will be located at the lowest corner of the property with the depth no less than 0.9 m. Where basements are proposed, the depths of the storm sewers and services shall be increased where feasible. The service connection invert shall be at least 0.6 m below the Minimum Building Elevation (MBE).

Connections to new mains shall be made with a standard wye fitting. Connections to existing mains may use wye saddle or insertable tee. The service connection centreline must not be below the centreline of the sewer main.

Inspection chambers are required on residential connections unless the service is less than 2.5 m long and connects to a manhole. Service connections exceeding 30 m in length shall be designed as storm sewers. Manholes are required on service connections larger than 250 mm diameter.

3.4.12 Surcharged Sewers

Every effort should be made to avoid surcharge of existing or proposed sewers unless surcharge is unavoidable due to conflicts with existing utilities, structures or other implications.

Surcharged sewers will have the 1:10 year and 1:25 year return storm hydraulic grade lines shown on the design drawings. In cases where the catch basins and storm sewers are designed to convey the 1:100 year return storm runoff, the 1:100 year hydraulic grade line shall also be shown. The 1:100 year hydraulic grade line shall be at least 0.3 below the lowest Minimum Building Elevation (MBE) of all of the serviced properties.

3.4.13 Culverts

The minimum culvert diameter will be:

a) 450mm for driveway crossing (Mainland)
b) 600mm or equivalent for driveway crossing (Queensborough)
c) 600mm for road crossings

Culverts crossing roads will be designed to accommodate the major flow with either an inlet or outlet control.
On collector and local roads, road overtopping is only allowed when the backwater profile does not negatively encumber properties. Where road overtopping is anticipated, appropriate scour protection shall be provided. All roads will be graded to provide the low point (sag) at the

watercourse culvert crossing to provide a fail-safe major system outlet with limited ponding on the road right-of-way.

Inlet and outlet structures are required for all major culverts. Design considerations are to include inlet control and outlet control conditions, energy dissipation and erosion control. The Consulting Engineer shall determine whether the culvert will operate under inlet or outlet control at design conditions. Aquatic habitat protection requirements must be considered for culverts in natural channels.

Driveway culverts shall be installed or approved for installation by the City. All new driveway culverts shall be sized to ensure that there is no adverse impact on the adjacent properties under the major system runoff conditions.

Culvert design calculations and assumptions shall be submitted for City and other regulatory agency approvals.

3.4.14 Flood Boxes

New flood boxes through an existing dike may be required to facilitate drainage. New flood boxes shall have a minimum diameter of 600 mm or as directed by the Director of Engineering. Flood boxes will incorporate a flap gate on the river side of the dike, and be reverse graded to ensure proper seating of the flap gate during high tide conditions.

Pressure treated timber support piles shall be installed on either side of the flood box and connected above and below the flood box with pressure treated 2x4 wood slats on the river side of the dike to anchor the flood box in place. At least 1/3 of the total height of the timber support piles will be buried below grade.

Flood boxes shall be backfilled with structural clay, containing no organics, compacted to 95% Standard Proctor Density (SPD). A non-woven geotextile may also be required beneath the flood box, as designed by the Consulting Engineer.

3.4.15 Ditches and Swales

Ditches are only permitted where approved by the Director of Engineering and shall be designed to convey minor system flows. Ditches shall be trapezoidal in shape having maximum side slopes of 1.5 H:1V and a minimum bottom width of 0.5 m, depending on the soil characteristics.

The minimum ditch profile slope is 0.5%, except in lowland areas. The maximum velocity in an unlined ditch will be 1.0 m/s. Higher velocities may be permitted where soil conditions are suitable or where erosion protection has been provided. On steep slopes, grade control structures may be used to reduce velocities.

The ditch right-of-way shall be sufficiently wide to provide a 3.6 m graded access road suitable for maintenance vehicles, in addition to the width required for the ditch, where the ditch is not adjacent to a municipal roadway.

Swales shall be used in road allowances where there is no curb and gutter to direct flow towards catch basins or the storm sewer system. Swales will be used in conjunction with proper lot grading to convey runoff and minor flows, as well as direct major flows within City right-of-way.

Ditches and swales are to be incorporated into road designs.

3.4.16 Inlet and Outlet Structures

The Standard Detail Drawings shall be used as a guide for designing inlet and outlet structures for storm sewers and culverts. Structures that vary from the standard drawings shall include specific structural design with details shown on the drawings.

Design of inlet and outlet structures is to include consideration of energy dissipation and erosion control. Outlets for culverts and storm sewers having discharge velocities greater than 1.0 m/s require evaluation of the downstream channel. Rip-rap or an approved energy dissipating structure may be required to control erosion.

A trash screen/safety grillage is required at the entrance to every permanent storm sewer or culvert over 450 mm diameter or greater than 30 m in length (except large culverts over 1200 mm diameter). Grating with vertical bars, spaced no more than 150 mm apart, shall be installed and fixed in the form of a gate with adequate means for locking in a closed position. Provision for opening or removal of the gate for cleaning or replacing the bars is required. Gratings shall be designed to break away under extreme hydraulic loads in the case of blockage.

Outfalls located in parks, ravines or on river banks should be aesthetically pleasing and safe. The appearance of these structures is important and cosmetic treatment or concealment shall be part of the design.

Guard-rails or fences made of corrosion resistant material shall be installed along concrete headwalls and wing walls to provide protection against persons inadvertently falling over the wall.

A storm sewer inlet from a ditch shall have a minimum diameter of 450 mm.

3.4.17 Flow Control Structures

For the design of flow control of storage facilities, riparian diversions and trunk sewer diversions, the orifice and weir equations may be used.

Orifice Equation:

$$Q = CA(2gh)^{0.5}$$

Where, Q = Desired Release flow (m^3/s)
A = Area of Orifice (m^2)
g = Acceleration due to Gravity (m/s^2)
h = Net Head on the Orifice Plate (m)
C = Coefficient of Discharge (0.62 for sharp or square edged orifices)

The minimum orifice size shall be 100 mm in diameter. Where smaller orifices are required, special provisions are required to prevent blockage. These special provisions shall be clearly marked on the design drawings.

Weir Equation:

$$Q = CLH^{1.5}$$

Where, Q = Desired Release flow (m^3/s)
C = Coefficient of Discharge (0.62 for sharp or square edged orifice)
L = Effective Length of Weir Crest (m)
H = Total Head on Crest (m)

Flow control manholes shall be a minimum of 1200 mm diameter to provide for access and maintenance. The design of a flow control structure will include provision for safe conveyance of overflows.

3.4.18 Ditch Enclosure

Roadside ditch enclosures will be replaced with an approved storm sewer system:

a) To provide access to adjacent municipal or private property;
b) To meet safety needs; or
c) To meet community objectives if the ditch is classified as Class C or D under the City's Watercourse Classification System.

Open ditches along local streets in Queensborough are required to be enclosed with an engineered storm drainage system unless otherwise specified by the Director of Engineering.

For Class B and higher classification watercourses, input from qualified environmental professionals and authorization from regulatory agencies will be required.
The design of the storm sewer system must provide compensation for lost storage volume resulting from the enclosure and ensure that there is no negative impact to upstream private or municipal property or infrastructure. Water surface profiles and hydraulic grade lines within the ditch in the vicinity of the proposed enclosure shall be shown on the design drawings.

3.4.19 Major Flow Routes

Unless the storm sewer system is oversized to accommodate the major flow (i.e. 1:100 year return frequency storm), overland major flow routing is required. The major flow routing will normally be provided along roadways, culvert crossings and watercourses. In some cases the major flow may be carried alongside the road in swales or across side and rear of lots. These designated flow paths shall be protected by restrictive covenants or statutory rights-of-way and clearly identified in the Stormwater Management Plans.

The quantity of flow to be conveyed by the surface flow path is the total overland flow minus the capacity of the piped system. The major flow routing shall be designed to ensure public safety and to minimize property damage under the major flow conditions.

Urban roadways with curbs and gutters can be designed as wide shallow channels to convey overland major flow. The maximum depths of flow shall not exceed 140 mm above the gutter line.

The design of intersections shall ensure that the surface flow can continue along the designated path crossing over lateral streets. Similar considerations are required if a change of direction is required at an intersection.

Flooding will not permitted on private properties except in flow channels in municipal rights-of-way.
Flow capacity of the overland flow routes can be calculated using the Manning formula presented in Section 3.3.3. Typical values of the Manning's roughness coefficient "n" are:

- 0.018 for paved roadway
- 0.030 for grassed boulevards and swales;
- 0.040 to 0.100 for irregular or treed channels.

All habitable areas of buildings, including basements, shall be above the 1:100 year HGL, except where specific flood proofing measures to eliminate backwater effects from the downstream City system have been incorporated.

In special circumstances, or to accommodate low building elevations, the minor storm drainage system may be enlarged or supplemented to accommodate major flows, subject to the approval by the Director of Engineering.

3.5 Stormwater Runoff Rate Controls

Stormwater runoff controls are required to meet the objectives of the Citywide ISMP. Proper operations and maintenance of the on-site and off-site systems are required to ensure the long-term effectiveness of these controls.

- For on-site facilities (typically located within multi-family residential and non-residential sites), registered covenants for proper maintenance by the Owner is required to the satisfaction of the Director of Engineering.
- For off-site facilities (public lands, road right-of-ways and parks), operation and maintenance is the responsibility of the City.

Detention storage facilities to control discharge rates include:

- On-line control where the flow path is within the storage facility; and
- Off-line control where the storage facility is separate from the normal flow path and is filled by overflow during severe event.

Refer to the *New Westminster Citywide ISMP Volume II, Best Management Practice Toolkit* for specific onsite stormwater management facility options and design guidelines. Off-site runoff control facility options and design guidelines are provided in the section below.
Large storage facilities shall include provisions for discharges rates greater than design release rates. Rapid drawdown of the water level may be necessary for emergency purposes or to restore the available storage to accommodate subsequent storm events.

3.5.1 Off-Site Detention Storage Facilities

a) Underground Storage

Underground storage can be provided with subsurface tanks or oversized pipes with outlet controls. Storage facilities may be on-line or off-line. Cross sections, inlet and outlet locations and maintenance access shall be designed to minimize maintenance requirements.

Structural design is required to accommodate anticipated traffic loads and groundwater pressure.

Runoff controls are required to meet the objectives indicated in previous sections.

b) Dry Detention Ponds

Dry ponds are intended to provide storage only during severe storm events. They may be on-line or off-line and are generally located off-site. Dry Ponds shall accommodate active recreational uses. Overflow elevations shall be designed below adjacent MBE's.

Design details, other than discharge rates, should be in accordance with current technologies as outlined in *Land Development Guidelines for Protection of Aquatic Habitat* (Canada/BC), and related documents.

c) Wet Detention Ponds

Wet ponds are intended to provide on-line detention storage and maintain a permanent minimum water level year round. They are generally located off-site.

A wet pond shall have a minimum tributary catchment area of 20 ha to limit number of ponds and also to ensure sufficient base flows to sustain wet storage without the pond becoming stagnant.

Overflow elevations shall be designed below adjacent MBE's.

Design details other than discharge rates should be in accordance with current technologies as outlined in *Land Development Guidelines for Protection of Aquatic Habitat* (Canada/BC), and related documents.

3.5.2 Outlet Controls

Outlet controls for storage facilities may be designed using the standard orifice and weir equations provided in Section 3.4.17.

Provisions to accommodate higher discharges will involve oversizing the fixed openings and sewers connected to the outlet control structure. Adjustable mechanisms such as slide gates or removable orifice plates can be used to regulate design release rates. The extent of the oversizing will depend on the capacity of the downstream drainage system.

The access to the outlet control structures shall be provided with access hatches with lock.

3.6 Stormwater Quality and Volume Controls

Stormwater quality and volume control will typically be provided onsite at or near the source. Refer to the *New Westminster Citywide ISMP Volume II, Best Management Practice Toolkit* for specific onsite stormwater management facility options and design guidelines. A number of additional stormwater quality control measures are also listed herein.

Stormwater Quality Source Control Criteria

a) **Single Family, Duplex and Triplex Residential Area**: Treat 28 mm rainfall in 24 hours.

Ground level paved surfaces (including driveways, patios and walkways) shall:

- Drain to vegetation area with deep (450 mm) absorbent soils;
- Use pervious paving; or
- Collect and drain runoff through a sump prior to discharge to the City storm sewer system.

b) **All other lands uses and streets**: Treat 50 mm rainfall in 24 hours from impervious areas with appropriate Best Management Practices (BMP's) in consultation with the City. Rate of discharge will not be greater than required to provide suitable hydraulic retention time as to maximize the effectiveness of the specific BMP.

Stormwater Volume Reduction Criteria

c) Capture the first 25 mm to 50 mm rainfall in 24 hours onsite. Volume reduction targets vary depending on land use type and receiving water as per the Citywide ISMP.

Stormwater Detention and Rate Control Criteria

d) "Large Scale Developments": Use detention and/or other best practices to reduce post development runoff rates as per the rate control targets set for different areas in the Citywide ISMP.

3.6.1 Roof Drainage

Roof runoff for all new dwellings is encouraged to be harvested and reused such as discharging to on-site absorbent landscape areas via downspout splash pads. Disconnected roof drainage will be subject to an approval process and only in neighbourhoods with foundation drains at buildings.

In cases where roof drainage is directed to the ground surface, water quality and volume reduction targets will apply to the roof drainage. The use of deep absorbent soils and/or properly sized rain gardens for infiltration of the small and large storm events shall be considered with provision for safe conveyance of extreme storm overflow from private property to the public major drainage flow path.

Where discharge of roof leaders to splash pads is not feasible, roof drainage may be discharged into the City drainage system at the discretion of the Director of Engineering if the proposed or existing storm sewer can be shown to accommodate the anticipated flows. The roof leaders shall be connected directly to the storm service connection at the property line. Roof leaders shall not be connected to foundation drains.

3.6.2 Oil and Grit Separators

Oil and grit separators are used to remove coarse sediments and capture oil from surface runoff. They shall be provided by the Owner to service parking lots, multi-family residential, commercial, institutional and industrial sites as well as other hard surfaces.

The Consulting Engineer is responsible to select an appropriate type of separator to suit each application. The location for installations shall be accessible for cleaning and inspection.

Design details shall be provided by the product supplier or the Consulting Engineer for approval by the Director of Engineering.

3.6.3 Coalescing Plate Oil Separator

Where requested by the Director of Engineering, at sites likely to generate high concentrations of oil for sustained periods (generally > 20 mg/L) such as gasoline service stations, vehicle maintenance yards and industrial areas, a coalescing plate oil separator shall be installed. These units are oil and grit separators with the addition of coalescing plate packs to significantly enhance oil capture capabilities.

Table 3-2

TABLE 3.2: STORM SEWER DESIGN - RATIONAL METHOD (TEMPLATE)

Project Title: ____________
Project Location: ____________
Municipal Proj #: ____________
Client: ____________

Storm Sewer Design Criteria
Design Return Period: 1:10 Year
Climate Change Design Horizon: 2050
MANNINGS "n": 0.013 Concrete Pipe
CONSULTANT: ABC Company
RAIN DATA: New Westminster IDF Curves

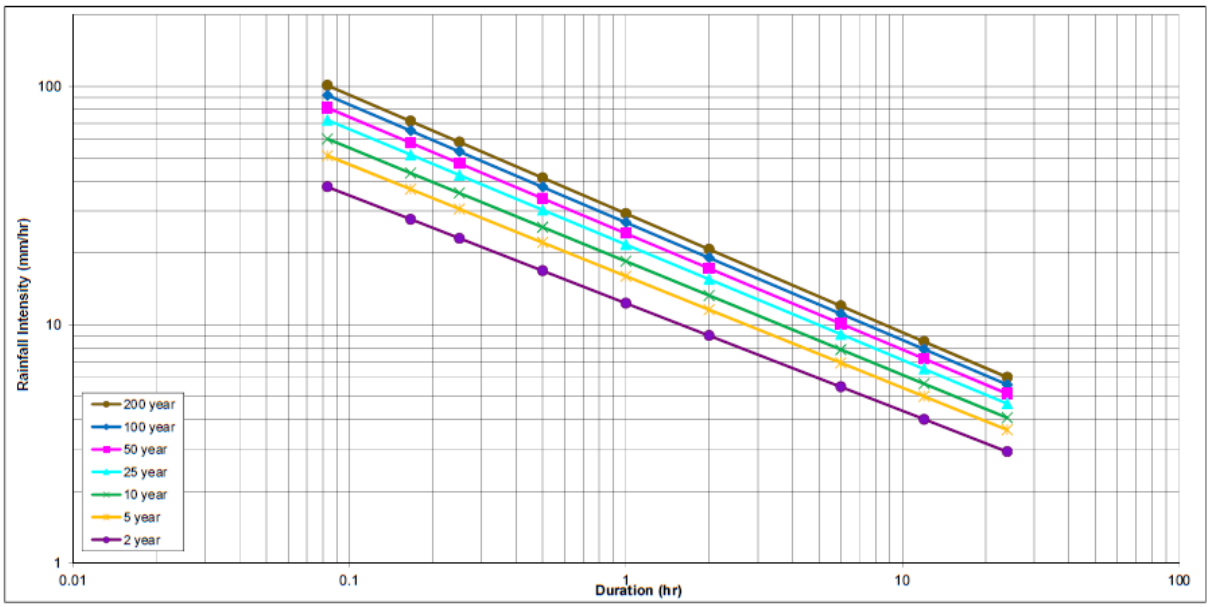
Consultant Proj #: XX-XXX
Page: 1 of 1
Designed by: XXX
Checked by: XXX
Date: DD/MM/YYYY

