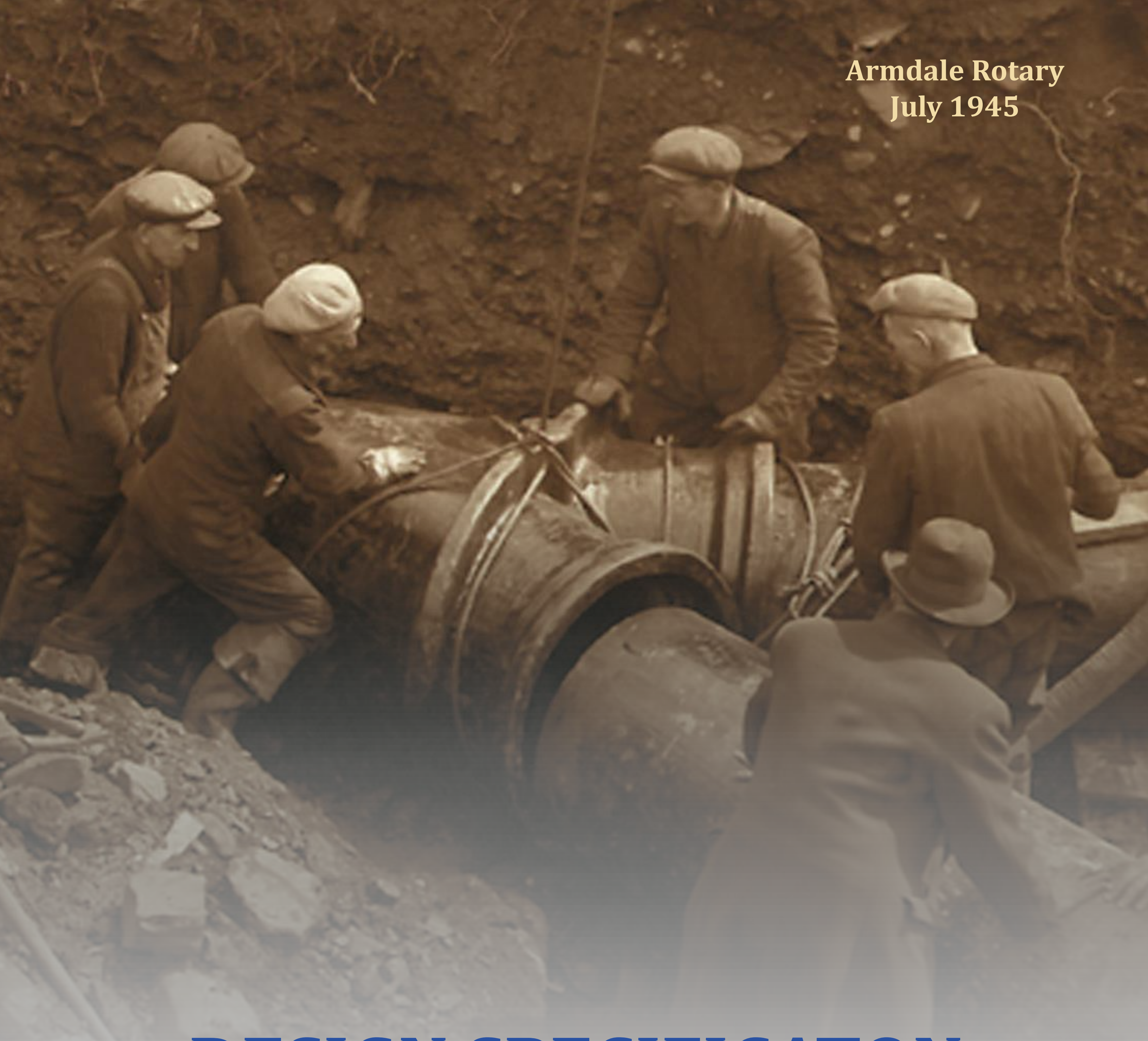

DESIGN SPECIFICATON

for WATER, WASTEWATER & STORMWATER SYSTEMS

Halifax Water

2017 Edition

June 1st, 2017

To our readers:

The *Halifax Regional Water Commission (HRWC) Design Specification* and *HRWC Supplementary Standard Specification* have been revised. In order to provide clarity to building plumbing designers we have created the *HRWC Water Meter & Backflow Prevention Device Design & Installation Manual*. All three documents are available for download on the HRWC website at www.halifaxwater.ca.

Considerable effort has been made this year to better organize the documents and simplify the language to provide clear direction. Much has been done, but there is still more to do. The *HRWC Supplementary Standard Specifications* are to substitute the corresponding sections within the *Standard Specification for Municipal Services* prepared by the Nova Scotia Road Builders Association and the Consulting Engineers of Nova Scotia. It is the intention of the HRWC to conform to the advancements and improvements in the practice of municipal engineering, and we look forward to a successful implementation of this document.

Our mandate provides for ownership, operation and maintenance of municipal water, wastewater and stormwater infrastructure within specific boundaries set by Halifax Regional Municipality. In order to establish, as far as practicable, uniformity of practice within the Halifax Regional Municipality, these specifications have been developed by staff of HRWC. They are to be used as the minimum standards to be met in the design and installation HRWC Water, Wastewater and Stormwater Systems within the Halifax Regional Municipality.

These specifications are developed to provide consistency in design and installation of the HRWC Systems. Any comments or suggested changes to the document are welcomed and encouraged from all interested parties. Comments received will be reviewed and considered for the 2018 update. Comments are to be forwarded to EngineeringApprovals@halifaxwater.ca.

It is the responsibility of the users of these specifications to access the HRWC website on an annual basis for the most current version of this document. The requirements of these HRWC Specifications will take effect **July 1st, 2017**, all applications made after this date, must meet the HRWC Specifications.

Yours very truly,

Kenda MacKenzie, P.Eng.
Director, Regulatory Services

ACKNOWLEDGEMENT

We must recognize the workshop participants for their contribution and continued support to this specification throughout the year. We also thank our consulting engineering and construction community for their suggestions and we encourage them to continue providing us feedback.

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Thank you all.