Locations			Sub-Catchments							Flow Calculations		Pipe Parameters								Comments
Street	Manhole		Sub-Catchment No.	Area	Runoff Coefficient	AxR	SUM AxR	Time of Concentration		Rainfall Intensity	Q_5 Q_{100}	Sewer Design						Flow Ratio (Max/Full Flow)		Location of HGL
	From	To		A ha	R			Ti min	Total Tc min	I mm/hr	cms	SLOPE %	DIA mm	L m	n	Vcap m/s	Qcap cms	Q_5/Qcap %	Q_{100}/Qcap %	100 YEAR FLOW ROUTES

NOTES:

NEW WESTMINSTER RAINFALL INTENSITY DATA

FIGURE 3.1: CURRENT (2016) CLIMATE RAINFALL INTENSITY - DURATION FREQUENCY CURVE
RAINFALL ZONE 4 DIMENSIONLESS IDF CURVE WITH SELECTED PEAK INDEX RAINS FOR NEW WESTMINSTER
DATA FROM STUDY OF THE IMPACTS OF CLIMATE CHANGE ON PRECIPITATION AND STORMWATER MANAGEMENT (AUG 2018)



RAINFALL INTENSITY-DURATION FREQUENCY INTERPOLATION EQUATION

IDF EQUATION	RETURN PERIOD						
PARAMETERS	2 year	5 year	10 year	25 year	50 year	100 year	200 year
Coefficient A	12.306	15.995	18.445	21.688	24.161	26.882	29.259
Exponent B	-0.452	-0.468	-0.476	-0.484	-0.488	-0.494	-0.498

I = A*T^B (I = intensity in mm/h, T = storm duration in hours)

RAINFALL INTENSITY-DURATION FREQUENCY VALUES (All Duration)
COMPUTED FROM THE INTERPOLATION EQUATION

DURATION	RETURN PERIOD						
	2 year	5 year	10 year	25 year	50 year	100 year	200 year
	Rainfall Intensity (mm/hr)						
5 min	37.8	51.2	60.2	72.2	81.2	91.7	100.9
10 min	27.7	37.0	43.3	51.6	57.9	65.1	71.4
15 min	23.0	30.6	35.7	42.4	47.5	53.3	58.4
30 min	16.8	22.1	25.7	30.3	33.9	37.9	41.3
1 h	12.3	16.0	18.4	21.7	24.2	26.9	29.3
2 h	9.0	11.6	13.3	15.5	17.2	19.1	20.7
6 h	5.5	6.9	7.9	9.1	10.1	11.1	12.0
12 h	4.0	5.0	5.7	6.5	7.2	7.9	8.5
24 h	2.9	3.6	4.1	4.7	5.1	5.6	6.0

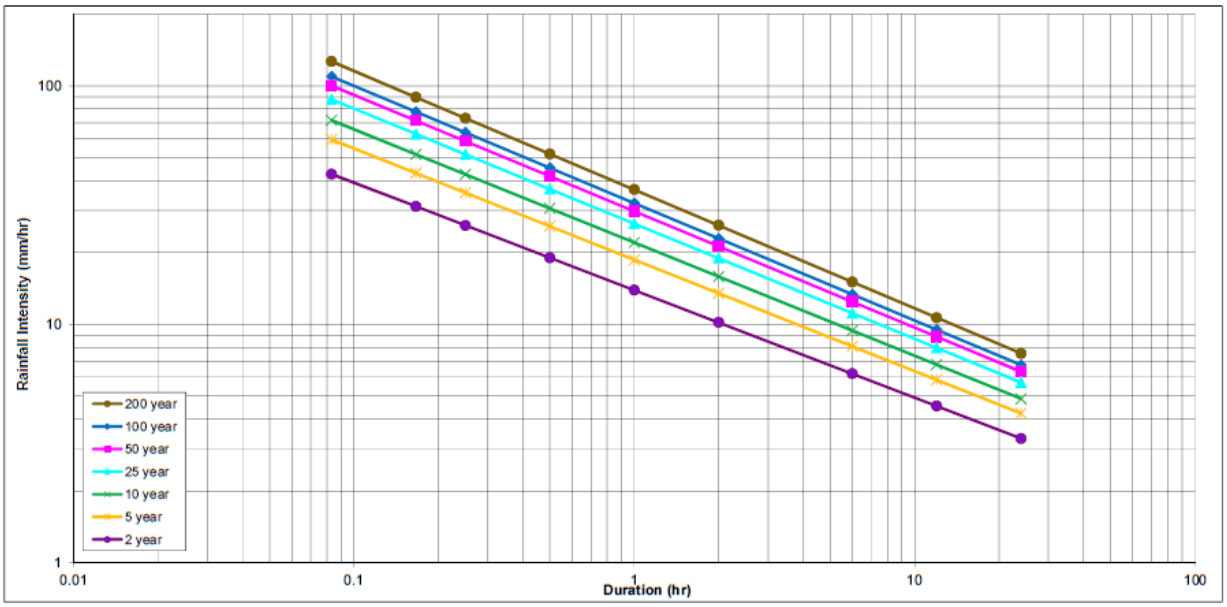
RETURN PERIOD DESIGN RAINFALL AMOUNTS (All Duration)

DURATION	RETURN PERIOD						
	2 year	5 year	10 year	25 year	50 year	100 year	200 year
	Rainfall Amount (mm)						
1h	12.3	16.0	18.4	21.7	24.2	26.9	29.3
2 h	18.0	23.1	26.5	31.0	34.5	38.2	41.4
6 h	32.9	41.5	47.2	54.7	60.5	66.6	71.9
12 h	48.0	60.0	67.8	78.2	86.2	94.5	101.9
24 h	70.2	86.7	97.5	111.8	123.0	134.2	144.3

NEW WESTMINSTER RAINFALL INTENSITY DATA

FIGURE 3.2: FUTURE 2050 CLIMATE RAINFALL INTENSITY - DURATION FREQUENCY CURVE WITH ZONE 4 DELTA CHANGES FOR 2050 MODERATE CLIMATE CHANGE SCENARIO

DATA FROM STUDY OF THE IMPACTS OF CLIMATE CHANGE ON PRECIPITATION AND STORMWATER MANAGEMENT (AUG 2018)



RAINFALL INTENSITY-DURATION FREQUENCY INTERPOLATION EQUATION

IDF EQUATION PARAMETERS	RETURN PERIOD						
	2 year	5 year	10 year	25 year	50 year	100 year	200 year
Coefficient A	13.894	18.636	22.024	26.430	29.781	32.202	36.692
Exponent B	-0.451	-0.467	-0.475	-0.483	-0.488	-0.492	-0.498

I = A*T^B (I = intensity in mm/h, T = storm duration in hours)

RAINFALL INTENSITY-DURATION FREQUENCY VALUES (All Duration)
COMPUTED FROM THE INTERPOLATION EQUATION

DURATION	RETURN PERIOD						
	2 year	5 year	10 year	25 year	50 year	100 year	200 year
	Rainfall Intensity (mm/hr)						
5 min	42.6	59.5	71.7	87.8	100.1	109.4	126.5
10 min	31.2	43.0	51.6	62.8	71.4	77.8	89.6
15 min	26.0	35.6	42.5	51.6	58.6	63.7	73.2
30 min	19.0	25.8	30.6	36.9	41.8	45.3	51.8
1 h	13.9	18.6	22.0	26.4	29.8	32.2	36.7
2 h	10.2	13.5	15.8	18.9	21.2	22.9	26.0
6 h	6.2	8.1	9.4	11.1	12.4	13.3	15.0
12 h	4.5	5.8	6.8	8.0	8.9	9.5	10.6
24 h	3.3	4.2	4.9	5.7	6.3	6.7	7.5

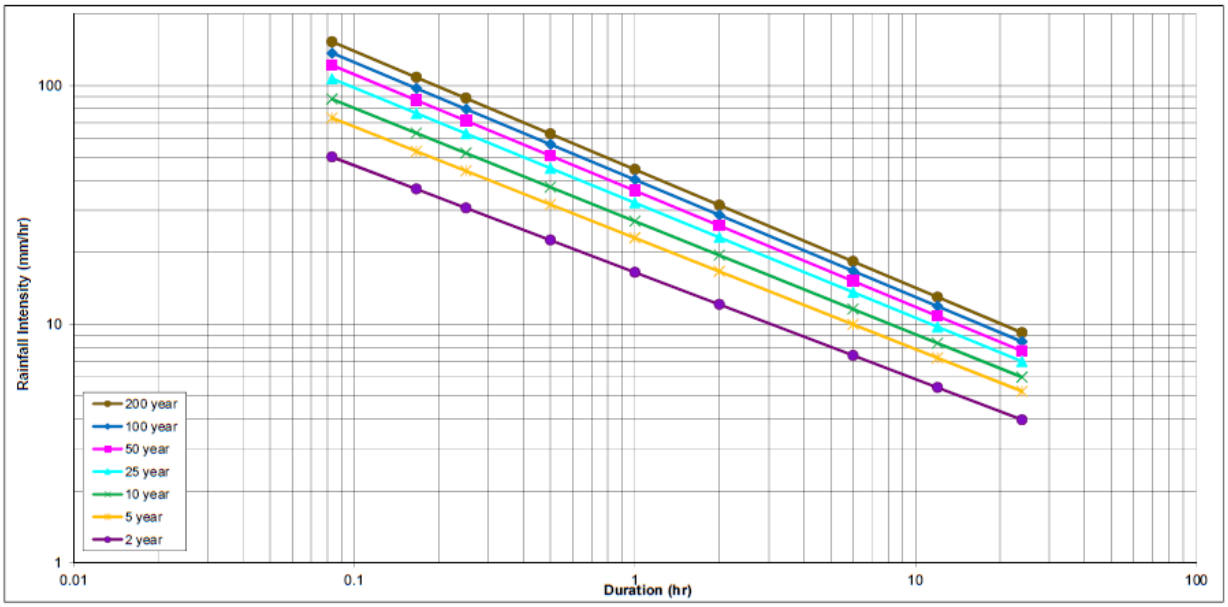
RETURN PERIOD DESIGN RAINFALL AMOUNTS (All Duration)

DURATION	RETURN PERIOD						
	2 year	5 year	10 year	25 year	50 year	100 year	200 year
	Rainfall Amount (mm)						
1h	13.9	18.6	22.0	26.4	29.8	32.2	36.7
2 h	20.3	27.0	31.7	37.8	42.5	45.8	52.0
6 h	37.2	48.4	56.4	66.7	74.5	80.0	90.2
12 h	54.4	70.1	81.2	95.5	106.3	113.8	127.7
24 h	79.5	101.4	116.8	136.7	151.6	161.8	180.9

NEW WESTMINSTER RAINFALL INTENSITY DATA

FIGURE 3.3: FUTURE 2100 CLIMATE RAINFALL INTENSITY - DURATION FREQUENCY CURVE WITH ZONE 4 DELTA CHANGES FOR 2100 MODERATE CLIMATE CHANGE SCENARIO

DATA FROM STUDY OF THE IMPACTS OF CLIMATE CHANGE ON PRECIPITATION AND STORMWATER MANAGEMENT (AUG 2018)



RAINFALL INTENSITY-DURATION FREQUENCY INTERPOLATION EQUATION

IDF EQUATION PARAMETERS	RETURN PERIOD						
	2 year	5 year	10 year	25 year	50 year	100 year	200 year
Coefficient A	16.493	22.981	27.015	32.257	36.257	40.330	44.490
Exponent B	-0.448	-0.466	-0.474	-0.482	-0.487	-0.492	-0.496

I = A*T^B (I = intensity in mm/h, T = storm duration in hours)

RAINFALL INTENSITY-DURATION FREQUENCY VALUES (All Duration)
COMPUTED FROM THE INTERPOLATION EQUATION

DURATION	RETURN PERIOD						
	2 year	5 year	10 year	25 year	50 year	100 year	200 year
	Rainfall Intensity (mm/hr)						
5 min	50.2	73.2	87.7	106.9	121.6	137.0	152.6
10 min	36.8	53.0	63.2	76.5	86.8	97.4	108.2
15 min	30.7	43.8	52.1	62.9	71.2	79.8	88.5
30 min	22.5	31.7	37.5	45.1	50.8	56.7	62.7
1 h	16.5	23.0	27.0	32.3	36.3	40.3	44.5
2 h	12.1	16.6	19.4	23.1	25.9	28.7	31.5
6 h	7.4	10.0	11.6	13.6	15.2	16.7	18.3
12 h	5.4	7.2	8.3	9.7	10.8	11.9	13.0
24 h	4.0	5.2	6.0	7.0	7.7	8.4	9.2

RETURN PERIOD DESIGN RAINFALL AMOUNTS (All Duration)

DURATION	RETURN PERIOD						
	2 year	5 year	10 year	25 year	50 year	100 year	200 year
	Rainfall Amount (mm)						
1h	16.5	23.0	27.0	32.3	36.3	40.3	44.5
2 h	24.2	33.3	38.9	46.2	51.7	57.4	63.1
6 h	44.3	59.8	69.3	81.6	90.9	100.2	109.8
12 h	65.0	86.6	99.8	116.9	129.7	142.5	155.7
24 h	95.3	125.4	143.7	167.3	185.1	202.7	220.7

TABLE 3.4: NEW WESTMINSTER DESIGN STORM
1:2-Year Design Storms - CURRENT CLIMATE

1-Hour Storm		2-Hour Storm		6-Hour Storm		12-Hour Storm		24-Hour Storm	
Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)
0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5	7.38	5	5.40	10	3.95	10	1.21	20	1.36
10	8.86	10	5.40	20	3.95	20	1.21	40	1.41
15	13.29	15	6.48	30	3.95	30	1.21	60	1.41
20	13.29	20	6.48	40	4.61	40	2.42	80	1.76
25	14.77	25	9.71	50	4.61	50	2.42	100	1.76
30	16.25	30	9.71	60	4.61	60	2.42	120	1.76
35	20.67	35	9.71	70	5.91	70	2.91	140	2.11
40	16.25	40	9.71	80	5.91	80	2.91	160	2.11
45	11.81	45	10.81	90	5.91	90	2.91	180	2.11
50	10.35	50	10.81	100	5.26	100	3.39	200	2.45
55	8.86	55	11.87	110	5.23	110	3.39	220	2.45
60	5.90	60	11.87	120	5.26	120	3.39	240	2.45
		65	15.11	130	5.26	130	4.35	260	3.15
		70	15.11	140	5.23	140	4.35	280	3.15
		75	11.87	150	5.26	150	4.35	300	3.15
		80	11.87	160	7.89	160	5.81	320	4.22
		85	8.64	170	7.89	170	5.81	340	4.22
		90	8.64	180	7.89	180	5.81	360	4.22
		95	7.55	190	5.91	190	8.23	380	5.97
		100	7.55	200	5.91	200	8.23	400	5.97
		105	6.48	210	5.91	210	8.23	420	5.97
		110	6.48	220	5.91	220	10.17	440	7.37
		115	4.32	230	5.91	230	10.17	460	7.37
		120	4.32	240	5.91	240	10.17	480	7.37
				250	5.91	250	7.74	500	5.61
				260	5.91	260	7.74	520	5.61
				270	5.91	270	7.74	540	5.61
				280	5.26	280	6.29	560	4.56
				290	5.25	290	6.29	580	4.56
				300	5.26	300	6.29	600	4.56
				310	5.26	310	5.81	620	4.22
				320	5.23	320	5.81	640	4.22
				330	5.26	330	5.81	660	4.22
				340	4.61	340	4.84	680	3.51
				350	4.61	350	4.84	700	3.51
				360	4.61	360	4.84	720	3.51
						370	3.87	740	2.81
						380	3.87	760	2.81
						390	3.87	780	2.81
						400	4.35	800	3.15
						410	4.35	820	3.15
						420	4.35	840	3.15
						430	2.91	860	2.11
						440	2.91	880	2.11
						450	2.91	900	2.11
						460	3.87	920	2.81
						470	3.87	940	2.81
						480	3.87	960	2.81
						490	2.91	980	2.11
						500	2.91	1000	2.11
						510	2.91	1020	2.11
						520	2.42	1040	1.76
						530	2.42	1060	1.76
						540	2.42	1080	1.76
						550	1.94	1100	1.41
						560	1.94	1120	1.41
						570	1.94	1140	1.41
						580	2.42	1160	1.76
						590	2.42	1180	1.76
						600	2.42	1200	1.76
						610	1.94	1220	1.41
						620	1.94	1240	1.41
						630	1.94	1260	1.41
						640	1.94	1280	1.41
						650	1.94	1300	1.41
						660	1.94	1320	1.41
						670	2.42	1340	1.76
						680	2.42	1360	1.76
						690	2.42	1380	1.76
						700	1.94	1400	1.41
						710	1.94	1420	1.41
						720	1.94	1440	1.41
Total Rain (mm)	12.31		17.99		32.85		48.03		70.22

TABLE 3.5: NEW WESTMINSTER DESIGN STORM
1:5-Year Design Storms - CURRENT CLIMATE

1-Hour Storm		2-Hour Storm		6-Hour Storm		12-Hour Storm		24-Hour Storm	
Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)
0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5	9.60	5	6.94	10	4.99	10	1.51	20	1.68
10	11.52	10	6.94	20	4.99	20	1.51	40	1.74
15	17.27	15	8.33	30	4.99	30	1.51	60	1.74
20	17.27	20	8.33	40	5.82	40	3.02	80	2.18
25	19.19	25	12.48	50	5.82	50	3.02	100	2.18
30	21.12	30	12.48	60	5.82	60	3.02	120	2.18
35	26.87	35	12.48	70	7.46	70	3.63	140	2.60
40	21.12	40	12.48	80	7.46	80	3.63	160	2.60
45	15.34	45	13.90	90	7.46	90	3.63	180	2.60
50	13.45	50	13.90	100	6.65	100	4.23	200	3.03
55	11.52	55	15.26	110	6.60	110	4.23	220	3.03
60	7.67	60	15.26	120	6.65	120	4.23	240	3.03
		65	19.42	130	6.65	130	5.44	260	3.89
		70	19.42	140	6.60	140	5.44	280	3.89
		75	15.26	150	6.65	150	5.44	300	3.89
		80	15.26	160	9.96	160	7.25	320	5.21
		85	11.11	170	9.96	170	7.25	340	5.21
		90	11.11	180	9.96	180	7.25	360	5.21
		95	9.70	190	7.46	190	10.28	380	7.37
		100	9.70	200	7.46	200	10.28	400	7.37
		105	8.33	210	7.46	210	10.28	420	7.37
		110	8.33	220	7.46	220	12.70	440	9.11
		115	5.55	230	7.46	230	12.70	460	9.11
		120	5.55	240	7.46	240	12.70	480	9.11
				250	7.46	250	9.67	500	6.93
				260	7.46	260	9.67	520	6.93
				270	7.46	270	9.67	540	6.93
				280	6.65	280	7.85	560	5.64
				290	6.64	290	7.85	580	5.64
				300	6.65	300	7.85	600	5.64
				310	6.65	310	7.25	620	5.21
				320	6.60	320	7.25	640	5.21
				330	6.65	330	7.25	660	5.21
				340	5.82	340	6.05	680	4.34
				350	5.82	350	6.05	700	4.34
				360	5.82	360	6.05	720	4.34
						370	4.83	740	3.47
						380	4.83	760	3.47
						390	4.83	780	3.47
						400	5.44	800	3.89
						410	5.44	820	3.89
						420	5.44	840	3.89
						430	3.63	860	2.60
						440	3.63	880	2.60
						450	3.63	900	2.60
						460	4.83	920	3.47
						470	4.83	940	3.47
						480	4.83	960	3.47
						490	3.63	980	2.60
						500	3.63	1000	2.60
						510	3.63	1020	2.60
						520	3.02	1040	2.18
						530	3.02	1060	2.18
						540	3.02	1080	2.18
						550	2.42	1100	1.74
						560	2.42	1120	1.74
						570	2.42	1140	1.74
						580	3.02	1160	2.18
						590	3.02	1180	2.18
						600	3.02	1200	2.18
						610	2.42	1220	1.74
						620	2.42	1240	1.74
						630	2.42	1260	1.74
						640	2.42	1280	1.74
						650	2.42	1300	1.74
						660	2.42	1320	1.74
						670	3.02	1340	2.18
						680	3.02	1360	2.18
						690	3.02	1380	2.18
						700	2.42	1400	1.74
						710	2.42	1420	1.74
						720	2.42	1440	1.74
Total Rain (mm)	16.00		23.13		41.49		59.99		86.75

TABLE 3.6: NEW WESTMINSTER DESIGN STORMS
1:10-Year Design Storms - CURRENT CLIMATE

1-Hour Storm		2-Hour Storm		6-Hour Storm		12-Hour Storm		24-Hour Storm	
Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)
0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5	11.07	5	7.96	10	5.67	10	1.71	20	1.89
10	13.29	10	7.96	20	5.67	20	1.71	40	1.95
15	19.91	15	9.55	30	5.67	30	1.71	60	1.95
20	19.91	20	9.55	40	6.61	40	3.41	80	2.45
25	22.13	25	14.32	50	6.61	50	3.41	100	2.45
30	24.35	30	14.32	60	6.61	60	3.41	120	2.45
35	30.98	35	14.32	70	8.49	70	4.11	140	2.93
40	24.35	40	14.32	80	8.49	80	4.11	160	2.93
45	17.69	45	15.94	90	8.49	90	4.11	180	2.93
50	15.51	50	15.94	100	7.56	100	4.79	200	3.41
55	13.29	55	17.50	110	7.50	110	4.79	220	3.41
60	8.85	60	17.50	120	7.56	120	4.79	240	3.41
		65	22.27	130	7.56	130	6.15	260	4.37
		70	22.27	140	7.50	140	6.15	280	4.37
		75	17.50	150	7.56	150	6.15	300	4.37
		80	17.50	160	11.33	160	8.20	320	5.86
		85	12.74	170	11.33	170	8.20	340	5.86
		90	12.74	180	11.33	180	8.20	360	5.86
		95	11.13	190	8.49	190	11.63	380	8.29
		100	11.13	200	8.49	200	11.63	400	8.29
		105	9.55	210	8.49	210	11.63	420	8.29
		110	9.55	220	8.49	220	14.36	440	10.24
		115	6.36	230	8.49	230	14.36	460	10.24
		120	6.36	240	8.49	240	14.36	480	10.24
				250	8.49	250	10.93	500	7.79
				260	8.49	260	10.93	520	7.79
				270	8.49	270	10.93	540	7.79
				280	7.56	280	8.88	560	6.34
				290	7.54	290	8.88	580	6.34
				300	7.56	300	8.88	600	6.34
				310	7.56	310	8.20	620	5.86
				320	7.50	320	8.20	640	5.86
				330	7.56	330	8.20	660	5.86
				340	6.61	340	6.84	680	4.88
				350	6.61	350	6.84	700	4.88
				360	6.61	360	6.84	720	4.88
						370	5.47	740	3.90
						380	5.47	760	3.90
						390	5.47	780	3.90
						400	6.15	800	4.37
						410	6.15	820	4.37
						420	6.15	840	4.37
						430	4.11	860	2.93
						440	4.11	880	2.93
						450	4.11	900	2.93
						460	5.47	920	3.90
						470	5.47	940	3.90
						480	5.47	960	3.90
						490	4.11	980	2.93
						500	4.11	1000	2.93
						510	4.11	1020	2.93
						520	3.41	1040	2.45
						530	3.41	1060	2.45
						540	3.41	1080	2.45
						550	2.73	1100	1.95
						560	2.73	1120	1.95
						570	2.73	1140	1.95
						580	3.41	1160	2.45
						590	3.41	1180	2.45
						600	3.41	1200	2.45
						610	2.73	1220	1.95
						620	2.73	1240	1.95
						630	2.73	1260	1.95
						640	2.73	1280	1.95
						650	2.73	1300	1.95
						660	2.73	1320	1.95
						670	3.41	1340	2.45
						680	3.41	1360	2.45
						690	3.41	1380	2.45
						700	2.73	1400	1.95
						710	2.73	1420	1.95
						720	2.73	1440	1.95
Total Rain (mm)	18.45		26.52		47.17		67.82		97.52

TABLE 3.7: NEW WESTMINSTER DESIGN STORMS
1:25-Year Design Storms - CURRENT CLIMATE

1-Hour Storm		2-Hour Storm		6-Hour Storm		12-Hour Storm		24-Hour Storm	
Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)
0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5	13.01	5	9.30	10	6.57	10	1.97	20	2.17
10	15.62	10	9.30	20	6.57	20	1.97	40	2.24
15	23.42	15	11.17	30	6.57	30	1.97	60	2.24
20	23.42	20	11.17	40	7.67	40	3.93	80	2.81
25	26.03	25	16.74	50	7.67	50	3.93	100	2.81
30	28.64	30	16.74	60	7.67	60	3.93	120	2.81
35	36.43	35	16.74	70	9.84	70	4.73	140	3.36
40	28.64	40	16.74	80	9.84	80	4.73	160	3.36
45	20.81	45	18.64	90	9.84	90	4.73	180	3.36
50	18.23	50	18.64	100	8.76	100	5.52	200	3.91
55	15.62	55	20.47	110	8.70	110	5.52	220	3.91
60	10.40	60	20.47	120	8.76	120	5.52	240	3.91
		65	26.04	130	8.76	130	7.08	260	5.01
		70	26.04	140	8.70	140	7.08	280	5.01
		75	20.47	150	8.76	150	7.08	300	5.01
		80	20.47	160	13.13	160	9.45	320	6.71
		85	14.89	170	13.13	170	9.45	340	6.71
		90	14.89	180	13.13	180	9.45	360	6.71
		95	13.01	190	9.84	190	13.40	380	9.50
		100	13.01	200	9.84	200	13.40	400	9.50
		105	11.17	210	9.84	210	13.40	420	9.50
		110	11.17	220	9.84	220	16.55	440	11.74
		115	7.44	230	9.84	230	16.55	460	11.74
		120	7.44	240	9.84	240	16.55	480	11.74
				250	9.84	250	12.60	500	8.93
				260	9.84	260	12.60	520	8.93
				270	9.84	270	12.60	540	8.93
				280	8.76	280	10.23	560	7.26
				290	8.74	290	10.23	580	7.26
				300	8.76	300	10.23	600	7.26
				310	8.76	310	9.45	620	6.71
				320	8.70	320	9.45	640	6.71
				330	8.76	330	9.45	660	6.71
				340	7.67	340	7.88	680	5.59
				350	7.67	350	7.88	700	5.59
				360	7.67	360	7.88	720	5.59
						370	6.30	740	4.48
						380	6.30	760	4.48
						390	6.30	780	4.48
						400	7.08	800	5.01
						410	7.08	820	5.01
						420	7.08	840	5.01
						430	4.73	860	3.36
						440	4.73	880	3.36
						450	4.73	900	3.36
						460	6.30	920	4.48
						470	6.30	940	4.48
						480	6.30	960	4.48
						490	4.73	980	3.36
						500	4.73	1000	3.36
						510	4.73	1020	3.36
						520	3.93	1040	2.81
						530	3.93	1060	2.81
						540	3.93	1080	2.81
						550	3.15	1100	2.24
						560	3.15	1120	2.24
						570	3.15	1140	2.24
						580	3.93	1160	2.81
						590	3.93	1180	2.81
						600	3.93	1200	2.81
						610	3.15	1220	2.24
						620	3.15	1240	2.24
						630	3.15	1260	2.24
						640	3.15	1280	2.24
						650	3.15	1300	2.24
						660	3.15	1320	2.24
						670	3.93	1340	2.81
						680	3.93	1360	2.81
						690	3.93	1380	2.81
						700	3.15	1400	2.24
						710	3.15	1420	2.24
						720	3.15	1440	2.24
Total Rain (mm)	21.69		31.01		54.67		78.18		111.79

TABLE 3.8: NEW WESTMINSTER DESIGN STORMS
1:100-Year Design Storms - CURRENT CLIMATE

1-Hour Storm		2-Hour Storm		6-Hour Storm		12-Hour Storm		24-Hour Storm	
Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)	Time (min)	Intensity (mm/hr)
0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5	16.13	5	11.45	10	8.00	10	2.38	20	2.61
10	19.36	10	11.45	20	8.00	20	2.38	40	2.69
15	29.02	15	13.74	30	8.00	30	2.38	60	2.69
20	29.02	20	13.74	40	9.33	40	4.76	80	3.37
25	32.26	25	20.61	50	9.33	50	4.76	100	3.37
30	35.49	30	20.61	60	9.33	60	4.76	120	3.37
35	45.15	35	20.61	70	11.97	70	5.72	140	4.03
40	35.49	40	20.61	80	11.97	80	5.72	160	4.03
45	25.79	45	22.94	90	11.97	90	5.72	180	4.03
50	22.60	50	22.94	100	10.66	100	6.67	200	4.69
55	19.36	55	25.20	110	10.59	110	6.67	220	4.69
60	12.89	60	25.20	120	10.66	120	6.67	240	4.69
		65	32.06	130	10.66	130	8.56	260	6.02
		70	32.06	140	10.59	140	8.56	280	6.02
		75	25.20	150	10.66	150	8.56	300	6.02
		80	25.20	160	15.98	160	11.43	320	8.06
		85	18.33	170	15.98	170	11.43	340	8.06
		90	18.33	180	15.98	180	11.43	360	8.06
		95	16.02	190	11.97	190	16.20	380	11.41
		100	16.02	200	11.97	200	16.20	400	11.41
		105	13.74	210	11.97	210	16.20	420	11.41
		110	13.74	220	11.97	220	20.01	440	14.10
		115	9.16	230	11.97	230	20.01	460	14.10
		120	9.16	240	11.97	240	20.01	480	14.10
				250	11.97	250	15.23	500	10.73
				260	11.97	260	15.23	520	10.73
				270	11.97	270	15.23	540	10.73
				280	10.66	280	12.37	560	8.72
				290	10.64	290	12.37	580	8.72
				300	10.66	300	12.37	600	8.72
				310	10.66	310	11.43	620	8.06
				320	10.59	320	11.43	640	8.06
				330	10.66	330	11.43	660	8.06
				340	9.33	340	9.53	680	6.72
				350	9.33	350	9.53	700	6.72
				360	9.33	360	9.53	720	6.72
						370	7.62	740	5.37
						380	7.62	760	5.37
						390	7.62	780	5.37
						400	8.56	800	6.02
						410	8.56	820	6.02
						420	8.56	840	6.02
						430	5.72	860	4.03
						440	5.72	880	4.03
						450	5.72	900	4.03
						460	7.62	920	5.37
						470	7.62	940	5.37
						480	7.62	960	5.37
						490	5.72	980	4.03
						500	5.72	1000	4.03
						510	5.72	1020	4.03
						520	4.76	1040	3.37
						530	4.76	1060	3.37
						540	4.76	1080	3.37
						550	3.81	1100	2.69
						560	3.81	1120	2.69
						570	3.81	1140	2.69
						580	4.76	1160	3.37
						590	4.76	1180	3.37
						600	4.76	1200	3.37
						610	3.81	1220	2.69
						620	3.81	1240	2.69
						630	3.81	1260	2.69
						640	3.81	1280	2.69
						650	3.81	1300	2.69
						660	3.81	1320	2.69
						670	4.76	1340	3.37
						680	4.76	1360	3.37
						690	4.76	1380	3.37
						700	3.81	1400	2.69
						710	3.81	1420	2.69
						720	3.81	1440	2.69
Total Rain (mm)	26.88		38.18		66.56		94.52		134.23

BYLAW 8128, 2019

4. SANITARY SEWER SYSTEM

4.1 General

Sanitary sewer design shall be prepared by the Consulting Engineer with qualified expertise in sanitary sewer systems. Design criteria only specify the minimum requirements and the Consulting Engineer shall confirm with the City on the design requirements. Sanitary designs shall conform to local government bylaws, regulations, guidelines, policies, regional Liquid Waste Management Plan and federal and provincial statutes.

The Consulting Engineer will need to confirm the following:

- Sewer service catchment boundary
- Planned land uses within the sewer service catchment
- Location of major pumped and gravity facilities
- Location of the future gravity conveyance systems

The presence of an existing municipal sanitary or combined sewer system does not mean, nor imply that the existing system has adequate capacity to accommodate the proposed design flows either adjacent to the site or further downstream, nor does it indicate that the existing system pattern is acceptable to the City. Undersized or inadequate existing sanitary or combined sewer facilities must be upgraded at the Developer's expense to accommodate the appropriate flows as specified herein.

For all new developments, the discharge of storm water into the sanitary system or the combined sewer system is prohibited unless authorized by the Director of Engineering. A separated new storm system shall be provided for the development project.

4.2 Sewage Flow Generation

4.2.1 Residential

Residential flow shall be based on 300 L/capita/day x population.

The population is the ultimate saturation population from land use designations in accordance with the Official Community Plan (OCP) and related neighbourhood community plans for the subject catchment area. Refer to General Requirements Section: Design Population by Land Use. All design population assumptions must be approved by the Director of Engineering.

4.2.2 Non-residential

Average Dry Weather Flows (ADWF) for non-residential areas shall be based on specific data related to the development or zoning.

Table 4.1 Sewage Flows

Land Use	Average Dry Weather Flow
General Commercial	34,000 litres/ha/day
Office Towers	85,000 litres/ha/day
Industrial	Actual or expected land use with a minimum of 34,000 litres/ha/day
Institutional	
• Hospitals	900 litres / bed/day
• Nursing Homes	681 litres/bed/day
• Schools	90 litres/student
• Other	According to Health Act Guidelines with a minimum of 23,200 L/ha/day

Where sanitary flow from the development is expected to exceed calculated minimum flow from the above table, the actual development parameters shall govern.

Separated Sewer Areas
For development within existing areas, the design basis shall be based on the greater of:

a) flows from the present development combined with anticipated flows for extension of the sewer to both developed and undeveloped lands; and
b) flows from future development of the catchment area to full OCP density and land-use.

Combined Sewer Areas

For combined sewerage area where the proposed development will be discharging into the combined sewer system, the difference between the post-development and pre-development sewage flows must be estimated and the stormwater discharge be reduced by the same amount. Effectively, the increased sanitary flow from the development is offset by reducing the stormwater discharge which ultimately results in the same flow rate as the pre-development conditions entering the sewer system.

Until full separation of combined sewers is completed, the current combined sewer flows upstream and downstream of the subject development is to be used in the sanitary flow calculation, and any designated sanitary sewer systems may operate at a full flow condition (i.e. d/D =0.85) until full sewer separation within the catchment has occurred and all onsite/offsite drainage sources removed.

4.2.3 Design Flow

Sanitary sewers shall be designed to convey the calculated peak sewage flows, including an allowance for inflow and infiltration. The steady-state design flow rate shall be calculated as follows:

Q_{design} = Peak Dry Weather Flow + Infiltration and Inflow

Where:

Peak Dry Weather Flow =		Q_{ADWF} x Peaking Factor + Q_{PUMPED}
Q_{ADWF}	=	Average Dry Weather Flow from all sources upstream that is conveyed by gravity
Q_{PUMPED}	=	Peak Wet Weather Pumping Rate from all upstream pump stations.

The total design sewage flow shall be based on the greater of:

a) ultimate population densities and land use designations as outlined in the Official Community Plan for the entire catchment area, or

b) planned developments for the entire catchment area.

4.2.4 Peaking Factor

The Peaking Factor will be calculated using the Harmon Equation for the design residential population or equivalent population:

$$\text{Peaking Factor} = 1 + \frac{14}{4 + \sqrt{\frac{Population}{1000}}}$$

4.2.5 Infiltration

- Mainland area inflow and infiltration allowance is 15,000 litres/ha/day
- Queensborough area inflow and infiltration allowance is 30,000 litres/ha/day.