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Manager, Engineering Approvals

1.0 INTRODUCTION

The Halifax Regional Water Commission (HRWC) is the municipal water, wastewater and stormwater utility serving our customers within the Halifax Regional Municipality pursuant to the Public Utilities Act. An autonomous, self-financed utility, HRWC is a fully metered water utility providing water, fire protection, wastewater and stormwater services as regulated by the Nova Scotia Utility and Review Board.

The *HRWC Design Specification*, *HRWC Supplementary Standard Specification*, and the *HRWC Water Meter & Backflow Prevention Device Design & Installation Manual* are the minimum standards that must be met in the design, installation and testing of HRWC Systems. A complete documentation of all parameters relating to the design, installation and testing of proposed HRWC Systems is beyond the scope of this document, however, an attempt has been made to touch upon the parameters of greatest importance and to present the policies and accepted procedures of the HRWC.

The design of HRWC Systems, when submitted to the Engineer, must be under the seal of a Professional Engineer in accordance with the Nova Scotia Engineering Profession Act. *R.S., c. 148, s. 1*.

This document is not intended to eliminate the necessity for detailed design; rather it is intended to standardize the materials, design criteria and method of construction to be utilized in the installation of municipal services systems. Further, it is not the intention of the HRWC to stifle innovation. Where, in the judgment of the Design Engineer, variations from this document are justified or required, and where the Design Engineer can show that alternate approaches can produce the desired results, such approaches will be considered for approval. In considering requests for variations from these design criteria, the Engineer will take into consideration such factors as safety, nuisance, system maintenance, operational costs, life cycle costs, environmental issues, natural topography, and configuration of the bulk land. Where the Design Engineer uses standards other than those outlined in this document, all appropriate documents and plans are to indicate the standards referenced. The acceptance by the Engineer of the design of proposed HRWC Systems does not relieve the Design Engineer of the responsibility of proper design nor does it imply the Engineer has checked the design exhaustively for compliance with this document. Where the Engineer has accepted a design which does not comply with this specification and where the Design Engineer has not brought variations from this document to the attention of the Engineer, the provisions of this document still stand.

All contract documents prepared for the expansion of the HRWC Systems contain a clause requiring the contractor to carry out all work in compliance with all applicable Municipal, Provincial and Federal Regulations, including, but not limited to, the Occupational Health and Safety Act for the Province of Nova Scotia. HRWC Systems are not permitted to be constructed until the design has been approved by the Engineer.

In addition to this design specification, all applicable and relevant codes and standards to be used by the Design Engineer, include, but not limited, to the following:

- American Society for Testing and Materials (ASTM)
- American Water Works Association (AWWA)
- Atlantic Canada Water Works Association (ACWWA)
- Building Code Act of Nova Scotia
- Canadian Standards Association (CSA)
- Ductile Iron Pipe Research Association (DIPRA)
- Environment Canada
- Fire Safety Act of Nova Scotia
- Hydraulic Institute Standards
- Insurers Advisory Organization
- National Association of Sewer Service Companies (NASSCO)
- National Building Code of Canada
- National Fire Protection Association
- National Plumbing Code of Canada
- National Sanitation Federation (NSF)
- Nova Scotia Environment (NSE)
- Underwriters Laboratories of Canada
- Uni-Bell PVC Pipe Association

The Engineer's decision is final and binding in matters of design, installation and testing. In any case where this document requires expansion or clarification, the latest revisions of the following documents may be used for reference:

- Standard Specification for Municipal Services, prepared by the Nova Scotia Road Builders Association and the Consulting Engineers of Nova Scotia.
- Atlantic Canada Guidelines for the Supply, Treatment, Storage, Distribution, and Operational of Drinking Water Supply Systems – ACWWA & Atlantic Provinces
- Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment, and Disposal (2006), prepared by Environment Canada.

The Design Engineer is to assess the possible change in ground water movement caused by the development (in particular the use of impervious bedding material) and is responsible for the design of corrective measures to prevent flooding or lowering of ground water table as a result of this ground water movement. The Design Engineer is to provide a report prepared by a geo-technical engineer on the effectiveness of the proposed corrective measures.

The design, installation and testing specifications in this document will be revised periodically to conform to advances and improvement in the practice of engineering. It is the responsibility of the Design Engineer to remain current with revisions to this document.

2.0 DEFINITIONS

Approval	Refers to the approval of the Engineer. The Engineer's decision will be final and binding in matters of design, installation, inspection and acceptance.
Applicant	A person or company that makes application to extend, or connect to, the HRWC Systems.
Average Day Demand	The total amount of water demand within a certain time period, usually one year, divided by the number of days within that time period.
Carrier Pipe	A pipe designed by the Design Engineer used in horizontal underground drilling or open cut trench to protect utility services from being damaged
Combined System	A system intended to function simultaneously as a Stormwater and a Wastewater System and vested in or under the control of HRWC.
Commissioning	A process by which equipment, station, facility or plant is tested to verify if it functions according to its design specifications prior to acceptance by the Engineer.
Contractor	Any person who, for another person, carries out work or supplies labour for the alteration, construction, demolition, excavation, or development of land or a structure.
Design Engineer	A person who practices professional engineering and is a registered member, in good standing, of Engineers Nova Scotia. Referenced in this document, as the Professional Engineer under whose signature the engineering design is sealed.
Development	Includes any erection, construction, addition, alteration, replacement or relocation of or to any building or structure and any change or alteration in the use made of land, buildings or structures.
Ditch	An excavated or constructed open channel, which is vested in or under the control of HRWC.