4.3 Sewer System Capacity Review

4.3.1 System Capacity

The Consulting Engineer shall discuss downstream system capacity requirements with the Director of Engineering. If required, the calculation of sufficient capacity of the existing system downstream of the proposed catchment area will be based on modelling results provided by the City at Developer's cost or as otherwise directed by the Director of Engineering.

4.3.2 Hydraulic Analysis

The hydraulic analysis of gravity sewer pipes shall be conducted using the Manning equation under steady-state full flow condition:

Flow Rate

$$Q = \frac{A \cdot R^{\frac{2}{3}} \cdot S^{\frac{1}{2}}}{n}$$

Where: Q = full pipe flow in cubic meters per second
A = cross sectional area of pipe in square metres
R = hydraulic radius in meters, D/4 (for circular pipes)
D = inside diameter of pipe in metres
S = slope of energy grade line in metres/metre of length
n = Manning coefficient of roughness; 0.013 for all pipes

Force Mains analysis shall be conducted using the Hazen Williams formula:

$$Q = \frac{C \cdot D^{2.63} \cdot S^{0.54}}{278780}$$

Where: Q = Rate of flow in L/s
D = Internal pipe diameter in mm
S = Slope of hydraulic grade line in m/m
C = Friction coefficient = 120 for all pipes

4.4 Sanitary Sewers and Appurtenances

4.4.1 Flow Velocity

Design velocities for gravity sewers are:

- Minimum 0.6 m/s;
- Maximum 6.0 m/s.

Where design velocities are supercritical or in excess of 3.0 m/s, special provisions shall be made to protect against sewer displacement.

4.4.2 Minimum Sewer Diameter and Grade

The minimum diameter of sanitary sewers is:

- Gravity sewers: 200mm
- Sewage force mains: 100mm

Sanitary sewers will be designed as open channels with the depth of flow, under maximum design flow condition, not to exceed:

- Up to 450mm diameter: 50% of the internal diameter (e.g. d/D=0.5)
- 525 mm diameter or larger 70% of the internal diameter (e.g. d/D=0.7)

For new extensions, no reduction in pipe size will be made for pipes downstream irrespective of grade provided on the pipe unless specifically approved by the Director of Engineering.

Sewers are to be designed with constant grade. Pipes with grades at 15% or greater shall have an anchoring system and scour protection as approved by the Director of Engineering.

The upstream terminal section of sewers may require steeper grade to ensure a self-cleansing velocity under partial flow conditions. The following design minimum grades are acceptable:

- 1.0% if sewer section servicing 6 houses or less,
- 0.6% if sewer section is servicing 7 to 12 houses,
- 0.5% if sewer section is servicing 13 or more houses.

4.4.3 Sanitary Sewer Location

Sanitary sewers and service connections shall be located within public road rights-of-way. Side or rear yard statutory rights-of-way or easements should be avoided if possible. The location of the sanitary sewer will be in accordance with the Supplementary Detail Drawings - “Typical Roadway Cross Section”. If the location shown is impractical, the offset may be varied with the approval of the Director of Engineering but in all cases it shall be located under the road pavement and clear of curbs and gutters.

At least 3.0 m horizontal clearance from water mains shall be maintained. Provincial regulatory separation requirements will govern where sewers are adjacent to or crossing existing or proposed water mains.

Sewers must extend across the full width of each lot to the boundary of the development plan; thus allowing future extension and connection beyond the development where such extension is possible.

Where not technically feasible to locate within a road right-of-way, a sanitary sewer may be located within an open lane or a statutory right-of-way (SROW) if authorized by the Director of Engineering and that:

g) The open lane meets the minimum requirements of 6.0 m width;
h) The open lane is capable of supporting maintenance vehicles and equipment access under all weather conditions;
i) Within a statutory rights-of-way, the Owner must provide unimpeded maintenance vehicles and equipment access under all weather conditions;
j) Within a statutory rights-of-way, the sewer shall be centred within the registered SROW with a minimum width of 3.0 m, unless the sewer depth exceeds 3.0 m or is combined with a storm sewer, in which case a greater SROW width shall be provided;
k) There are no service connections or manholes within the SROW; and
l) The sewer alignment in the lane or SROW is straight.

All-weather vehicular access must be provided to all manholes, inlet structures, inspection chambers and flow control structures.

The elevations of all existing underground utilities crossing the proposed sanitary sewer shall be confirmed in the field and shown on the profile and plan drawings.

Where a new sewer will service existing buildings and existing vacant properties, the crown of the sewer will be at least 1.0m below the basement elevations of the lots to be serviced.

4.4.4 Sewer Depth

Sanitary sewer depth shall be installed at a depth to:

- Provide gravity service to all properties tributary to the sewer;
- Prevent freezing;
- Accommodate ultimate saturation population from all tributary lands;
- Clear other underground utilities;
- Prevent damage from surface loading;
- Be between 2.0m and 4.5m, from finished ground surface to pipe invert unless otherwise approved by the Director of Engineering.

The Consulting Engineer shall verify that the pipe material and bedding are suitable for the live and dead load imposed on the pipe. In no case shall the cover be less than 0.9m and greater than 6.0 m without the approval of the Director of Engineering.

4.4.5 Curvilinear Sewers

Pipes are not to be laid on a curve unless authorized by the Director of Engineering.

4.5 Manholes

Manholes are required:

- every change of grade or direction;
- where sewers intersect;
- when pipe sizes change;
- at maximum pipe intervals of 100 m;
- at the end of each sewer line;
- downstream of curved sewers (if a curvilinear sewer is approved by the City); and
- wherever future extensions are anticipated.

Generally, frames and covers should be located outside the vehicular and bicycle wheel path on the roadway.

The inside diameter of manholes shall conform to the City approved edition of the MMCD and the City Supplementary Specifications and Detail Drawings.

A sump manhole is to be provided immediately upstream of any line feeding to a pump station, siphon or forcemain system.

Manholes are required at service connection tie-ins to mains where the service connection size is greater than ½ the diameter of the sewer main or the service connection is 200mm diameter or greater.

Drop manholes will only be used when a new incoming sewer cannot be steepened or where site conditions do not permit excavation to the base of an existing manhole. Outside drop shall be provided where the difference between the inlet and outlet inverts exceeds 600mm. The minimum manhole diameter for inside drop shall be:

- 1200mm diameter manholes for mains 300mm or smaller;
- 1500mm diameter manholes with an inside drop for mains larger then 300mm.

Temporary cleanouts are required where an extension of the sewer, in the future, will provide a manhole at an appropriate spacing.

Manholes shall be designed to incorporate a minimum pipe invert elevation difference of at least 30 mm in addition to the normal grade of the lateral sewer. For alignment deflections in excess of 45 degrees a 60 mm drop shall be provided. The crown elevations of sewers entering a manhole shall not be lower than the crown elevation of the sewer leaving the manhole.

4.6 Service Connections

Each lot will have:

c) A gravity connection to the frontage sanitary sewer; or
d) A gravity connection to the sanitary sewer in an open lane, walkway or service corridor with an access road.

Every lot (existing or newly created) capable of being serviced, whether it is vacant or not, shall be provided with a separated service connection. Only one service connection will be provided for each parcel. The service connection shall be installed in accordance with the standard drawings.

The size of service connection shall be designed to accommodate the peak flow rate on the property being served. The minimum diameters shall be 100 mm for single family dwellings and 150mm for all other land uses. The slope shall not less than 2.0% from the property line to the main. Refer to the Supplementary Specifications and Detail Drawings for the location of sanitary sewer connections. No service connection shall be installed on sewers greater than 4.5 m depth unless otherwise approved by the Director of Engineering.

Connections to new mains shall be made with a standard wye fitting. Connections to existing mains may use wye saddle or insertable tee. The service connection centreline must not be below the centreline of the sewer main.

Inspection chambers are required on residential connections. Service connections exceeding 30 m in length shall be designed as sanitary sewers. Manholes are required on service connections larger than 150 mm diameter.

Building elevation and plumbing will be established to allow service connection to function by gravity. Pumped connections may be permitted subject to the approval of the Director of Engineer prior to sewer design with appropriate restrictive covenants provided.

Existing service connections over 40 years old will be replaced in conjunction with the new sewer main installation.

4.7 Pumping Stations

4.7.1 General

Specific requirements and instructions including the defined tributary catchment for pumping stations and forcemains shall be obtained from the Director of Engineering prior to undertaking design. The Consulting Engineer will submit a preliminary design report that addresses the requirements for approval by the Director of Engineering prior to proceeding with detailed design.

The City of New Westminster Engineering Design Criteria ("Design Criteria") is to be used as a guide to the design process. They provide a general outline of design criteria system requirements and plant and products to maintain uniformity in the City and a guide to designers as to what is likely to be approved. MMCD specifications are to be met at a minimum with this document to overrule and supplement the standard. Good engineering design practice shall be used in the design of sanitary sewage pump stations and sewage forcemains.

Upgrades or modifications to existing wastewater pump stations shall meet these standards to the extent practical. These criteria govern submersible sanitary pump stations. Larger capacity stations or stations with special design criteria may require additional assessment and design criteria.

4.7.2 Pump Station Design

Sewage pump stations will be designed by a Consulting Engineer with specific expertise in pump station design, construction and operations. The design shall satisfy the hydraulic conditions of the planned station in accordance with the City's Design Criteria, Bylaws and Hydraulic Institute Standards.

Sewage pump stations shall be designed to accommodate the projected peak hour flow rate for existing and future developments.

The Consulting Engineer shall provide system head curve calculations using recommended pipe friction coefficients (C-factor) for both new and aged pipe materials, and for pumping discharge flows at High Water Level (HWL) and Low Water Level (LWL) static conditions. The Consulting Engineer shall confirm that the pump will be suitable for each flow operating condition and shall identify the pumping unit efficiencies for the various operating conditions.

For Total Dynamic Head (TDH) calculations, the Consulting Engineer shall use C=120 (for PVC Pipe) and then recalculate the system curve using a C= 145 to ensure adequate motor horsepower and pump characteristics.

Pump/system curves will be shown for individual and combined simultaneous pump operation. The design calculations shall be submitted in the preliminary design report along with all design assumptions, limitations and restrictions.

The Consulting Engineer shall include in the calculations the Net Positive Suction Head Available (NPSHA) as well as the Net Positive Suction Head Required (NPSHR) to assure cavitation will not occur.

4.7.3 Wet Well Configuration

Pump stations will be a packaged engineered Fibre Reinforced Plastic (FRP) wet well containing duplex (at a minimum) submersible Flygt pumps for a Duty/Standby operation to a safety factor of N+1.
Wet wells will be considered a hazardous environment, as classified in the latest edition of NFPA 820 and designed accordingly.

4.7.4 Pump Station Piping

The Consulting Engineer will be responsible for designing and/or reviewing the forcemain that the pump station will be discharging to.

The below velocities shall be used as limiting criteria for the design of all pipework.

Pump Discharge Pipes	Minimum Velocity = 1.0 m/s Maximum Velocity = 3.5 m/s
Common Discharge Header	Maximum Velocity = 3.0 m/s
Forcemain pipe	Minimum Velocity = 1.0 m/s Maximum Velocity = 3.0 m

4.7.5 Valves, Valve Chambers and Bypass Chambers

The pump station will be equipped with an external valve vault/chamber. Isolation valves to be provided on each discharge pipe to permit removal and maintenance of pumps and check valves without affecting the operation of remaining pumps. Isolation valves will be full port (100% opening) plug valves. Check valves will be of the sinking ball type, HDL Model 5087 or approved equivalent. All check valves to be installed on the horizontal and in accordance with the manufacturer's recommendations to suppress water hammer. Clear access is to be provided into the chamber for maintenance. An FRP pre-engineered valve vault with wet well is preferred.

Influent sewers to the wet well will have an isolation valve immediately upstream of pump station. The valve will have a nelson box to house the actuator.

A bypass chamber is required on the discharge pipe downstream of the valve chamber to allow for emergency bypass pumping from the wet well. An isolation valve will be installed immediately downstream of the bypass chamber. The bypass chamber will be equipped with a 100 mm diameter pipe complete with blind flange.

4.7.6 Appurtenance

- Water Service – the pump station shall be serviced by a 50mm water supply. The water service connection will be housed in a separate vault/box adjacent the wet well and not in the electrical kiosk.

- A pressure gauge shall be provided in the valve chamber at a location that is easily accessible and readable. All gauges shall include an oil isolation diaphragm for isolation of the gauge from the wastewater.

- A pump station may be subject to the provision of a magnetic flow meter although this is not a standard item. Such provision will be project dependant at the direction of the City.

4.7.7 Control and Level Regulation

The control and level regulation of the pump station shall be designed to ensure robust, optimum and alternating pump cycle times in accordance with the pump manufacturer's recommendations. The pumping active volume will be appropriate to avert any septic conditions in both the wet well and forcemain. Sewage levels will be controlled continuously by an ultrasonic level transmitter with back-up float switches (Flygt ENM-10) for an emergency high and low level alarm. These systems within the wet well shall be located to minimize the turbulent influences of flow into the wet well and on the control of the sewage levels.

4.7.8 Station Access

Both the wet well and valve vault shall be equipped with an aluminum access hatch. The wet well access hatch shall be positioned so that a truck mounted crane can lift each piece of equipment out of the pump station vertically.

4.7.9 Emergency Storage and Emergency Power

Emergency storage capacity will be provided to accommodate a minimum of one (1) hour of peak hour design flow. The wet well, collection system and/or auxiliary containment can all function as the emergency storage provided that the one (1) hour requirement is met without any

spill occurring. Additional storage time may be required by the City based on the project specifics.

Standby electric power generator shall be provided. The Consulting Engineer must review full requirements of the electrical power system and controls with the Director of Engineering. For small stations of less than 5 horse power combined power (excluding standby unit) and serving less than 50 lots, standby power may not be required at the sole discretion of the Director of Engineering, provided that adequate emergency storage is available and a Crouse-Hinds receptacle with reverse contacts and manual transfer switch suitable for connecting emergency electric standby power generator is included.

4.7.10 Electrical Controls

There will be a Programmable Logic Controller (PLC) and telemetering system, compatible with the City SCADA System. The controller will be the Allen-Bradley Model 5/03 PLC or approved later model of PLC based on the City's standard.

Pump stations shall be designed to run on 3-phase service (600V or 208V) and equipped with a VFD (variable frequency drive) unless otherwise directed by the City.

The Pump Station Control Kiosk shall be located adjacent to the pump station wet well, no further than 3 m away. The control side of the kiosk is to face the pump station wet well. The enclosure will be NEMA 4X classification. All switches, breakers and wires will be clearly marked or labeled. Standard control panel layout for 2 or more pumps will be provided with the following section of panels at a minimum:

- City Electrical/BC Hydro metering and main breakers
- Automatic transfer switch
- Circuit breakers and starters for unit heaters, portable pump, main
- Wastewater pumps, fans, etc., station power transformer
- Pump controls including cycle counters and running time clocks
- Solid-state reduced voltage starters for constant speed main wastewater pumps

4.7.11 Ventilation

Pump stations shall be provided with a separate ventilating system sized to provide a minimum of 10 air changes per hour and to meet or exceed Worker Compensation Board (WCB) requirements for ventilation of a confined space. Ventilation shall be accomplished by the introduction of fresh air into the pump station under positive pressure.

Odour control may be required at the request of the City and specific to the project criteria. Where required, a suitable odour control system shall be provided and be approved by the Director of Engineering.

4.7.12 Pump Station Testing

Pump Stations will be tested using water where sewage is not available. The pump stations will be tested through the operating range of the pump station to simulate and verify emergency operation, pumps, controls, alarms, backup power and manual operation. Testing and Commissioning of the station shall be conducted under the supervision of the Consulting Engineer, Manufacturer's representative and City representative.

4.8 Force Mains

The following criteria apply to force main design:

- The Consulting Engineer shall provide maximum time the sewerage will be stagnant inside the force main in order for the City to assess potential for septic conditions.
- An automatic air relief and/or vacuum valve will be placed at high points in the force main. Odour control devices shall be installed on air vents unless otherwise approved by the Director of Engineering.
- Isolation valves will be provided at least every 1,000 m. Valves shall be full port type to allow for pigging. A resilient seated gate valve is required on a force main prior to tie-in to a trunk force main.
- Provisions shall be made to allow for force main cleaning. This will include pig launching and receiving points and selection of appropriate bends and pipe sizes to allow for pigging of the forcemain.

Mechanical thrust restraint shall be provided for all valves, tees, bends, and caps. The required length of restrained pipe will be shown on the design drawings. The Consulting Engineer shall design mechanical thrust restraint systems with due regard for pipeline pressure transients and expected test pressures. Thrust block restraints are not permitted.

4.9 Restrictive Covenant and Sanitary Right of Way

The land title for each legal lot served by a private pump station unit on the subject lot shall include a restrictive covenant, filed by the Owner, requiring the Owner to undertake in perpetuity operation, maintenance and renewal of the pump unit and service connection to the City forcemain or manhole, including the section of the service connection within the road right-of-way.

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5. WATER DISTRIBUTION SYSTEM

5.1 General

Water works design shall be prepared by the Consulting Engineer with qualified expertise in water distribution systems. Design criteria only specify the minimum requirements and the Consulting Engineer shall confirm with the City on the design requirements. Water system shall conform to City master waterworks plans, local government bylaws, regulations, guidelines, policies, regional Drinking Water Management Plan and federal and provincial statutes.

The location of pressure zone boundaries, pressure reducing valve stations and pumping stations will be pre-determined by the Director of Engineering.

Water system designs shall be approved by Fraser Health Authority.

5.2 Demands

The water distribution system shall be designed to meet peak domestic consumption and fire protection demands at a desirable pressure.

Consumption demand will be based on all land uses (i.e. residential, industrial, commercial and institutional) during the high demand summer season including irrigation or lawn sprinkling.

5.2.1 Consumption Demand

Design demand will be based on ultimate saturation population and land use designations in accordance with the City's Official Community Plan (OCP) and related neighbourhood community plans for the subject service area. Refer to General Requirements: Table for Design Population by Land Use including provision for secondary suites, coach houses and laneway houses.

	Demand (L/capita/day)	
Land Use	**Maximum Day**	**Peak Hour**
Residential	800	1,600
Commercial	72	72
Institutional	60	48

For Commercial and Institutional Use, see Design Population by Land Use Table in Section 1: General Requirement

For Industrial Use, the water demand will be based on the greater of the existing consumption or proposed development consumption. The minimum is 10,000 Litre/hectare/day.

Note that the above rates do not include outdoor irrigation.

5.2.2 Fire Flow

Fire flow requirements shall be determined using the latest edition of "Water Supply for Public Fire Protection – A Guide to Recommended Practice" published by the Fire Underwriters Survey. The minimum acceptable values are in the following table:

Land Use	**Required Fire Flow (L/s)**
Single and Two Family Residential	60
Townhouse & Multi-Family	150
Apartments 6-8 Suite	120
High Rise Apartment	200
Commercial, Institutional	150
Industrial	225

Design fire flow shall be available to the furthest distance within the site from the service location and/or at the point of highest elevation.

If the maximum available fire flow is less than the required flow for the fire protection of the site, the Developer is responsible to either upgrade the water system sufficiently to provide the required fire flow or take whatever other measures necessary within the development to reduce fire protection requirements to match the level of protection available from the City's distribution system.

All commercial and multi-family developments are to be reviewed by the City's Fire Department.

5.2.3 Design Demand

The water distribution system shall be capable of providing the greater of:

a) Maximum Day Demand (MDD) plus the fire flow in L/s; or
b) Peak Hour Demand (PHD) in L/s.

5.3 Hydraulics

5.3.1 Level of Service

The water distribution system shall be designed to convey the design flow at a residual output head in excess of the minimum permissible pressure as follow:

Maximum Allowable Pressure	1035 kPa
Minimum Pressure at Peak Hour Demand	280 kPa
Minimum Pressure anywhere in the system during design fire flow and Maximum Day Demand	140 kPa

All systems shall be looped in the distribution system. Dead ends will only be permitted upon approval of the Director of Engineering.

5.3.2 Source Nodes Analysis

The input head into the network analysis will be the head at the near pressure reducing valve station or reservoir. The Consulting Engineer shall conduct a flow test to confirm the existing system pressure. The analysis including pipe and node data, domestic flows and fire flows shall be submitted to the City for approval.

For local distribution systems, sources may be assumed to be the nearest water mains that are 300 mm diameter or larger continually tied to the supply source. Available heads and flows will be confirmed by hydrant flow tests and approved by the Director of Engineering.

5.3.3 Design Calculation

The analysis of the proposed distribution system shall be carried out using the Hazen-Williams formula:

Force Mains analysis shall be conducted using the Hazen Williams formula:

$$Q = \frac{C \cdot D^{2.63} \cdot S^{0.54}}{278780}$$

Where: Q = Rate of flow in L/s
D = Internal pipe diameter in mm
S = Slope of hydraulic grade line in m/m
C = 125 for all water mains 250mm diameter and larger
C = 100 for all water mains 200mm diameter and smaller

5.3.4 Velocity and Head Loss

In all water distribution system analysis, the Consulting Engineer shall consider the impacts of surge pressures. For mains 400mm and larger, the Consulting Engineer shall keep velocities below 3.0 m/s.

5.4 Piping

5.4.1 Minimum Diameter, Material and Pressure Rating

The minimum size of water mains shall be 150 mm diameter in single family residential areas and 200 mm in multi-family, commercial or industrial areas.

All water mains shall be ductile iron meeting MMCD specifications. All pipe and appurtenances shall be a minimum of 235 psi pressure class rated.

5.4.2 Water Main Location

Water mains shall be located within public road right-of-way in accordance with the Supplementary Detail Drawings - "Typical Roadway Cross Section". If the location shown is impractical, the offset may be varied with the approval of the Director of Engineering but in all cases it shall be located under the road pavement and clear of curbs and gutters. Water mains will be kept parallel to the property line as much as possible and the offset distance from the property line shall be shown on the design drawings.

The minimum grade on a water main shall be 0.1%. The minimum cover of any water main, including service connections, will be designed to prevent freezing and not less than 1.0 meter.

When the slope of a water main equals or exceeds 10%, provisions shall be made to anchor the pipe. Curvilinear pipe installation will not be permitted.

A 3.0 meter horizontal separation from sewer mains shall be maintained. For utility crossings, the water main is to be located a minimum of 0.5 m above storm sewers and sanitary sewers. If the water main is less than 0.5 m above the sewer, the water main must be installed so that the crossing is made midway between the joints on a full length of water main pipe. If this is not attainable the water main joints are to be wrapped with heat shrink plastic or packed with compound and wrapped with tape. If the water main is beneath the sewer, there shall be a minimum of 300 mm vertical separation. The crossing shall be made midway on the full length of the water main pipe and the water main joints shrink wrapped over length extending 3m either side of sewer (as per specification below).

Standards: ANSI/AWWA C214 (factory applied)

ANSI/AWWA C209 (field applied)
ANSI/AWWA C217-90 (petrolatum tape)
all materials to have zero Health Hazard.

For crossing of gas mains or similar installations, the water main normally will be laid above such installations, with a minimum of 300 mm vertical clearance between the water main and the other installation unless otherwise approved. Consult with FortisBC and other utilities to establish their minimum clearances.

Where the water main is parallel to utilities other than storm and sanitary, the water main shall have a minimum clear separation of 1.0 metre from the other utility.

Water mains 200mm and larger will be designed to minimize high points.

The elevations of all existing underground utilities crossing the proposed water mains shall be confirmed in the field and shown on the plan and profile design.

The design of invert grades of water mains shall ensure proper clearance between top of valves and valve box covers.

The water main must extend across the full width of each lot to the boundary of the development plan; thus allowing future extension and connection beyond the development where such extension is possible.

5.4.3 Crossings

Wherever the water main crosses a railway, a Provincial Highway, an Arterial Road as determined by the Director of Engineering or a major watercourse, the pipe shall be installed in an encasement carrier pipe to the approval of the relevant authority. The size of the casing pipe shall be a minimum of 25% larger than the outside diameter of the water main pipe bell. Service connections crossing Provincial highways and railroads should be avoided.

5.5 Appurtenances

5.5.1 Thrust/Joint Restraints

Thrust restraint shall be provided for all valves, tees, bends, and caps. The mechanical joint restraint systems shall be designed with due regard for pipeline pressure transients and expected test pressures. The required length of restrained pipe must be shown on the design drawings.

5.5.2 Line Valves

The maximum length of water main between isolation line valves is:

a) 200 m in residential districts and 150 m in all other districts for mains 350mm diameter or less;
b) 800 m for mains larger than 350 mm or as approved by the Director of Engineering.

Line valves shall be located such that no more than one fire hydrant and/or 20 service connections will be affected during isolation of a section of the water main. The following number of valves shall be provided at network intersections either in a cluster or at projected property lines to avoid conflicts with curbs and sidewalks:

i) 3 valves at Cross "X" intersection
ii) 2 valves at Tee "T" intersection

New valves will be installed with water main replacement works.

All valves on water mains 300mm and smaller shall be resilient seated gate valves at the same diameter of the pipe. Line valves for 350mm and 400mm diameter water mains may be smaller by one size. Line valves for 450mm diameter water mains and larger may be smaller by two sizes. Geared operators with risers and extensions and a valve by-pass for equalizing pressure shall be provided on main line gate valves 350mm and larger.

Butterfly valves shall not be used unless approved by the Director of Engineering.

5.5.3 Hydrants

Hydrants shall be spaced at maximum 200 m apart, including both sides of the road.

A fire hydrant shall be located not more than 150 m from a single family residential building, 100 m from the principal entrance of all other buildings, and 45 m from Siamese or Fire Department Connection (FDC). Sufficient number of hydrants shall be provided ensure the required fire flow can be delivered.

New hydrants shall be installed with water main replacement works.

Hydrants shall be completely accessible and in such a manner that the possibility of damage from vehicles or injury to pedestrians are minimized. Where possible, hydrants will be located at the end of curb returns at road intersections, in mid-block locations and at the boundaries between properties. A gate valve shall be provided at the main on all hydrant connections.

Hydrants shall be offset a minimum of 1.0 m from the adjacent property line, at least 3.0 m away from lamp standard, utility pole or driveway and 1.0 m from service connection pipes and ditches. Hydrant shall be located within the furnishing or landscape boulevard zone where parking prohibitions are generally located and will not conflict with pedestrian movement zone.

In general, if the flow from the hydrant does not exceed 60 L/s, the hydraulic head required at the water main upstream of the hydrant is 14m. If the flow exceeds 60 L/s, the hydraulic head must be greater to account for the head losses through the hydrant. The minimum hydraulic head immediately upstream of the water main required for a single hydrant delivering fire flows is as follows:

Flow (L/s)	Minimum Hydraulic Head at Water Main/Nearest Node Required (m)
45	14.0
60	14.0
90	15.8
120	22.6
150	31.4

For flow rates not detailed above, and for situations where multiple hydrants are required to deliver the fire flow, the minimum hydraulic head can be calculated as the greater of 14m and 7m plus the head loss through the hydrant. However, regardless of the fire flow delivered, the minimum hydraulic head at the water main or the nearest node must be 14m.

Head loss through the hydrant(s) should be calculated as:

$$HL = 1{,}083 \times Q^2$$

Where: HL is head loss (m)
Q is fire flow (m^3/s)

5.5.4 Air Valves

Combination air valves will be installed at the summits of all mains of 200mm diameter and larger except as follows:

i. Where the difference in elevation between the summit and valley is less than 600mm
ii. Where it can be shown that air pockets will be carried by typical flows
iii. Where active service connections are suitably located to dissipate entrapped air.

Typical air valve sizes, subject to design analysis, are as follows:

i. 25mm for water mains 250mm to 350mm diameter
ii. 50mm for water mains 350mm to 600mm diameter
iii. Special design for water mains larger than 600mm diameter.

Air valves shall be vented to an appropriate above-grade location to eliminate any potential for cross connection in a flooded or contaminated chamber.

5.5.5 Flushouts / Blow-offs

Blow-offs shall be provided at the end of all dead-end mains. For 200mm and larger mains, blow-offs require special design. On all mains greater than 350mm diameter, install blowdowns at the lowest point in the pipeline profile between the line valves.
Flushing ports are to be of adequate size to permit a minimum flushing velocity of 0.8 m/s in the mains.

5.5.6 Service Connections

The Owner shall comply with connection requirements contained in the Waterworks Regulation Bylaw, as amended from time to time. Service connections shall be installed in accordance with the City approved edition of the MMCD and Supplementary Specifications and Detail Drawings.

Location
Water service connections shall be kept clear of sewer connections and driveways and installed at 90 degrees to the property line. Service connection shall be no more than 30 m in length. Where service location will conflict with fire hydrants or other obstructions, the locations may be specifically offset. Service connections will not be connected to 400 mm or larger mains unless specifically permitted by the Director of Engineering.

For water main replacements, all existing service connections shall be replaced up to the property line. For single family residential lots, service connection shall be one continuous pipe.

Service connections shall have a minimum cover of 0.75 m and a maximum of 1.5 m.

Size
Service connections shall be provided to each lot and sized to meet water demands. The minimum size is 19mm diameter for each single family parcel. Properties designed for a fire sprinkler system will have a minimum service connection of 50mm diameter.

Service connections 75mm or larger shall be specifically designed for the particular requirements. All connections 100mm and larger shall be joint restrained with a tee and a gate valve assembly at main to property line.

Service connections to parks, where required, shall be in accordance with Parks Department requirements.

5.5.7 Water Meters

All service connections shall have provisions for metering. Water meters are required for all connections as set out in the Waterworks Regulation Bylaw No.7631. The location, size and the remote reading device of the flow meter will be as specified by the Director of Engineering.

Where the on-site water system is looped between two connections to City water mains, a gate valve will be required at each connection and on the property side of a double check valve assembly.

Each service connection of 100 mm diameter or larger requires premise isolation. All residential service connections shall have provisions for metering and backflow prevention. Single Family residential lots shall be provided with water meter setter including backflow preventers and service box at the property line.

5.5.8 Street Ends

At the end of a street which may be extended in the future, the water main shall extend at least 1.5 metres beyond the end of the paving.

Water mains shall be terminated with a gate valve, followed by a 6 metre length of pipe, thrust restraint and blow-off assembly. Refer to Section 5.5.5 for blow-off sizing.

5.5.9 Cul-de-sacs

Water mains shall be looped unless otherwise approved by the Director or Engineering. If so approved, water mains at a cul-de-sac shall be terminated by 150 mm cap end complete with blow-off assembly.

5.6 Pressure Reducing Valve Station

Pressure Reducing Valve station design parameters will be reviewed and approved by the Director of Engineering before proceeding with detailed design.

5.6.1 Preliminary Design Parameters

- Design Flows:
  i. Peak hour
  ii. Maximum day plus fire
- Continuous, emergency or fire flow operation
- Location
- Chamber Details:
  i. Structure and access
  ii. Controls and monitoring
  iii. HVAC

5.6.2 Design Features

- Minimum chamber size: 3m x 2m x 2m (inside dimensions)
- Structure and piping in accordance with Chambers, Reservoir Valve Chambers and Pump Stations sections
- External bypass with closed valve
- Parallel pressure reducing valves sized for peak hour and maximum day plus fire flow
- Isolating valves
- Air release valves
- Basket strainers upstream of each control valve
- Upstream and downstream pressure gauges
- Flowmeter
- Interior and exterior of pipework coated to AWWA standards, or use stainless steel
- Forced air ventilation plus heat and light, subject to local authority review
- External kiosk, if electrical and electronic equipment is included.
- PLC-controlled with connection to SCADA system, if applicable, including:
  i. Discharge and suction pressure transmitters
  ii. Flow transmitter
  iii. Uninterruptible power supply (UPS)
  iv. Operator interface panel

Consulting Engineer is to provide three copies of a comprehensive Operating and Maintenance Manual.

5.7 Corrosion Protection

Where there is a potential for encountering corrosive soils, a geotechnical analysis on the water main alignment shall be conducted to determine the corrosiveness of the native soils.

Corrosive soil analysis shall be carried out based on the 10-point method given under Appendix A of AWWA C105. Cathodic protection or equivalent protection will be required along the pipeline and appurtenances if the cumulative total based on the above soil test evaluation equal or exceed ten points.

Polyethylene encasement alone is not considered as an acceptable method of corrosion protection.

5.8 Connection to Existing Water Mains

All tie-in's to existing water mains will be performed by or under the supervision of the City at the Developer's cost.

5.9 Water Main Seismic Design

All water mains shall be designed to reduce the risk of leakage or loss of service resulting from permanent ground deformations. Most earthquake damage to buried water mains result from pipe deformation caused by surrounding soil movements. These ground displacements may be caused by either temporary seismic wave propagation or permanent ground displacements from moderate or high soil liquefaction or slope instability.

5.9.1 Affected Areas

Areas of potential water system seismic vulnerability are generally located within the Fraser River floodplain and the Glenbrook Ravine.

5.9.2 Pipeline Design

In all areas subject to seismic vulnerability, the following design requirements shall apply:

i. The axial strain, joint slip-out resistance and joint deflection requirements as defined in ISO 16134 Earthquake- and Subsidence - Resistant Design of Ductile Iron Pipelines Standard
   - Axial Strain –Class S-2
   - Deflection Angle –Class M-3
   - Slip-out Resistance –Class A

ii. All pipe fittings, valves, hydrants and related components shall demonstrate the same restraining performance capacities as the pipeline design.

iii. Water mains shall be restrained ductile iron. PVC mains are not be permitted.

iv. All ductile iron pipe joints shall be integrally restrained with seismic provision.

v. To minimize the interaction between soil and the water main, all ductile iron pipes shall be installed in Polyethylene Encasement as per AWWA C105 Standard.

vi. The Consulting Engineer shall calculate the expected differential movement between pipe and the connecting structure and provide a design that will accommodate the anticipated movement.

vii. Provide an offset or loop in the service connection to accommodate movement up to 0.5 m of the pipeline through the soil.

6. STREET LIGHTING AND TRAFFIC SIGNALS

6.1 General

This document is intended to provide lighting and electrical criteria guidelines to aid in the design of street lighting in the City of New Westminster. The Consultant shall be fully knowledgeable with the Illuminating Engineering Society of North America (IESNA) standards and the most current edition of the Transportation Association of Canada (TAC) Guide for the Design of Roadway Lighting. The City intends to apply sections of these documents to outdoor lighting within the City as determined by the Director of Engineering.

In this document, the New Westminster Electrical Utility is referred to as the Supply Authority.

6.2 Visual and Environmental Issues

Obtrusive light, light trespass, light pollution and environmental zones are key project design issues that will be considered by the City. Engineering Consultants and Architects will utilize luminaires and design techniques that will mitigate these issues. The City prefers fixtures that have full cut-off optics, but if a full cut-off optical system is not available in the selected fixture, then the Director of Engineering may consider the use of a partial cut-off optical system.

6.3 Codes, Rules and Permits

For all projects, the Consultant shall:

a) Comply with the rules of the latest edition of the Canadian Electrical Code and any bulletins published by the Electrical Safety Branch, of the Province of BC.

b) Comply with the laws, rules and recommendations of agencies, including the Canadian Standards Association (CSA), the Supply Authority, Workers Compensation Board and regulatory City and governmental authorities.

c) Construct the lighting and traffic signal system in accordance with the City approved edition of the Master Municipal Construction Documents (MMCD) and the City's Supplementary Specifications and Detail Drawings for lighting and traffic signals.

d) Coordinate all works with the Supply Authority to ensure minimum clearances from their overhead and underground systems are achieved and exact service locations are confirmed.

e) Have all submitted plans sealed by a Professional Engineer registered with the Association of Professional Engineers and Geoscientists of British Columbia.