Diameter	The nominal internal diameter of the pipe – unless otherwise noted.
Domestic	Any residential, industrial, commercial and institutional non-fire water use.
Engineer	The Director of Regulatory Services of the HRWC, or their designated representative.
Feeder Main	A water main which typically receives flow from transmission mains or from pressure control facilities (i.e. booster stations or pressure reducing valves), and which supplies water to several branch mains (distribution mains). The feeder main provides a significant carrying capacity or flow capability to a large area.
Halifax Regional Municipality	Halifax Regional Municipality, a body corporate, as established under the *Municipal Government Act*, 1998, c. 18, s.1.
HRWC	Halifax Regional Water Commission, a body corporate, as established under the *Halifax Regional Water Commission Act*, 2007, c. 55, s. 2; 2012, c. 60, s.1., is the municipal water, wastewater and stormwater utility for Halifax Regional Municipality. The HRWC is authorized to own and operate the water supply, wastewater and stormwater facilities for Halifax Regional Municipality.
HRWC Regulations	HRWC's *Schedule of Rates, Rules and Regulations for Water, Wastewater and Stormwater Services*, as amended from time to time by the Nova Scotia Utility and Review Board.
HRWC Systems	The collective HRWC Water, Wastewater and Stormwater Systems.
Hyetograph	A graph showing average rainfall, rainfall intensities or volume over specified areas with respect to time.
Industrial, Commercial or Institutional	Industrial, Commercial or Institutional, includes or pertains to industry, manufacturing, commerce, trade, business, or institutions and includes multi-unit dwellings of four or more units.
Major Drainage System	The path which stormwater will follow during a Major Storm, when the capacity of the Minor Drainage System is exceeded.

Major Storm	The 1:100 year storm, which has a 1% probability of being equaled in any given year, and is the storm used as the basis for the design of the Minor and Major Drainage Systems together.
Maximum Day Demand	The average water demand over a 24 hour period (midnight to midnight) of highest water demand day within any one year.
Minimum Hour Demand	The smallest short term (1 hour) demand in a 24 hour period (midnight to midnight).
Minor Drainage System	The system which is used for initial stormwater flows, or for flows generated in high-frequency rainfalls.
Minor Storm	The 1:5 year storm, which has a 20% probability of being equaled in any given year, and is the storm used as the basis for the design of the Minor Drainage System.
Monitoring Access Point	An access point, including a chamber, in a Wastewater or Stormwater Service Connection to allow for observation, sampling and flow measurement of the wastewater, uncontaminated water or stormwater within a Service Connection.
Multi-Unit Residential	A building which contains four or more residential dwelling units.
NSE	Nova Scotia Environment.
NSTIR	Nova Scotia Transportation and Infrastructure Renewal.
Overland Flow	Also known as sheet flow is the natural flow of water over the ground surface before it becomes channelized.
Peak Hour Demand	The highest short term (1 hour) demand within a system not including fire flow in a 24 hour period (midnight to midnight).

Primary Services	Means those services which must be installed and accepted by the authority having jurisdiction prior to accepting a public street or highway and include park dedication, Water System, Wastewater System and Stormwater System, street construction including all gravel layers and base lift of asphaltic concrete or Portland cement concrete pavement including curb and gutter backfilled, permanent stabilization of all exposed areas, driveways, guiderails, electrical and communication distribution system including underground conduit, street name signs and sign base and standards, and street lighting system.
Professional Engineer	A person who practices professional engineering and is a registered member, in good standing, of Engineers Nova Scotia. Referenced in this document for the purposes of inspection and acceptance of HRWC Systems and may, but not necessarily be the Design Engineer whose signature the engineering design are sealed.
Runoff	That part of the precipitation which travels by surface flow.
Service	Water Service, Wastewater Service or Stormwater Service or any combination of each of them.
Service Connection(s)	Water Service Connection, Wastewater Service Connection, or Stormwater Service Connection, or any combination of each of them.
Service Requirement Map	A map forming part of the Halifax Regional Municipality Regional Subdivision By-law. This map identifies the type of HRWC Systems required when such systems are to be constructed within Halifax Regional Municipality.
Sprinkler Service Connection	A piping system that conveys water from a water main to a property for the sole purpose of providing fire protection.
Start-Up	A process where equipment, facility or utility plant is installed and tested by the contractor and certified complete by the Design Engineer that it meets its intended design or specification prior to Commissioning.
Stormwater	Water from precipitation of all kinds, and includes water from the melting of snow and ice, groundwater discharge and surface water.

Stormwater System The method or means of carrying stormwater, including ditches, swales, sewers, drains, canals, ravines, gullies, pumping stations, retention ponds, streams, water-courses, floodplains, ponds, springs, creeks, streets or private roads, roadways or driveways, which are vested in or under control of HRWC.

Stormwater Service Connection A piping system that conveys Stormwater from a property to a Stormwater System.

Stormwater Management Plan The compilation of data and mapping that delineates watersheds, indicates routes of the Major and Minor Drainage Systems, defines flood plains, and indicates constraints associated with water quality and quantity, outlines erosion and bank stability problems and shows specific flood control in the watershed. Designed to the requirements of Halifax Regional Municipality and the Halifax Regional Municipality Regional Subdivision By-law.

Subdivision The division of any area of land into two or more parcels, which may include a re-subdivision or a consolidation of two or more parcels.

Uncontaminated Water Potable water or any other water to which no matter has been added as a consequence of its use.

Unshrinkable Fill A low cementitious material consisting of Portland cement, flyash, water, aggregates and admixtures suitable for backfill in underground service, utility trenches and structures.

Wastewater Liquid waste containing animal, vegetable, mineral or chemical matter as well as water from sanitary appliances that contains human fecal matter or human urine in solution or suspension together with groundwater, surface water or Stormwater as may be present.

Wastewater Service Connection A piping system that conveys wastewater from a property to the Wastewater System.

Wastewater System The structures, pipes, devices, equipment, processes and related equipment used, or intended to be used, for the collection, transportation, pumping or treatment of wastewater and disposal of effluent, which are vested in or under control of HRWC.

Water Service Connection — A piping system that conveys domestic water from a water main to a property.

Water System — The source, structures, pipes, hydrants, meters, devices and related equipment used, or intended to be used, for the collection, transportation, pumping or treatment of water, and which are vested in or under the control of HRWC.

Watercourse — (i) the bed and shore of every river, stream, lake, creek, pond, spring, lagoon or other natural body of water, and the water therein, within the jurisdiction of the Province, whether it contains water or not, and

(ii) all groundwater.