6.4 Illuminance Levels

Roadways, parking facilities, pedestrian walkways and bikeways shall be illuminated for safety and to produce accurate and comfortable nighttime visibility.

The City has standardized the illuminance method for its lighting designs. The recommended minimum average maintained horizontal illuminance levels, uniformity ratios and veiling luminance ratios used by the City are listed in the ANSI/IES RP-8-00 – National Standard Practice for Roadway Lighting. Luminance and small target visibility (STV) methods shall be used where a specific circumstance warrants their use. Use of these alternate methods must meet the approval of the Director of Engineering.

Tables in RP-8-00 to be referenced for roadway lighting are:

Table 2:	Illuminance Method - Recommended Values.
Table 9:	Recommended Illuminance for the Intersection of Continuously Lighted Urban Streets.

Tables in RP-8-00 to be referenced for pedestrian walkway and bikeway lighting are:

Table 5:	Recommended Values for High Pedestrian Conflict Areas.
Table 6:	Recommended Values for Medium Pedestrian Conflict Areas.
Table 7:	Recommended Values for Low Pedestrian Conflict Areas.
Table 8:	Recommended Values for the Pedestrian Portion of Pedestrian Vehicular Underpasses and Exclusive Pedestrian Underpasses.

Prior to starting a project, the Consultant shall verify the Road Classification (i.e. arterial, collector, local, etc.) and the Pedestrian Conflict Area Classification with the City.

The road classifications, illuminance levels, ratios, road and pedestrian conflict areas proposed for each roadway and pedestrian walkway/bikeway shall be listed in a table format on the design drawings.

The Consultant shall calculate all illuminance levels and ratios as noted under Section 6.8 Lighting Calculations. For calculations where the roadway surface is asphalt, R3 road surface classification shall be used and for calculations where the surface is concrete, R1 road surface classification shall be used. Refer to RP-8-00 – Table 1: Road Surface Classifications.

Parking facilities shall be illuminated in accordance with the IESNA RP-20-98 – National Standard Practice for Lighting of Parking Facilities.

Tables in RP-20-98 to be referenced are:

Table 1: Recommended Maintained Illuminance Values for Parking Lots.
Table 2: Recommended Maintained Illuminance Values for Parking Garages.

6.5 Light Pole Spacing

All poles shall be davit style, unless decorative poles are requested by the Director of Engineering. Davit pole heights shall be 7.5m and 9.0m. Taller poles, 11.0m or 13.5m high, can be use on arterial roadways only with the City's approval.

Poles along the roadway shall be located at the outer edges behind curb and gutter or edge of pavement, or in special circumstances, in the median of the street. Where median lighting is being considered, the lighting levels on any sidewalks shall be met or additional supplemental sidewalk lighting maybe required. The exact offset of the pole (behind curb, edge of pavement or sidewalk) is typically defined on City's Standard Detail Drawings.

Poles at intersections shall be located to accommodate intersections, property corners and pedestrian walkways. Spacing shall be governed by roadway width, road configuration and intersecting property lines. Generally, where possible, poles shall be located close to property lines and shall avoid being placed in front of residential windows. Poles shall be located at a minimum of 1.5m from the start/end of curb returns and at a minimum of 1.5m from the widest part of the driveway, including the flare.

Pole spacing patterns include staggered, opposite, one side and median mount arrangements, depending on the roadway classification and road geometrics. The pole arrangements shall generally be as follows:

1) Roads 8.5m and narrower – One sided spacing
2) Roads over 8.5m wide – Staggered or opposite spacing
3) One sided spacing may be allowed when power line clearances cannot be met
4) Poles can be located in medians if a clearance of 0.5m from the pole to curb face can be maintained and posted speed is 60 km/h or less. A minimum of 2 consecutive poles should be required before considering poles in median islands
5) Maintain clearances of 3.0 m from overhead primary power lines to luminaires

Where trees are proposed lights may have to be installed on davit arms which extend out over the roadway beyond the ultimate tree canopy. Additional pedestrian scale lighting may be required for the sidewalk. The proposed locations, spacing, pole height, arm length and frequency of the trees may also need to be adjusted in conjunction with the lighting pole spacing. The minimum

separation between poles and trees shall be 6.0m. The placement of poles shall have priority over the placement of trees.

6.6 Luminaires, Light Source and Smart City

Luminaires

The Consultant shall select the most effective IESNA luminaire distribution type (i.e.; Type 2, Type 3 etc.) and also meet the Roadway Lighting energy performance standard CAN/CSA-C653, Performance Standard for Roadway Lighting Luminaires, to suit the roadway geometrics. Cobra head luminaires shall be used for all roadway lighting applications with the exception of those defined by the Director of Engineering as Decorative Street Lighting areas (refer to Section 6.7). Cobra head roadway luminaires shall be Ministry of Transportation and Infrastructure recognized product.

The preferred operating voltage for the street lighting system is 120/240V, single phase, 3 wire. Alternate voltages must meet the approval of the Director of Engineering and the Supply Authority.

Light Source

The light source for luminaires used on roadways, parking facilities, pedestrian walkways, bikeways, pedestrian crossings, pedestrian actuated traffic signals and decorative street lights shall be Light Emitting Diode (LED). High pressure sodium (HPS) may be required under certain circumstances as approved by the Director of Engineering.

Smart City

Design of street lighting and controls shall consider future technological advances (e.g. Intelligent City fibre network, electrical vehicle charging stations, autonomous vehicle systems, etc.) and include opportunities to implement smart/intelligent city applications, as deemed appropriate.

For development projects requiring pedestrian walkway/bikeway lighting, the cost for the supply and installation of the lighting system shall be borne by the Developer. The Consultant shall ensure the compliance of these design criteria and consult the Director of Engineering for specific fixture type, colour and model number information.

6.7 Decorative Street Lighting

The City has designated areas in which Decorative Street Lighting and other electrical features such as pole and tree receptacles and irrigation systems are utilized to enhance the streetscape. The City shall provide the Developer with generic details of the decorative lighting, the requirements for any other electrical features and a list of approved suppliers.

Decorative poles may be suitable for roadways not exceeding 11 m width. Where decorative poles are required, the poles and anchor bolts shall meet all applicable codes and standards.

The following details are required as part of the decorative lighting design:

1) Shop drawings of the street light poles proposed complete with pole design criteria
2) Signature and seal by the Professional Engineer, registered in the Province of B.C.
3) Detailed information and specifications of the luminaires proposed
4) Detailed information on pole accessories (decorative bases, banner arms, receptacles, etc.)
5) Drawings detailing assembled pole and luminaire units; and
6) Full size design drawings detailing the complete site installation.

6.8 Lighting Calculations

Lighting design requires a computer lighting design software or Visual Roadway and lighting supplier photometric files from lighting suppliers in the IESNA format. Typically luminaire photometric files are based on a lamp which can vary from actual lamp used in the test, provided it similar. This referred to as “relative” photometry. LED photometric files must be “absolute” which means the photometric file must be for the exact luminaire being tested.

The designer shall select luminaires with optical systems which efficiently light the interned area and properly illuminate the roadway and sidewalks as well as provide maximum spill light control beyond the sidewalk in order to reduce spill light and glare impacts on local residents. This shall be done by analyzing luminaire optical systems using the BUG method defined in Illuminating Engineering Society TM-15 Classification System for Outdoor Luminaires and Addendum A: Backlight, Uplight, and Glare (BUG) Ratings. The maximum nominal BUG rating of luminaires shall be B2-U1-G2 however lower BUG rating should be used where possible.

The designer shall apply Light Loss Factor to the lighting design. For LED's the Light Loss Factor (LLF) is a combination of several factors representing deterioration of the lamp and luminaire over their life-spans which is applied to a lighting design. Several individual factors combine to form the overall LLF. The LLF then is incorporated into the design calculations.

LLF = LLD x LDD x LATF
Where:
Lamp Lumen Depreciation (LLD) = 0.85.
Luminaire Dirt Depreciation (LDD) = 0.90
Luminaire Ambient Temperature Factor (LATF) = 1.04 (+10° C).

For LED's the range of LLF shall be 0.8.

Electrical design requirements include:

1) Allow for possibility of future expansion. Stub out conduit(s) at the last streetlight pole and / or into a temporary junction box at end of the development.
2) 1-75mm RPVC traffic signal interconnection conduit in conjunction with roadway lighting for all Arterial and Collector Roads. The conduit shall be common trenched with the street lighting system conduits.
3) All empty conduits shall have a 6 mm nylon pull string installed and capped ends.
4) Where required, include loads for pole receptacles (100 W/receptacle for LED's), tree lights, traffic signal controllers, electrical vehicle chargers (EVC) and other devices connected to the service panel.

6.9 Power Supply and Distribution

The designer shall confirm voltage and locations of suitable power sources for the proposed lighting system. The designer shall confirm if a new service is required or an existing lighting system in the area is suitable for extension. Lighting systems are typically serviced from a 120/240 Volt single phase 3 wire system. Use of other voltages must meet City approval.

Services are to be "Underground Dip" type or will tie into a service box. The designer shall select a suitable service location based on availability and what meets the City standards and the electrical utility

The power supply shall feed into a service base containing panel boards, breakers, lighting contactor(s) and switch. The lighting is controlled by a single photocell located on a luminaire. The service base shall be located:

1) Off the roadway where not likely to be impacted by motor vehicles;
2) Where it will not be a hazard or obstruction to pedestrians;
3) Where it can be accessed for easy servicing;
4) To accommodate extension to future lights and other possible loads (i.e. EVC.)

Power distribution requirements include:

1) Wiring to be installed in minimum 35mm Rigid PVC conduit.
2) Wiring to be stranded copper with RW90 insulation.
3) Wiring to be colour coded per Canadian Electrical Code (CEC).
4) Conduit burial depth as per Canadian electrical codes.

Conduit alignments shall be designed to avoid tree roots.

6.10 Traffic Signals

Traffic signal details are standardized throughout British Columbia to avoid potential confusion

to the travelling public, both local and visiting. They are defined in the BC Motor Vehicle Act. Items standardized include:

- Vertical mounted signal heads
- Left side secondary heads
- Order of signal indication.

The Standard Construction documents shall be used in conjunction with the B.C. Motor Vehicle Act Regulations - Division (23) Traffic Control Devices and the B.C. Motor Vehicle Act R.S.B.C. 1996, Chapter 318.

Refer to Part B - Traffic Signals of the most current edition of the Manual of Uniform Traffic Control Devices for Canada (MUTCD) for information on traffic signal specifications, concepts and terminology.

1) General locations of signal heads are as follows:

    a. Primary: Mounted over the roadway which a vehicle is to enter
    b. Secondary: Mounted to the left of the roadway which a vehicle is to enter
    c. Auxiliary: Mounted to the right of the primary head, or other location to enhance visibility
    d. Pedestrian: Mounted on the far side of the intersection in line with the painted crosswalk.

2) Traffic signal designs are highly specialized and shall therefore be prepared by a qualified Consultant recognized by the City. Prior to starting a traffic signal design the Consultant shall contact the City to confirm specific requirements of the signal, timing and coordination plans, operational requirements and specific issues or concerns.

3) In instances where the project capital costs are borne by the City, traffic signal controllers and specialty signal equipment shall be supplied by the City. The Consultant shall consult the City to determine exactly what equipment shall be supplied. In the case of private development projects requiring traffic signals, the cost for the design and the supply and installation of traffic controllers and specialty signal equipment shall be borne by the Developer. Traffic signal controllers and specialty signal equipment shall be supplied by the City at the Developer's cost. Traffic Engineering and timing/coordination plans shall be provided by the Developer and prepared by a qualified Consultant, recognized by the City.

4) If traffic signal control devices, pre-ducting of future traffic signal control devices or traffic signal communications conduit/cable are required for a proposed development, at the discretion of the Director of Engineering, these may be designed by City staff and their construction may be included with other City work related to the project. The City

requires the Developer to retain an electrical consulting firm to prepare the design drawings and the Consultant shall have sound knowledge of traffic signal design. All design and construction costs shall be the responsibility of the Developer.

5) All drawings submitted to the City for review and approval shall be sealed by a Professional Engineer registered with the Association of Professional Engineers and Geoscientists of British Columbia.

6) All traffic signal pole standards and luminaries shall be confirmed with the Director of Engineering. Decorative traffic signal poles shall be used in designated areas, as directed by the Director of Engineering.

7) The City requires that every effort be made to incorporate the traffic signal controller cabinet/base into the architecture and/or the landscaping of the new development without losing sight of the need to have the cabinet located so that clear visibility can be maintained between the signalized intersection and the cabinet.

6.11 Conduit

Conduits shall generally be parallel or perpendicular to the roadway, and routed to run in a direct line between adjacent poles or junction boxes. The exception would be where existing trees conflict with the conduit run.

Street lighting conduits shall be minimum 30mm diameter RPVC. Signal conduits shall be minimum 50mm RPVC and minimum 25mm RPVC for loop stub-outs. Service conduits shall be minimum 50mm RPVC.

6.12 Interconnect Conduit

The Consultant shall confirm the requirements for and coordinate the design of a traffic signal interconnect system if required with the Director of Engineering. Traffic signals in close proximity to rail crossings require interconnection with the rail crossing controls to ensure maximum driver safety.

6.13 Power Supply

The designer shall confirm voltage and locations of suitable power sources for the proposed signal system. Signals systems are typically serviced from a 120/240 Volt single phase 3 wire system. Alternately, 120/208 volt 3 phase 4 wire systems may be used if necessary and if approved by the Director of Engineering.

6.14 Uninterruptible Power Supplies (UPS's)

UPS's shall be considered where potential power outage is a concern or the intersection is located in a high collision or high risk area. UPS's shall be installed on the back of the traffic controller cabinet. The use of UPS shall be confirmed with the Director of Engineering.

6.15 Junction Boxes

Approved plastic junction boxes shall be used as follows:

1) Where the maximum number of 90° bends in a conduit run is exceeded.
2) Where branch conduit runs are required.
3) In conduit runs over 100m.
4) At service panels.

Approved junctions boxes shall be used for traffic signal installations only in the quadrant where the traffic controller is to be installed.

6.16 Conductors

For the purpose of standardization and to accommodate future expansion, street lighting feeder conductors shall be No. 6 RW90 copper red, black, and white. The bonding conductor is to be No. 8 RW90 and green in colour. The use of alternate conductor sizes will require the approval of the Director of Engineering.

For traffic signal installations, multi-conductor cable shall be used. The cable shall run continuous from the traffic controller to each pole with no splices.

6.17 Service Equipment

a) Electrical service shall be determined in consultation with the Supply Authority.

b) Street lighting systems are to be controlled with a lighting contactor and photocell in which case the photocell would be located on the luminaire nearest to the service panel. Under certain circumstances individual photocell located on each luminaire may be allowed. The use of lighting contactors shall meet the approval of the Director of Engineering.

c) Service panels for street lighting systems shall have a minimum of 60A – 2P breaker and shall be mounted in a service base as shown on the MMCD Standard Drawings. 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 minimum of 100A -2P main breaker, 2 x 60A –1P sub-breaker for street lighting and 1 x 40A –1P sub-breaker for traffic

controller power. The service panel shall be mounted in a service base or on the side of a streetlight pole or post located near the traffic controller; no signal equipment shall be mounted on the same pole as the service panel. Refer to MMCD Standard Drawings.

d) All services shall be 120/240V single phase, 3 wire system.

6.18 Concrete Bases

When selecting pole base locations, search out proposed or existing utility locations and identify sensitive tree root zones to avoid conflicts. The pole base shall be positioned outside the drip line of trees proposed for retention. The Consultant shall coordinate the design with the Landscape Architect where applicable. The placement of poles shall have priority over the placement of trees.

1) The Consultant shall select a concrete base to suit the required pole from those shown in the MMCD Standard Drawings. Where a custom base is required to accommodate unusual soils conditions or to avoid underground utilities, the custom base design shall be sealed by a Professional Engineer and meet the approval of the Director of Engineering.

2) Avoid running more than two conduits into a streetlight pole base. Where required, a junction box shall be used. An exception to this requirement may be granted where the pole base functions as the service base. Additional conduit may be required to facilitate future technology.

3) Ground rods/plates shall be incorporated into each concrete base utilizing a 25mm RPVC conduit sleeve.

4) Spread footing shape bases may be required at poor soil area determined by the Consultant.

7. TRANSPORTATION

BYLAW NO. 8369, 2023

7.1 General

Design of transportation infrastructure shall be prepared by a Consulting Engineer with qualified expertise in Transportation systems. Transportation infrastructure shall be designed in accordance with the policies and concepts of the City of New Westminster Master Transportation Plan, Official Community Plan, Trail and Greenway Master Plan, and appropriate community plans and neighborhood transportation plans, regional plans or other applicable plans. Except as required by this Bylaw, the design shall conform to:

a) Geometric Design Guide for Canadian Roads published by the Transportation Association of Canada (TAC), latest edition,

b) City of New Westminster Bylaws, and

c) Provincial legislation including the Motor Vehicle Act.

BYLAW NO. 8369, 2023

7.2 Geotechnical Report

A geotechnical report, completed by a Professional Geotechnical Engineer registered in BC, shall be submitted to the City for review. The geotechnical report shall outline the existing road conditions and recommended road structure for associated road design. The report must assess the roads designs relative to the provision of adequate drainage stability, and provide recommendations, as warranted for required measures to ensure safety in areas having unstable soil strata. If the underlying material is peat, a special stabilization method should be investigated, i.e., pre-load or peat removal. For this reason, the City stipulates the basic minimum required asphalt-concrete, gravel and road base thicknesses (as shown on road cross-section supplementary detail drawings).

The Consulting Engineer shall verify road structure design based on the geotechnical report, to the satisfaction of the Director of Engineering. The Director of Engineering reserves the right to change the asphalt-concrete and road base thicknesses, if deemed necessary, as the result of unstable sub-grade.

BYLAW NO. 8369, 2023

7.3 Road Classifications and Cross Sections

Prior to commencing detailed design, the Consulting Engineer shall consult the relevant transportation plans for area specific requirements and obtain approval for the proposed road cross section with the Director of Engineering.

BYLAW NO. 8369, 2023

7.3.1 Vehicle Travel Lane Widths

Vehicle travel lanes shall be designed according to Table 7.1:

Table 7.1 – Minimum Lane Width

Classification	Vehicle Travel Minimum Lane Width (metres)*
Arterial Road (includes TransLink's Major Road Network)	3.5
Collector Road (City)	3.3
Collector Road (Neighborhood)	3.2
Local Road	3.0
Lane (standard – additional width may be required	6.0 (total lane width)
Parking lane	2.4**

Note:
(*) May be wider along transit routes or designated emergency vehicle routes.
(**) Parking lane can be reduced to absolute minimum (2.2m), with approval from the Director of Engineering.

7.3.2 Right-of-Way Dedication Widths

Additional width in accordance to Sections 7.7 and 7.9 to accommodate desired boulevard features or Sidewalks may be required on a cases-by-case basis, depending on site-specific characteristics. For roads designated as active transportation routes (refer to Active Transportation Network Plan and Street & Traffic Bylaw No. 7664), the dedicated rights-of-way identified in Table 7.2, shall be widened to accommodate bicycles and other wheeled devices in accordance with Section 7.10.

Using the desired design standard widths in Section 7.3.1 and the preferred Sidewalk (Section 7.7), bike infrastructure (Section 7.10), and boulevard widths (Section 7.9), the road right-of-way dedications summarized in Table 7.2 are required:

Table 7.2 – Road Classification & dedication widths

Road Classification	Desired Right-of-Way Width (metres)	Restricted Right-of-Way Width (metres)

Arterial Road (includes TransLink's Major Road Network)	22 (four travel lanes) 20 (two travel lanes)	20
Collector Road (City)	22 (four travel lanes) 20 (two travel lanes)	20
Collector Road (Neighborhood)	19	15
Local Road	19	12
Lane (standard – additional width may be required	6.0 (total lane width)	n/a

If the proposed works involve extending an existing road, at the Director of Engineering's discretion the existing road width and characteristics may take precedence over these cross sections for the remainder of the block.

Where right of way restrictions exists, the Consulting Engineer shall prioritize the components as follows:

1. Sidewalk,
2. Bike lane,
3. Vehicle travel lane,
4. Boulevard, and
5. Parking.

BYLAW NO. 8369, 2023

7.4 Road Types

7.4.1 Half Roads (Interim Roads)

Where a road is to be constructed on an existing, unopened/unconstructed road allowance, the Consulting Engineer must complete the design for the full width road and indicate on the design drawings the portion that is to be completed by others as a future, separate project.

The half road shall include, at minimum, Sidewalk, boulevard, curb and gutter, utilities, and underground wiring, on one side of the road, as required in the standard cross sections, along with a minimum 6.0 meters pavement and provisions for appropriate road structure, drainage and grade differences on the opposite side to be completed by others.

Where a road is proposed to be dedicated along the perimeter of a parcel and may in future require access to land on the opposite side, the Director of Engineering shall determine if it is to be constructed as a half road or as a full width road.

7.4.2 Cul-de-sacs

Cul-de-sacs shall end in bulbs with the minimum diameters as defined by supplementary detail drawing SDR-20. The maximum road length for a cul-de-sac is 90 meters. If required, a hammerhead design may be provided at the discretion of the Director of Engineering.

7.4.3 Turnarounds

Turnaround provisions shall be required at the termination of Lanes including temporary conditions. Temporary turnarounds shall be designed for interim roads of all classifications longer than 90m. Temporary turnarounds shall be constructed as a paved cul-de-sac bulb with all necessary rights-of-way and cash-in-lieu for removal. Alternatively, a hammer head (3-point) turnaround is also acceptable.

7.4.4 Lanes

Lanes shall be a minimum of 6 meters. Refer to detail drawing SDR-8.

BYLAW NO. 8369, 2023

7.5 Driveways / Lane letdowns

Driveways are to be designed in accordance with City Bylaws and the Supplementary Specifications and Detail Drawings. One driveway is permitted per lot unless approved by the Director of Engineering.

Access to driveways may be restricted to certain movements for safety and/or traffic management. Restrictions are at the discretion of the Director of Engineering.
All driveways shall be concrete (preferred) or asphalt at the discretion of the Director of Engineering.

7.5.1 Location and Width

Driveway locations must be in accordance with the Street & Traffic Bylaw. Vehicular access to an Arterial Road, Collector Road, Great Street, Major Road Network, or the Cycle Network is not permitted except as outlined in the Street & Traffic Bylaw No. 7664, 2015, as amended from time to time
The minimum and maximum width of driveway / lane letdowns are based on the land use the driveway serves and are as outlined in Table 7.3. Minimum clearance from objects adjacent to driveways is as shown in Table 7.4.

Table 7.3 – Minimum clearance from Driveways

Land Use	Operation	Min. width (m)*	Max. width (m)
Low-density residential (SF, duplex, triplex, quadplex)	Two-way	3	5.5
High-density residential	Two-way	N/A	7.3
	One-way	3.0	4.5
Commercial, Institutional	Two-way	6	9.0
	One-way	3	4.5
Industrial	Two-way	6	11.0
	One-way	3	5.0

Note:
(*)To be confirmed by Consulting Engineer based on the type of vehicle accessing the site.

The minimum distance from side property line (S) and edge of driveway is at discretion of the Director of Engineering.

Table 7.4 – Minimum clearance from Driveways

Adjacent Objects	Distance*
Hydrants	1.5 m
Powers / Telecom poles / Anchors - Guy Wires	1.5 m
Kiosks	2.0 m
Street light poles	1.5 m
Boulevard / Trees	At the discretion of the City's Arborist
Retaining Walls/Fencings/Railings	2.0 m
Street corners / Intersections	6.0 m
Signage	1.5 m

Note:
(*) From edge of driveway letdown at its widest point.

7.5.2 Driveway / Sidewalk Interface

Sidewalks across driveways shall have a cross slope of no more than 2% unless approved by the Director of Engineering. Sidewalks across driveways should be of consistent grade (consistent with grade of adjacent street) to the extent possible. Design options for reducing cross slope include increasing grade of the driveway between the Sidewalk and curb and/or between the Sidewalk and property line, rather than across the Sidewalk. Adjusting the elevation of the Sidewalk across the driveway shall be minimized. Where necessary, the design of driveway flares should be adjusted to achieve accessible Sidewalk grades (unless street grades exceed accessible grades, in which case consultation with the Director of Engineering may be necessary).

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7.6 Intersections

The geometric design of all intersections shall follow guidelines in the latest version of the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads.

7.6.1 Curbs

Except where otherwise approved by the Director of Engineering, standard Master Municipal Construction Document (MMCD) curb type C4 shall be used.

7.6.2 Curb Returns

The following table lists typically recommended curb return radii. The Consultant shall confirm the required curb return radii based on the appropriate design vehicle, as approved by the Director of Engineering, and every effort must be made to minimize the curb radius to maximize traffic calming and pedestrian safety and accessibility benefits. The requirement of any curb returns larger than the desired radii shown must be confirmed with a swept path analysis using the approved design vehicle. Compound curves may be required on arterial/MRN streets for specific situations and design vehicles, in which case concrete truck aprons should be considered. Curb returns on bus routes, regardless of road classification, should be designed to accommodate the appropriate design vehicle and in accordance with TransLink Bus Infrastructure Design Guidelines.

Table 7.5 – Recommended curb return radii

	Intersection with		
	Local Road	**Collector Road**	**Arterial Road /MRN**
Local Road	5.0 m	5.5 m	5.5 m
Collector Road	-	5.5 m	5.5 m or as required to accommodate design vehicle
Arterial Road / MRN	-	-	As required to accommodate design vehicle
Industrial land use (all types)	As required to accommodate design vehicle	As required to accommodate design vehicle	As required to accommodate design vehicle

7.6.3 Corner Cuts

Corner cuts (property dedication) may be required to ensure adequate sightlines, accommodate traffic control equipment, and provide accessible queueing space for pedestrians.

Table 7.6 – Corner cut dimensions

Intersection Type	Corner Cut Dimensions
Arterial Road /MRN/Collector Road	5 m x 5 m
All other Roadway intersections*	3 m x 3 m

Note:
(*)Requirement may be waived at the discretion of the Director of Engineering.

7.6.4 Turn Channelization

The need for turn channelization shall be determined through the Comprehensive Transportation Review and generally used in limited circumstances. Design shall be in accordance with the latest edition of the Transportation Association of Canada Geometric Design Guide. Left-turn lanes shall have an opposing lane layout to improve driver sightlines and minimize through lane deflection.

7.6.5 Curb Extensions

Curb extensions are preferred and shall be considered for speed reduction, reduced pedestrian crossing distance, reduced parking violations, and improved pedestrian visibility. Where possible, curb extensions shall be designed to define the on-street parking clearances. Provisions for safe passage of bicycles shall be incorporated and turning movements are to be assessed and verified using turning templates for the appropriate class of vehicle as approved by the Director of Engineering.

7.6.6 Roundabouts

Roundabouts may be considered for intersection control through the Comprehensive Transportation Review process. Design must be consistent with the latest edition of the Transportation Association of Canada Geometric Design Guide for Canadian Roads, and must address universal accessibility for vulnerable road users.

7.6.7 Traffic Circles

Traffic circles may be installed at intersections as a traffic calming device, and considered on Local Roads with residential uses. The traffic circle shall be designed to allow the design vehicle (typically the largest vehicle to regularly use it such as a solid waste vehicle) to maneuver through the intersection while accounting for on-street parking. Landscaping or other objects in the traffic circle shall be such that adequate sightlines can be provided and maintained.

Unless approved by the Director of Engineering, traffic circles shall be avoided along bus routes, emergency response routes, and bicycle routes with steep grades.

7.6.8 Curb Ramps / Wheel Chair Ramps

Curb ramps shall be provided at all intersections and at designated crosswalks and may be considered for loading zones as specified on supplementary detail drawings.

Curb ramps shall be free of obstacles that limit or prohibit movement. Ramps shall ensure a smooth transition to and from the road surface (final lift of asphalt) with no 'lip' at the gutter. Ramps shall provide a maximum grade of 8%, with a preferred grade of between 5% and 7%. Where possible, ramps must incorporate a level 'bypass' behind the ramp(s) for people including wheelchair users who are not crossing the street.

Curb ramps shall provide directional score lines to assist people with visual impairments. They shall guide pedestrians safely into the crosswalk, line up in the desired direction of travel to the complementing curb ramp across the street, and be parallel with the crosswalk. They shall be provided as separate or split ramps serving each direction of travel, as specified on curb ramp supplementary detail drawings.

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7.7 Sidewalks

Concrete Sidewalks shall be contained within dedicated road allowances. Sidewalks are required on both sides of all streets.

7.7.1 Sidewalk Widths

Table 7.7 – Sidewalk Widths

Land Use	Minimum Width (m)*
Residential (Single-detached, Duplex, Triplex, Quadruplex, Infill Townhouse)	1.8
Residential – Apartment (mid-rise)	2.0
Residential – High-rise	2.0
Commercial , and Mixed-Use (Residential, Commercial) - High-Density	2.5
Institutional – Schools, Community Centers,	2.5
Industrial	1.8

Note:
(*) or at the discretion of the Director of Engineering.

7.7.2 Sidewalk Design

No obstructions or appurtenances, including hydrants, utility poles, sign posts, kiosks, or portions thereof, shall be placed within existing or proposed Sidewalks. Vista switches and junction boxes are preferred not to be located within Sidewalks. Where parkade entrances meet Sidewalks with no setback, a 3m by 3m (or as directed by developer's Consulting Engineer) view corridor shall be provided to ensure adequate stopping sight distance and avoid conflicts between drivers and pedestrians.

Longitudinal grades on Sidewalks shall remain constant (relative to adjacent street) and not exceed 10% where possible. Cross slopes shall not exceed 2% or be less than 1% except with approval of the Director of Engineering.

Finished Sidewalk elevation at the back of the Sidewalk shall be shown on the construction plan at locations corresponding to the gutter high and low point. Intermediate finished grade elevation shall also be shown at 10 m intervals corresponding to Roadway cross-sections.

7.7.3 Finishing and Universal Access

Sidewalks shall be broom-finished. To maximize universal accessibility, decorative features such as paver bands shall not be used in the clear Sidewalk zone unless approved by the Director of Engineering.

Sidewalks should generally be parallel to the adjacent property line and the adjacent street, and must not meander unnecessarily except where necessary to avoid immovable obstacles. Longitudinal variations must be navigable by persons with visual impairments. Street narrowing (e.g., curb extension) over short distances may be required to preserve consistent Sidewalk width around some obstacles.

7.7.4 Continuous Sidewalks and Lane crossings

Sidewalks along Collector Roads and Arterial Roads, the MRN and Great streets shall be continuous across Local Road and Lane intersections. This implies that broom-finished concrete shall be continued across the intersection at a consistent elevation through a raised crossing or at the discretion of the director of engineering. If there is a bike lane along the major street, it should also be continuous across the intersection at a consistent elevation.

BYLAW 8369, 2023

7.8 Crosswalks

The installation of marked crosswalks shall generally be in accordance with the latest Transportation Association Canada Pedestrian Crossing Control Guide. Enhanced measures outlined in the Guide, such as curb extensions and extended parking clearances, may be required at the discretion of the Director of Engineering.

Marked crosswalks, including those with enhanced measures such as flashing beacons, are generally only used at Collector Roads and Arterial Roads /MRN street intersections, but may be used at some Local Road intersections (e.g., near schools) as required or approved by the Director of Engineering. Midblock crossings must be marked regardless of road classification.

Marked crosswalks shall be at least 3.0 m wide and up to 5.0 m wide where crossings exceed or are forecasted to exceed 200 pedestrians in the peak hour.

Marked crosswalks shall consist of either twin parallel line crosswalk markings, or where it is desirable for greater conspicuity at the discretion of the Director of Engineering, zebra crossing markings.

School crosswalks (with appropriate signage) may be required on approved *Safe Routes to School* and other locations near schools with approval from the Director of Engineering.

Raised crosswalks may be required where a traffic calming benefit is desirable and/or warranted, but should not generally be used on Arterial Roads /MRN, Collector Roads, transit routes and/or primary emergency response routes. Their use must be considered in consultation with the Director of Engineering.

Where crosswalks are combined with cross-ride (“elephant’s feet”) markings, the cross ride markings shall be placed outside of the crosswalk markings.

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7.9 Boulevards

Boulevards, including street trees, are to be provided on all streets. Boulevards will be either hardscaped or landscaped, at the request of the Director of Engineering. All front boulevards shall be a minimum width of 1.5m from face of curb to front of Sidewalk, or 2.0m if street trees are required.

7.9.1 Landscaped Boulevards

Landscaped boulevards will be required in residential areas, or where deemed necessary by the Director of Engineering. The boulevards shall be prepared for boulevard Trees complete with a 1.0m deep New Westminster Planting Blend or approved equal growing medium for the full with of the boulevard, including drainage and irrigation. If adequate soil volume is not achievable, provisions shall be made for soil cell technology or any other approved method. Landscaped boulevards shall be levelled, drained and seeded with grass, or sodded, depending on weather conditions, at the discretion of the Director of Engineering. The Director of Engineering may require the seeding or sodding and other landscaping of the boulevards to be delayed until building construction in the development, or on the lots created by Subdivision, is 90% complete or such earlier time as determined by the Director of Engineering.

7.9.2 Hardscaped Boulevards

Hardscaped boulevards will be required in commercial and mixed-use areas, or where deemed necessary by the Director of Engineering. The concrete granular structure of hardscaped boulevards shall be equivalent to Sidewalk requirements and include drainage and irrigation.

BYLAW 8369, 2023

7.10 Cycling Facilities

The design of cycling facilities will be confirmed in consultation with the Director of Engineering and conform to the City's Active Transportation Network Plan and the latest editions of the BC Active Transportation Design Guide and TAC Geometric Design Guide. Intersection designs will require location-specific consideration but should follow principles of these and similar design guidance.

7.10.1 Facility Material & Width

Unless otherwise approved by the Director of Engineering, bicycle facilities must be paved in asphalt. Bicycle facilities must be designed according to the following table.

Table 7.8 – Bicycle facilities width

Configuration	Preferred width (m)	Minimum width (m)
Uni-directional bike lane	2.5*	1.8
Bi-directional bike lane	3.6*	2.5
Bi-directional multi-use pathway (shared with foot traffic)	4.0**	3.0
Painted bike lane (with buffer)	1.8*	1.5

Notes:
* May be wider in areas with high cyclists volume (7500 bikes/day)

** May be wider for high volume facilities with a variety of different user types. Mode separations should be considered if there are more than 1,500 combined users on a facility.

The width of the bicycle facility can be less than the minimum preferred width only over short distances due to constraints, with approval from the Director of Engineering.

7.10.2 Buffers

Where bicycle facilities are to be physically separated from other modes of travel, buffers must be incorporated according to the following table.

Table 7.9 – Bicycle facilities buffers

Design element	Minimum Preferred width (m)	Minimum width (m)
Buffer separating bike lane from parked motor vehicles	1.0	0.8
Buffer separating bike lane from moving motor vehicle traffic	0.6	0.3
Buffer separating bike lane from Sidewalk	0.5	0.2

A buffer separating a bicycle lane from parked motor vehicles may be hardscaped or landscaped but should provide passable locations where people may easily move between parked motor vehicles and the Sidewalk. Adjacent to a designated loading zone, rollover curb may be used to improve accessibility. A buffer separating a bicycle lane from moving motor vehicle traffic must include a barrier curb on the road side.