As defined by the *Environment Act* 1994-95, c. 1, s. 1

3.0 WATER SYSTEM – DESIGN REQUIREMENTS

3.1 SCOPE

A Water System is a complete and properly functioning system of water mains, service connections from the water main to the street lines and appurtenances, including booster stations, pressure control facilities and reservoirs, which is designed to carry and distribute an adequate supply of potable water for domestic, institutional, commercial, industrial, and fire protection purposes. The design will ensure that HRWC personnel are not exposed to hazards when conducting operation and maintenance of the water distribution system.

All water distribution systems are to conform to any requirements established by NSE. No HRWC Systems are to be constructed until the design has been approved by the Engineer.

Water System extensions must be carried out in conformance with a Water Master Plan prepared for the Water Service District in which the extension is to take place. The Water Master Plan is to identify major infrastructure such as transmission mains, feed mains, reservoir size and location, hydraulic system design calculations, pressure and/or flow control facilities, and operational information.

For an extension to the HRWC Water Systems, the Engineer requires the Applicant to enter into a HRWC Systems Agreement which defines the rights and obligations of HRWC and the Applicant regarding construction, inspection, record collection, acceptance and warranty of the new HRWC Water System.

3.2 WATER DISTRIBUTION SYSTEM DESIGN

3.2.1 Water Demand

Water distribution systems are to be designed to accommodate the greater of Maximum Day Demand plus fire flow demand, or Peak Hour Demand.

Fire flow demand is to be in accordance with the latest requirements contained within *Water Supply for Public Fire Protection,* by the Insurance Advisory Organization.

Water distribution systems are to be designed to accommodate the following:

- Average Day Demand 410 litres / person / day

Refer to the permitted land uses under the Halifax Regional Municipality Municipal Planning Strategy (MPS), Land Use Bylaw (LUB), or approved Development Agreement for a specific area . When determining site populations, refer to numbers below:

- Single unit dwellings 3.35 people / unit
- Semi-detached & townhouse 3.35 people / unit
- Multi-unit dwellings 2.25 people / unit

The design population or assumed domestic demand must be specified in the calculations submitted for review and approval.

3.2.2 Hydraulic Model

Water distribution designs are to be supported by a hydraulic analysis of the system which determines flows, pressures and velocities under Maximum Day Demand plus fire flow demand, Peak Hour Demand and Minimum Hour Demand conditions. The analysis is to identify and describe any impact on the existing system. The Design Engineer will be required to submit the hydraulic model used to conduct the analysis along with a design report describing the design methodology and results of the analysis.

The limits of the analysis begin at a location of known hydraulic grade determined in consultation with the Engineer and include demands on the existing system downstream of the known hydraulic grade line, as well as demands generated by the proposed development. The Design Engineer is to conduct a hydrant flow test to confirm the static hydraulic grade line and determine the system curve and available residual pressure at the boundaries of the analysis.

Maximum Day Demand plus fire flow demand analysis are to include sufficient scenarios to test all extreme conditions, such as high fire flow demand requirements, fires at locations of high elevations and fires at a location remote from the source or feeder main.

Subject to the Engineer's review, new Water System extensions of 30 single family units or less may not require a hydraulic model if it can be demonstrated that minimal or no impact will be created on the existing system.

3.2.2.1 Hydraulic Model Software

HRWC uses WaterCAD 8.0 by Bentley Systems and use of the same software by Design Engineers is encouraged. Where the Design Engineer does not have access to WaterCAD, digital submission of hydraulic models created using EPANET by the United States Environmental Protection Agency. EPANET is public domain software that may be freely copied and distributed.

The hydraulic model, in digital format, is required to follow these minimum requirements:

.1 The hydraulic model is to be in a format compatible with the latest release of Bentley WaterCAD or EPANET.

.2 The submission is to include all files required to run the model. Hydraulic networks should be drawn to scale and represented in "real world coordinates" using the ATS77 MTM Nova Scotia Zone 5 projection. **All surveys in Nova Scotia effective December 31, 2017 will be required to be referenced to horizontal datum NAD83 (CSRS) Epoch 2010.0 and vertical datum Canadian Geodetic Vertical Datum 2013. (Referred to as NAD83 and CGVD2013).**

.3 Background layers submitted in DXF or ESRI shapefile formats.

.4 Submit only the physical alternatives proposed in the design report.

.5 The Hazen Williams formula is to be used for the calculation of friction losses.

For each node, document the demand basis for that node (e.g. 5 residential units plus large format commercial) in that node's comments or unit's demands dialogue box.

3.2.2.2 Peaking Factors

The peaking factors used to calculate Minimum Hour Demand, Peak Hour Demand and Maximum Day Demand must be based on:

- Historical information
- Nova Scotia Environment guidelines, or
- As directed by the Engineer

Table 3.1 – Peaking Factors

Land Use	Minimum Hour	Peak Hour	Maximum Day
Low Density Residential	0.70	2.48	1.65
High Density Residential	0.84	2.50	1.30
Industrial	0.84	0.90	1.10
Commercial	0.84	1.20	1.10
Institutional	0.84	0.90	1.10

3.2.2.3 Friction Factors

Hazen Williams 'C' values to be used for the design of water distribution systems, regardless of pipe material, will be:

Table 3.2 – Friction Factors

Diameter of Water Main	'C' factor
150 mm	100
200 mm to 250 mm	110
300 mm to 600 mm	120
larger than 600 mm	130

When evaluating existing systems, the 'C' factor should be determined by actual field tests, whenever possible.

3.2.2.4 Fire Protection

Fire flows used must be supported by HRWC minimum requirements and/or calculation as prescribed in *Water Supply for Public Fire Protection*, by the Insurance Advisory Organization, whichever requires the higher flow rate. Fire flows must be checked for all critical locations which include locations of high fire demand, remote from the source of supply or relatively high elevation. Analysis of further scenarios may be required at the request of the Engineer.

Estimated fire flow requirements compiled from the Insurance Advisory Organization is shown in the table below.

Table 3.3 – Fire Flow Requirements

Land Use	Fire Flow (litres/minute)	Duration (hours)	Number of Fire Hydrants
Single unit dwellings	3300	1.5	1
Two family dwellings	3300	1.5	1
Townhouse	4542	1.75	1
Multi-unit high rise	13620	3	3
Commercial	13620	3	3
Industrial	13620	3	3
Institutional	13620	3	3

This table is a guideline for the Water System. The Design Engineer the Sprinkler Service Connection will be required to design the private sprinkler arrangement specific to proposed land use and actual Water System conditions.

3.2.2.5 Fire Hydrant Spacing

The layout of the hydrants within the Water System are to be designed in consideration of the following desirable location criteria:

.1 In residential single family, semi-detached and townhouse developments; the maximum spacing of fire hydrants cannot exceed 150 metres.

.2 In Industrial, Commercial and Institutional developments, the maximum spacing of fire hydrants cannot not exceed 90 metres.

.3 Locate hydrants mid-block on cul-de-sacs that have a looped connection to the distribution system.

.4 Dead end mains are to terminate at a hydrant for flushing purposes/

Where a hydrant serves a building(s) that is provided with a siamese connection, the hydrant will be located not more than 45 metres unobstructed from the siamese connection(s) and where the building(s) other than residential, is not provided with a siamese connection, all portions of the exterior wall are to be no more than 90 metres unobstructed from a fire hydrant.

The door to the furthest dwelling unit in a residential structure such as single family dwellings, apartments, condominiums, hotels, motels and so on must be no more than 90 metres from a fire hydrant.

3.2.2.6 Fire Flow Testing

Consult the Engineer to determine the necessity of a fire flow test.

If it is determined a fire flow test is required, call the Halifax Water Customer Care Centre at (902) 490-4820 to schedule a fire flow test.

Fire flow tests will only be scheduled to begin between 10:00 pm or 12:00 am. HRWC Water Services is required to be present to operate the HRWC Water System.

Fire flow tests will not be scheduled during freezing conditions. HRWC Water Services will determine if the weather conditions permit a test to take place. If there is a risk of freezing, the Applicant is to have salt on hand to offset the paved surface from freezing.

The Applicant requesting the test will provide all gauges and test equipment necessary to carry out the test and perform all necessary calculations.

The Applicant is responsible to provide traffic control, if required.

Send fire flow test results to EngineeringApprovals@halifaxwater.ca.

Fire flow testing is required for all applications to confirm static and residual pressures. If any operational problems are discovered during the fire flow testing, it should be brought to the attention of the Engineer.

3.2.2.7 Maximum Velocity

The maximum velocity in the pipe is not to exceed 1.5 m/s during Peak Hour Demand flow conditions or 2.4 m/s during fire flow conditions.

3.2.2.8 Allowable Pressure Range

The preferred design pressure ranges for:

- Average Day & Maximum Day Demand between 350 kPa (50 Psi) and 550 kPa (80 Psi).
- Minimum Hour & Peak Hour Demand between 275 kPa (40 Psi) and 620 kPa (90 Psi).

Pressures outside of these ranges are acceptable to the limits outlined below but are not desirable.

Non-Fire Scenarios

The minimum residual pressure under any non-fire flow demand scenario will not be less than 275 kPa (40 Psi) at any location in the water distribution system.

Fire Scenarios

The minimum residual pressure during a Maximum Day Demand plus fire flow demand scenarios will not be less than 150 kPa (22 Psi) at any location in the water distribution system.

Maximum Pressure

Maximum water pressure during Minimum Hour Demand is not to exceed 620 kPa (90 Psi) unless approved by the Engineer.

3.2.2.9 Supply Redundancy

Water distribution systems is to be designed such that no group of 30 or more metered customers are supplied by a single source of supply.

Water distribution systems are to be designed to exclude any dead-ended pipe.

3.2.2.10 Water Main Size

.1 Minimum size for local distribution water main is 200 mm.

.2 Minimum size for feeder water main is 300 mm.

3.2.2.11 Hydraulic Analysis Report

The Design Engineer is to prepare a Hydraulic Analysis Report for review and approval by the Engineer prior to final detailed design.

The Hydraulic Analysis Report will contain:

.1 A general description of the existing and proposed system extension including nature of the development (residential, commercial, industrial, mixed use), total area to be developed, total projected population (or population equivalent).

.2 A description of the site contour information including maximum and minimum elevations to be serviced and how this relates to the hydraulic grade line in adjacent pressure zones.

.3 A table showing the ultimate serviced population at full build out of the proposed Water System extension including a breakdown of residential, commercial, industrial and institutional.

.4 If the development is to occur in phases, a similar breakdown showing cumulative population at the completion of each phase.

.5 Tables showing the serviced population, average day demand, maximum day demand, peak hour demand and peak instantaneous demand cumulatively for each phase.

.6 Discussion of the required fire flow for the proposed development.

.7 Discussion of the hydrant flow test results.

.8 Presentation and discussion of the domestic hydraulic analysis results. The minimum and maximum pressures from each scenario should be identified. A table of the calculated minimum and maximum pressures at each node will be presented in the appendix.

.9 Presentation and discussion of the fire flow hydraulic analysis results. The minimum and maximum pressures and minimum residual pressure should be identified. A table of the calculated minimum and maximum pressures at each node will be presented in the appendix.

.10 A schematic of the proposed distribution system extension, including the location(s) of connection to the existing system, and land areas of the development. The schematic should also include 2 metre contours for the proposed development and identify the location of minimum and maximum pressure nodes identified in the hydraulic analysis.

3.2.3 Water Main

3.2.3.1 Water Main Material

The following types of pipe are approved for use as water mains when installed in compliance with the standard specifications and subject to the stated restrictions.

.1 Ductile Iron (DI) Pipe AWWA C151/A21.51 Special Class 52 cement mortar lined with interior asphaltic seal coat.

- All Ductile Iron (DI) pipe and fittings will be installed with polyethylene encasement.
- All valves, hydrants and service connections will be installed with an attached zinc anode for cathodic protection.
- DI pipe will not be installed below the salt water tidal zone.
- The approved service connection pipe material for Ductile Iron (DI) mains will be Ductile Iron Special Class 52 cement mortar lined with interior asphaltic seal coat or Type K copper tube.