A buffer separating a bicycle lane from the Sidewalk must be detectable and accessible by people with disabilities. To achieve this, the buffer may be landscaped, grade separated with a detectable and accessible curb (e.g., sloped curb), or at the same grade with a cane-detectable longitudinal tactile surface indicator.

BYLAW 8369, 2023

7.11 Transit Facilities

The Consulting Engineer shall confirm the requirements for transit service and transit facilities for all roads designated as existing or future bus routes. The TAC Geometric Design Guide and TransLink's - Transit Infrastructure Design Guidelines shall be referenced.

BYLAW 8369, 2023

7.12 Railway Grade Crossings

As soon as planning is initiated or proposals are known by municipalities, notification and consultation should be initiated for:

a) Development or redevelopment proposals within 300 meters of rail operations, or for proposals for rail-serviced industrial parks; and

b) Infrastructure works, which may affect a rail facility, such as roads, utilities, etc.

Municipalities, land Developers, property Owners, and railways all need to place a higher priority on information sharing and establishing better working relationships both informally and formally through consultation protocols and procedures.

Applicants are encouraged to provide clear direction and reference the City strategic Plans (e.g. through District Plans, Official Plans, Official Community Plans, Zoning By-laws, etc.) to ensure that land development respects and protects rail infrastructure and will not lead to future conflicts. This may include:

- Undertaking a comprehensive evaluation of land uses in proximity to railway operations, with a view to minimizing potential conflicts due to proximity, including those related to safety, vibration, and noise. For example, residential development may not be appropriate in low-density areas where lot sizes hinder the possibility of incorporating standard mitigation measures. Additionally, schools or commercial uses located across a railway corridor from residential uses are likely to result in trespassing issues if there are no public crossings in the immediate vicinity.
- Undertaking a comprehensive review of site access and railway crossings with a view to ensuring adequate site access setbacks from at-grade crossings (to prevent vehicular blockage of crossings), protecting at-grade road/ rail crossing sightlines, implementing crossing improvements, and discouraging new at-grade road crossings;
- Planning and protecting for future infrastructure improvements (e.g. grade separations and rail corridor widening); and
- Respecting safe transportation principles. For example, the assessment of new, at-grade rail crossings should consider safe community planning principles and whether other alternatives are possible, not just simply whether a crossing is technically feasible.

Whenever roadworks cross an existing railway or railway right-of-way appropriate permits and approvals must be obtained.

If these roadworks involve improvements to Arterial Roads, the MRN, Collector Roads, or Roadways with designated bicycle routes. Surface treatment will be at the discretion of the rail company at railway crossings.

Consultation with all stakeholders, including the railways, at the planning process is important to building, understanding and informing nearby neighbors. In addition, initiating a conversation with railways can confirm the feasibility of a project and the practicality of proceeding. Key issues or concerns that may need to be addressed will be identified.

Early contact between the applicant and the railway (preferably in the project's early design phase), is highly recommended, especially for sites in close proximity to railway corridors. This consultation is important in order to determine:

a) The location of the site in relation to the rail corridor;

b) The nature of the proposed development;

c) The frequency, types, and speeds of trains travelling within the corridor;

d) The potential for expansion of train traffic within the corridor;

e) Any issues the railway may have with the new development or with specific uses proposed for the new development;

f) The capacity for the site to accommodate standard mitigation measures;

g) Any suggestions for alternate mitigation measures that may be appropriate for the site; and

h) The specifications to be applied to the project.

Applicants should be aware of and implement, where feasible, Transport Canada’s safety recommendations with respect to sightlines for at-grade crossings. The recommendations include a minimum 30-metre distance between the railway right-of-way and any vehicular ingress/egress. In addition, trees, utility poles, mitigation measures, etc. are not to block sightlines or views of the crossing warning signs or systems.

At a minimum, all new residential developments in proximity to railway corridors must include a 1.83 meter high chain link fence along the entire mutual property line, to be constructed by the Owner entirely on private property. Other materials may also be considered, in consultation with the relevant railway and the municipality. Noise barriers and crash walls are generally acceptable substitutes for standard fencing, although additional standard fencing may be required in any location with direct exposure to the rail corridor in order to ensure there is a continuous barrier to trespassing.

BYLAW NO. 8369, 2023

7.13 Community Mailbox

The applicant shall set the location of community mail boxes within the development and shall obtain agreement in writing from Canada Post regarding the location(s). The location of the community mail boxes shall not restrict access to any surface or underground infrastructure, and is subject to the City's acceptance. The Consultant shall provide the required SROW at the community box locations to enable Canada Post to install and maintain the box.

BYLAW NO. 8369, 2023

7.14 Traffic Control Devices

Traffic control will be determined through the Comprehensive Transportation Review process.

BYLAW NO. 8369, 2023

7.14.1 Traffic Signals

Where traffic signals are recommended, design shall be in accordance with Section 6 and be consistent with the Signalized Intersection Policy with a strong focus on designing for vulnerable road users. Controlled pedestrian crossings will be in accordance with the TAC Pedestrian Crossing Control Guide and consistent with the Signalized Intersection Policy. Bicycle traffic signal displays are required to be consistent with the TAC Manual of Uniform Traffic Control Devices for Canada. Detection of cyclists – preferably touchless (e.g., radar, camera, induction loop) – must be integrated with all pedestrian signals.

7.14.2 Traffic Signs and Street Markings

If traffic signs are required for a proposed development, these will be designed by the Consultant and consistent with the Transportation Association of Canada Manual of Uniform Traffic Control Devices or the Ministry of Transportation and Infrastructure Manual of Standard Traffic Signs & Pavement Markings, and approved by the Director of Engineering. Fabrication and installation will be completed by City forces. If pavement markings are required for proposed developments these will be designed by the Consulting Engineer.

BYLAW 8369, 2023

7.15 Traffic Calming

Appropriate traffic calming measures shall be considered and may be required by the Director of Engineering. Traffic calming design shall conform to the latest edition of the Transportation Association of Canada (TAC) / Canadian Institute of Transportation Engineers (CITE) "Guide to Neighborhood Traffic Calming".

Alternative street designs may be considered as an option in lieu of traffic calming as approved by the Director of Engineering.

BYLAW NO. 8369, 2023

7.15.1 Speed Humps

Speed humps shall be provided at the request of the Director of Engineering as per supplementary detail drawing included in this bylaw.

BYLAW NO. 8369, 2023

7.16 Geometric Design Requirements

BYLAW NO. 8369. 2023

7.16.1 Design Speeds

The following minimum design speeds must be provided for both vertical and horizontal alignment, unless otherwise approved by the Director of Engineering:

Table 7.10 – Road Classification & Design Speed

Road Classification	Design Speed
Arterial Road/MRN	50 km/h
Collector Road	50 km/h
Local Road	30 km/h
Lanes	20 km/h

BYLAW 8369, 2023

7.16.2 Design Gradients

A smooth grade line with gradual changes, consistent with the class of road and the character of the terrain, is preferable to an alignment with numerous breaks and short lengths of grade. The "roller-coaster" or "hidden dip" type of profile shall be avoided.

At intersections of roads of unequal classification, the grade of the road centerline of higher designation will be maintained and the grade of the other road centerline will be altered to conform to the crown of the more major road.

At intersections of roads of equal classification, the grade of the road centerline of each road will be constructed level for the width of the intersection.

At any locations with grade transitions, the grade line shall ensure that the design vehicle underside or the front/ rear bumpers do not contact the pavement, with reference to the latest edition of the Transportation Association of Canada Geometric Design Guide for Canadian Roads or other appropriate design guidelines.

BYLAW NO. 8369, 2023

7.16.3 Cross Slopes and Super elevation

Cross slopes for all Roadways shall not be less than 2% or not more than 4% in the direction indicated on the appropriate Road Cross Sections. The crown shall be in the center of the pavement. A standard "V-Shaped" cross section should be used for lane design. The need for any super elevation on any new roads shall be confirmed by the Consulting Engineer and approved by the Director of Engineering.

BYLAW NO. 8369, 2023

7.16.4 Drainage

On Roadways with curbs, drainage is the essential consideration. Longitudinal gradients must be set to eliminate excessive accumulation of water on the pavements.

Unless otherwise specified the following minimum gutter line gradients shall be used:

i) Road – 0.36%

j) Cul-de-Sac – 0.50%.

To provide drainage for flat roads that require false grading, the maximum gradient should not exceed 0.56% for roads and 1% for cul-de-sacs.

Unless otherwise directed by the Director of Engineering, these gradients shall be used for all normal conditions of rainfall and outlet spacing. In special cases, a hydraulic analysis should be made to determine whether water will flow at an undesirable depth in the gutter.

BYLAW NO. 8369, 2023

7.16.5 Vertical Curves

Vertical curves shall be designed in accordance with the latest edition of the TAC Geometric Design Guide for Canadian Roads, governed by the design speed of the road or laneway.

BYLAW NO. 8369, 2023

7.16.6 Horizontal Curves

Horizontal curves shall also be designed in accordance with the latest version of the TAC Geometric Design Guide for Canadian Roads, governed by the design speed of the road or laneway.

BYLAW NO. 8369, 2023

7.17 Structural Design Requirements

BYLAW NO. 8369, 2023

7.17.1 Handrails, bollards and baffle gates

Handrails, bollards and baffle gates shall also be designed in accordance with the latest edition of the Master Municipal Construction Documents (MMCD).

7.17.2 Retaining Walls

Retaining structures may be required within street or lane rights-of-way or on private property to support roads, utilities, buildings, or to create a useable building envelope. The requirements for retaining structures shall be determined on the bases of a Site Grading Plan submitted for each development.

Design drawings for retaining structures must be prepared and certified by the Consulting Engineer. Building permits are required for structures in excess of 1.2 meters in height and located on private property. Certification of inspection by the Consulting Engineer may be required by the Director of Engineering, as a condition of approval.

Handrails shall be installed on all retaining walls. Poly-coated wire mesh may be required to be attached to handrails where adjoining hazards are deemed significant by the Director of Engineering.

Exposed concrete surfaces of an aesthetically pleasing appearance shall be specified for retaining walls.

BYLAW NO. 8369, 2023

7.17.3 Curb/gutter

All roads shall be complete with concrete curbs and gutters in accordance with the City's approved edition of the Master Municipal Construction Documents (MMCD) and Supplementary Specifications and Detail Drawings.

Traffic circle and lane curb and gutter requirements shall be approved by the Director of Engineering.

BYLAW NO. 8369, 2023

7.17.4 Medians

Medians shall be sized in accordance with the Road Cross Sections and landscaped as outlined in Section 9.

BYLAW NO. 8369, 2023

7.17.5 Electrical and Telecommunications Utility Relocations

It will be the responsibility of the Consulting Engineer to liaise with the City's Electrical Utility and other Telecom utilities at the preliminary design stage, to resolve the new locations and off-sets of the utilities and to meet the requirements of all parties.

BYLAW NO. 8369, 2023

7.17.6 Road Embankment Grading

Road embankment shall be shaped to a slope of 1 vertical to 3 horizontal with sand fill and shall be finished with a seeded topsoil meeting the existing ground level or suitable alternative in accordance with Section 9.

If the embankment slope is not achievable and it is adversely affecting drainage and driveways, retaining walls complete with top hand rail shall be used. The use of retaining walls should be avoided except in extreme cases.

BYLAW NO. 8369, 2023

7.18 Pavement Structures

7.18.1 General Pavement Design

The basic road pavement structural design shall be adequate for an expected road life of 20 years under the expected traffic conditions for the class of road. This shall be determined by the results of soils tests and analysis of the results of deflection testing performed on the surface of the road base gravel by a registered Professional Engineer. The minimum total flexible pavement structure thickness for any road shall be in accordance with standard drawings or greater if determined by the testing.

The Director of Engineering may require the submission of a geotechnical report to confirm the structural adequacy of any existing or proposed street.

BYLAW 8369, 2023

7.18.2 Existing Pavement

Overlay of existing pavement shall be based on analysis of the results of Benkleman Beam tests, or other approved method, carried out on the existing road which is to be upgraded.

The Benkleman Beam testing shall be carried out in accordance with current standards, published by the Transportation Association of Canada (TAC).

The maximum Benkleman Beam deflection corrected for seasonal variation shall not be greater than:

k) Industrial and Arterial Road /MRN – 1.00 mm

l) Collector Road and Commercial streets – 1.25 mm

m) All other road classifications – 1.50 mm

The overlay thickness shall be determined by both the Benkleman Beam testing and by the shape of the cross-section of the existing pavement, so that an adequate crossfall on the existing pavement is obtained. The structure and/or grade of the existing pavement may indicate complete removal and reconstruction, which shall be carried out at the discretion of the Director of Engineering.

All joints between existing and new asphalt surfaces shall be lap joints. The location and specifications of all joints shall be shown on the Consultant's drawings.

BYLAW 8369, 2023

7.18.3 Asphalt-Concrete Pavement

The following minimum pavement, gravel and sand thickness presented below shall be maintained.

Table 7.11 – Pavement and Gravel Thickness

Pavement and Gravel Thickness				
Road Classification	**75 mm Granular Subbase (mm)**	**19 mm Crushed Granular Base (mm)**	**Asphalt-Concrete**	
			Lower Course (mm)	**Upper Course (mm)**
Major Road Network	500 (Crushed)	150	100 mm super pave (19mm)	50 mm super pave (12.5 mm)
Major Arterial	500 (Crushed)	150	100 mm super pave (19mm)	50 mm super pave (12.5 mm)
Arterial Road	400 (Crushed)	150	75 mm super pave (19mm)	50 mm super pave (12.5 mm)
Collector Road	300 (Select)	125	60 mm Lower Course 1	40 mm Upper Course 1
Lanes, Local Road & Multi-use pathways	300 (Select)	100	45 mm Lower Course 2	40 mm Upper Course 2
Driveways	100 (Crushed)	100	40 mm Lower Course 2	35 mm Upper Course 2

BYLAW 8412, 2023

8. STREET TREES & LANDSCAPING

8.1 General

Trees and landscaping are to be planted on all city road right of ways and within new subdivisions. The location of all civil works shall be shown in relation to the street trees and landscape areas.

8.1.1 Approval

The species of trees to be planted as street trees and plant material shall be reviewed and approved by the City Parks Department.

8.2 Design Criteria

8.2.1 Landscaping Medians and Boulevards

The area between the back of curb or sidewalk and the property line (boulevard area) and the non-travelled central portions of divided arterial roads (medians) normally shall be finished to a lawn or grassed surface using sod unless otherwise approved by the Parks and Engineering Departments. The non-travelled central portions of divided arterial roads (medians) shall be finished to a hard surfaced standard (brushed concrete or brick) or landscaped finish (grassed surface with trees, shrubs or combination of these) or alternative as approved by the Parks and Engineering Departments.

The City Parks Department will plant all trees on City property. The developer/contractor is responsible for all site preparation for the street trees and other landscape areas as noted above.

8.2.2 Minimum Standards

Trees planted along all streets typically shall be:

- Columnar in shape in commercial and high-density areas and of a broader, spreading shape elsewhere;
- Of a size, type and method of planting to be specified by the City Parks Department;
- Spaced at approximately 6.0 m – 10.0 m intervals; and
- Planted in a single row, centered in boulevard along both sides of the street or a second parallel row of trees of equal spacing. Trees may be planted on private property in a right-of-way at the City's discretion.

Unless required or pre-approved by the City, trees will not be planted within:

a) 6 m from Street Lighting;
b) 2 m from Catch Basins;
c) 8 m from Street Intersections (measured from the curb return);
d) 3 m from Hydrants;
e) 2 m from Manholes
f) 2 m from Driveways;
g) 3 m from Electrical Junction Boxes;
h) 2 m from Kiosks.

8.2.3 Selection of Trees Species

The City Parks Department shall select and plant all street trees at the Developers cost. The designer will identify tree spacing requirements.

8.2.4 Grating Requirements

For planting in hard surfaced areas such as concrete or paving stone, unless otherwise specified, concrete grates are required.

8.2.5 Tree Root Restraints

A root restraint mechanism approved by the Parks Department shall be provided where tree roots may interfere with service corridors for underground utilities or sidewalks if they are within 1 meter of the tree. The restraint mechanism will be designed such that the major root structure will be restrained from extending into other utility corridors, but still allow for the normal growth of the tree.

8.2.6 Growing Medium

In grassed boulevards the growing medium shall be installed to the satisfaction of the City Parks Department. Where native material is suitable the growing medium will be 25% native material and 75% amended soil or as otherwise specified by the City Parks Department. The amended soil is to be approved by the City Parks Department. Under hard surfaced areas such as under sidewalks, a structural soil mixture shall be installed to the City Parks Department specifications.

8.2.7 Irrigation

Where required by the City Parks Department for the maintenance of trees, grass or other landscaping located in boulevards or medians in the road right-of-way, an underground sprinkler system shall be provided by the Developer. The system must be capable of providing the necessary irrigation as required and shall be automatically activated through a timed control system. Under hard surfaced areas with structural soil mix, irrigation is required from an independent supply. In grassed boulevards (with the exception of single family parcels) irrigation is required and shall be provided from the on-site irrigation system at the Developer's cost.

8.2.8 Drainage

Drainage shall be installed where required and tied into the catchbasins. The drainage system shall be 100mm perforated PVC drainage pipe surrounded by 150mm of drain rock and wrapped with filter cloth. A clean out shall be installed every 15m and at the high end of the system with a Nelson box style lid.

8.2.9 Drawings

The following are required on all drawings:

a) Typical Cross-section with drainage detail;

b) Tree Planting and Staking Detail;

c) Tree Grate Detail;

d) Proposed Tree and Shrub Species Table
Species to be reviewed by the City;

e) Plan showing curb gutter and sidewalk, driveway locations including street lights and proposal trees with the chainages;

f) Irrigation and timer details; and

g) All civil works within the proximity of trees and shrub root zones.