.2 Polyvinyl Chloride (PVC) Pipe AWWA C900 Class 305, DR14, in accordance with CSA 137.3

- Subject to the Engineer's discretion, PVC pipe may be approved for installation in sizes up to and including 300 mm diameter for use in standard residential development.

- The approved service connection pipe material for Polyvinyl Chloride (PVC) mains will be Polyvinyl Chloride (Class 350, DR14) pipe and Cross Linked Polyethylene (PEX-a) tubing.

- All valves, hydrants, and service connections will be installed with an attached zinc anode for cathodic protection. If cross linked polyethylene (PEX-a) service pipe is utilized, than an anode is not required.

- All fittings for PVC pipe, excluding tapping couplings, to AWWA C110.

- All fittings will be installed with polyethylene encasement.

- All PVC & PEX-a pipe installations are to include a trace wire system for pipe location purposes.

- All service connection taps will be completed using an approved saddle or approved tapping coupling. Wet tapping of PVC pipe is not permitted when the pipe and/or trench environment is below 0° Celsius.

.3 Consistency of pipe material within a section of the distribution system or within a particular subdivision will be maintained.

Subject to the Engineer's direction, alternative pipe materials and fittings may be required to address specific site conditions.

3.2.3.2 Water Main Cover

.1 Minimum cover is 1.6 metres.

.2 Maximum cover is 2.0 metres.

The depth of cover is measured from the finished surface design grade over the pipe to the crown of the water main.

3.2.3.3 Water Main Location

.1 All water mains to be installed at a consistent grade to avoid localized high points in the same trench as the gravity Wastewater and Stormwater Systems. The location of the water mains and service connections relative to Wastewater and Stormwater Systems are to meet the minimum requirements of NSE. The water main is to maintain a minimum 500 mm horizontal and a 300 mm vertical separation in common trench conditions from the Wastewater and Stormwater Systems. If this separation cannot be achieved, the water main is to be installed in a separate trench with a minimum 3.0 metres separation from the Wastewater and Stormwater Systems.

.2 Water mains are to maintain a minimum horizontal separation from manholes of 500 mm. Insulation is to be installed on manholes to protect the water main from freezing temperatures for horizontal separations up to 1.2 metres from manholes.

.3 When it is not possible to obtain proper horizontal and vertical separation as stipulated, the Wastewater and Stormwater Systems are to be designed and constructed equal to water main and be pressure-tested to assure water tightness.

.4 Whenever Wastewater and Stormwater Systems must cross under water mains, a separation of at least 450 mm must be maintained between the top of the Wastewater and Stormwater Systems and the bottom of the water main. When the elevation of the Wastewater and Stormwater Systems cannot be varied to meet this requirement, the water main is to be relocated to provide this separation. Indicate catch basin lead inverts on the drawings to facilitate checking of clearances.

.5 Where possible the water mains are to be installed in a straight line within the travelled way portion of the street right of way and a minimum of 1.5 metres from the face of the curb. On existing streets without curb and gutter the water main may be installed within the gravel shoulder area. Changes in alignment may be accomplished by the use of pre-manufactured bends. Minor curvature of pipe along its length or at joints may be permitted under certain site conditions at the discretion of the Engineer.

.6 Easements will only be considered where there are no alternative servicing routes and where the option of locating a street over a servicing corridor has been precluded. A cross section is to be provided of the easement showing the side slopes in compliance with the safe trench requirements of the Department of Labor and Advanced Education. The water main is to be located as close as possible to the centre-line of the easement. Depending upon the length and location of the easement, a travel way within the easement may be required for maintenance. This travel way is to be a gravel surface for grades up to 6% and asphalt for grades 6% to 8%. Where the water easement is within a walkway, the easement will be granted to the HRWC prior to the transfer of ownership of the walkway to the Halifax Regional Municipality.

.7 Water mains are to maintain a minimum 2.0 metres horizontal separation from permanent underground and above ground infrastructure / structures. This applies to electrical or telephone conduit, steam or hot water piping, transformer pads, utility poles, signs or other utilities.

.8 Water mains are required to maintain horizontal and vertical separation from gas lines depending on water main size.

.9 Where a need is identified to facilitate future development on the adjacent lands, Water Systems, are required to be extended to the limit of the property boundary as per the Halifax Regional Municipality Regional Subdivision By-law.

3.2.3.4 Water Main Thrust Restraint

.1 Any change in direction of the water main, in excess of the pipe joint deflection tolerance, will be made using an appropriate fitting. Thrust block design to consider these fittings.

.2 The thrust block design to consider the operating pressure, surge pressure, peak flow velocity and in situ material bearing strength.

.3 Thrust restraints for vertical bends are to be by gravity thrust blocks located below the fitting, connected utilizing galvanized tie rods securely embedded in concrete.

.4 The use of mechanical joint restraint is permitted on 11.25°, 22.5°, and 45° horizontal bends on 300 mm diameter pipe and smaller. No pipe joints are allowed within the “minimum pipe length” as denoted in the Standard Details of the *HRWC Supplementary Standard Specification*.

.5 Mechanical restraint devices may be used in addition to gradient restraint anchor blocks for pipes installed at grades steeper than 16%.

.6 Mechanically restrained joints are required where there is a potential for separation of joints as a result of fill settlement or where future excavation may expose the main.

3.2.3.5 Water Main Extension Connecting to Existing System

.1 Where a new distribution system is connecting to the existing system and where no means of connection is provided (stub, cap and valve) the connection will be made by cutting in a new tee and valve. The water main is to be disinfected and flushed as per the Supplementary Standard Specifications.

.2 Utilizing a tapping sleeve for a new system connection is permitted only with the approval of the Engineer where the magnitude of a service disruption makes cutting in a new tee impractical. In this situation the use of a tapping sleeve will only be approved when the pipe to be tapped is a minimum of one size increment larger than the connecting pipe. Additionally, all tapping is subject to visual inspection by HRWC Water Services prior to tapping to confirm that the pipe structural condition is acceptable for tapping.

3.2.3.6 Water Main Crossings

.1 Lay water mains crossing wastewater or stormwater mains with a minimum vertical distance of 450 mm between the outside of the water main and the outside of the wastewater or stormwater main. Preference is given to water main located above the wastewater or stormwater main. One full length of water pipe should be located so both joints will be as far from the wastewater or stormwater main as possible. Structural support of the water, wastewater or stormwater mains may be required.

.2 Variance from the requirements outlined above, when it is impossible to obtain the specified separation distances, may be allowed. Where separations of water mains and wastewater or stormwater mains cannot be met, the wastewater or stormwater main materials are to be water class and pressure tested to 1000 kPa (145 Psi) for water tightness.

.3 When crossing under a railway, highway, bridge structure or water course the water main is to be installed in a carrier pipe. Subject to future accessibility, the carrier pipe and the method of water main installation are to be designed by the Design Engineer.

3.2.3.7 Water Main Automatic Flushing Station

Automatic flushing stations are required in the distribution system at locations as identified by the Engineer for the efficient operation of the Water System.

3.2.3.8 Water Main Trench Drainage Relief System

The design of the Water System is to consider possible change in ground water movement caused by the use of pervious bedding materials. The design is to include corrective measures to prevent flooding as a result of this ground water movement.

.1 Water mains installed in a single pipe trench may require a trench drainage relief system to lower the ground water in the trench. The relief system design is to be specific to the situation with consideration for topography, subsurface conditions, ground water conditions and local drainage patterns.

.2 Service connection trenches that have a trench bed sloping down from the main trench may require the installation of an appropriate clay plug, or similar solution, to prevent the flow of ground water from the trench towards the abutting properties.

3.2.4 Valve

Valves installed within the Water System on water mains and Water Service Connections provide the ability to isolate buildings and streets to facilitate construction, maintenance and emergency repair. Dead end stubs require at least one pipe length, with a valve, for future extensions. Valves on dead end stubs are to be restrained/tied back to upstream piping as required to protect against the thrust that develops in the Water System. If a valve is located in a gravel shoulder or outside of the street right-of-way an asphalt apron will be provided.

Refer to *HRWC Supplementary Standard Specification* for Standard Details of valve layout arrangements. Valves requirements on water mains:

.1 Intersections are isolation points for water mains. For instance, a four-way intersection with bisecting water mains would require four valves. The number of valves required is dictated on the ability to isolate a water main.

.2 Main line valves are to be located outside of the street intersection in line with the cross street curb locations.

.3 On straight runs the maximum spacing for main line valves is 150 metres for commercial/industrial areas, and 250 metres for urban residential areas. This maximum spacing may be increased in residential areas with larger lot sizes as approved by the Engineer.

.4 For looped systems with close intersection spacing, main line and intersection valve spacing may be adjusted providing that adequate shut down capability is provided on the system without putting more than 30 customers out of service at any time.

.5 For cul-de-sacs looped through easements a valve is required to separate the street and the easement, and located within the asphalt portion of the cu-de-sac bulb.

.6 Use gate valves for 300 mm water mains and smaller.

.7 Use butterfly valves for 350 mm water mains and larger.

3.2.4.1 Pressure Reducing Valves

Air relief and vacuum valves are to be installed, in manholes, at all significant high points in the distribution system and at such other locations as required for efficient operation of the Water System.

3.2.4.2 Air Relief & Vacuum Valves

Air relief and vacuum valves are to be installed, in manholes, at all significant high points in the distribution system and at such other locations as required for efficient operation of the Water System.

3.2.5 Fire Hydrant

The Supplement Standard Specification provides fire hydrant details for urban and rural installations.

3.2.5.1 Fire Hydrant Location

Fire hydrants spacing as per the Section 3.2.2.5 Fire Hydrant Spacing in this Specification. The layout of the hydrants within the Water System must consider the following criteria:

.1 Locate hydrants at the extension of the boundary line between two lots.

.2 Locate hydrants a minimum 1.8 metres from the edge of a driveway flare and minimum 3.0 metres from a utility pole, transformer, or utility junction box, refer to *HRWC Supplementary Standard Specification* for Standard Details.

.3 Locate hydrants at high point of water main profile unless automatic air release valves are required at that location.

.4 Locate hydrants mid-block on cul-de-sacs that have a looped connection to the distribution system.

.5 Dead end mains require a hydrant to permit flushing of the distribution system.

3.2.5.2 Fire Hydrant Connection to Water Main

Fire hydrant leads are 150 mm in diameter and include a 150 mm hydrant valve connected directly to the main with a hydrant anchor tee. For greater thrust protection the hydrant is to be mechanically restrained from the valve to the hydrant. Where the hydrant lead is the extension of a dead end main, the hydrant valve and lead are to be mechanically tied to the distribution system. All fire hydrants and valves require a Zinc 24-48 anode.

3.2.5.3 Fire Hydrant Product Consistency in Subdivisions

Hydrant models to be installed as part of new subdivision development or system extensions are to be consistent for that approved development phase or system extension limit.

3.2.6 Water Service Connection

3.2.6.1 Water Service Connection General Requirements

The following are the requirements for Water Service Connections:

.1 Every building is required to be connected separately to the mains from any other building, except that an ancillary building on the same property may be serviced by the same Water Service Connection (National Plumbing Code of Canada).

.2 A single Water Service Connection, from the main line to the property line, is required for HRWC Systems extensions to each lot.

.3 Minimum 1.6 metres cover.

.4 Maximum 2.0 metres cover.

.5 Minimum 300 mm horizontal and vertical separation distance from gravity Wastewater and Stormwater Service Connection.

.6 Minimum 450 mm vertical separation when crossing above a Wastewater or Stormwater Service Connection.

.7 Minimum 3.0 metres horizontal separation, separate trench, from a pressurized Wastewater Service Connection.

.8 Minimum 3.0 metres horizontal separation from an outdoor fuel tank and septic tank.

.9 Minimum 6.0 metres horizontal separation from septic disposal field.

.10 Minimum 2.0 metres horizontal separation from gas lines, underground electrical / telephone conduit, steam or hot water piping, transformer pads, utility poles or other utilities.

3.2.6.2 Water Service Connection Pressure

.1 In lower elevation areas of Halifax Regional Municipality, the pressure in the Water System is higher. Where the calculated pressure in the pressure in the Water Service Connection at the building floor elevation exceeds 550 kPa (80 Psi), the Applicant is to provide a pressure reducing valve, at no cost to the HRWC.

The pressure reducing valve is to be installed prior to the water meter.

For multi-unit, industrial, commercial and institutional uses, it is the responsibility of the Design Engineer to account for the pressure in the Water System in the design water meter and backflow prevention device arrangement.

.2 In higher elevation areas of Halifax Regional Municipality, the pressure in the Water System is lower. Where the calculated pressure in the pressure in the Water Service Connection at the building floor elevation is lower than 275 kPa (40 Psi), the Engineer will recommend a booster pump be installed. The Applicant is responsible to hire a qualified professional to size, specify and install the booster pump at no cost to the HRWC.

The booster pump, within a bypass arrangement, is to be installed after the water meter and backflow prevention device.

3.2.6.3 Water Service Connection 50 mm & Smaller

In addition to the general requirements, Water Service Connections 50 mm and smaller requires the following:

.1 Shut-off valve (curb stop) to be located within the right-of-way, 300 mm from the boundary. In areas where a public sidewalk exists, locate shut-off valve 1.0 metres from the sidewalk, and provide a minimum 1.0 metre easement, in all directions, around the shut-off valve.

.2 All Water Service Connections fitted with Zinc 24-48 anode.

.3 All Water Service Connections are to be installed with pipe sleeve insulation.

.4 No joints between the shut-off valve and the building. Services greater than 20 metres are permitted one compression fitting every 20 metres.

.5 A Water Service Connection that is set back 50 metres or greater from the public right of way or public easement boundary may require that the water meter and backflow prevention device to be installed in the building.

.6 All Water Service Connections connecting to the Water System are to be tapped by HRWC Water Services. All parts and materials supplied by the Applicant.

.7 Rigid polystyrene insulation of Water Service Connections is required in the following situations:

a. Sites where service connections are to be installed in trenches that have been excavated in rock.

b. Sites where stockpiled or processed rock material is to be used for backfill.

c. All situations where the service connection is considered to be at risk of freezing as determined by HRWC Water Services.

d. Where a Water Service Connection is crossing a ditch with a minimum of 1.2 metres of cover.

.8 The standard minimum domestic Water Service Connection sizing to be as follows:

- 19 mm copper Type K
- 25 mm copper Type K where the Water System pressure is less than 345 kPa (50 Psi) or the setback is greater than 30 metres.
- 25 mm for all PEX-a installations
- 25 mm copper Type K or PEX-a for all ICI installations

.9 Maximum velocity is 4.5 m/s in a Water Service Connection.

.10 Locate public portion of Water Service Connections, including curb stops, 1.5 metres from driveways.

3.2.6.4 Water Service Connection 100 mm & Greater

In addition to the general requirements, Water Service Connections 100 mm and greater requires the following:

.1 Where a Water Service Connection stub is not available, a new tee and valve is required to be cut into the water main. The installation requires disinfection as per the Supplementary Standard Specification.

.2 Tapping sleeves are only permitted under the direction of HRWC Water Services where the magnitude of a service disruption makes cutting in a new tee impractical. In this situation the use of a tapping sleeve will only be approved when the pipe to be tapped is a minimum of one size increment larger than the connecting pipe. Additionally, all tapping is subject to visual inspection by HRWC Water Services prior to tapping to confirm that the pipe structural condition is acceptable for tapping.

.3 All Water Service Connection valves in the right-of-way require a Zinc 24-48 anode.

.4 All pipe and fittings to be installed with polyethylene encasement.

.5 A Water Service Connection that is set back 50 metres or greater from the public right of way or public easement boundary may require the water meter and backflow prevention device be installed in a private meter chamber, on private property, adjacent to the right-of-way or easement boundary.

.6 The installation of a private fire hydrant off a Sprinkler Service Connection requires adherence to the National Building Code of Canada. The fire department connection to a hydrant is not more than 45 metres and is unobstructed.

.7 Private fire hydrants are to be installed such that the hydrant lead is connected to the Sprinkler Service Connection downstream of a CSA approved detector assembly backflow prevention device (Double Check Detector Assembly or Reduced Pressure Detector Assembly). The detector assembly device must be supplied with a positive displacement type meter. If the meter is not an HRWC approved water meter, HRWC will supply a water meter to be installed on the detector assembly's bypass.

.8 Water Service Connections in a master meter arrangement require a private meter chamber, on private property, adjacent to the right-of-way or easement boundary.

3.2.6.5 Water Service Connection Abandonment

Water Service Connections are required to be abandoned at the water main for all Halifax Regional Municipality Demolition Permits. The method for abandonment is dependent on the site conditions specific to the Water Service Connection in question. HRWC Water Services will dictate the abandonment method to be used.

3.2.6.6 Water Service Connection Reutilization

An existing Water Service Connection may be reused subject to all of the following conditions being met:

.1 The proposed land use and building size is known.

.2 The Water Service Connection is of adequate size and meets current pipe material specifications.

.3 HRWC Water Services confirms the condition of the Water Service Connection warrants reuse.

3.2.7 Water Meter

The HRWC Regulations state all Water Service Connections to the HRWC Water System are required to be metered. For new connections, the installation of a water meter is triggered by a Halifax Regional Municipality Building Permit Application, or a *HRWC New Service & Renewal Application* for existing premises. The requirement for a water meter applies to:

- New Water Service Connections for new building construction
- New Water Service Connections for an existing building
- Temporary Water Service Connections for buildings under construction
- Temporary Water Service Connections for events
- Seasonal Water Service Connections

The design requirements for water meter arrangements can be found in the *HRWC Water Meter & Backflow Prevention Device Design & Installation Manual*.

Water Service Connections greater than 50 metres (164 feet) in length from the street right-of-way boundary may require the water meter to be located in a meter chamber on private property adjacent to the street right-of-way, at the discretion of the Engineer.

3.2.8 Cross Connection Control Program

The Cross Connection Control Program utilizes premise isolation to minimize the risk of contaminants entering the Water System from the premises through backflow. Backflow can occur if water is siphoned from premises due to a reduction in pressure in the distribution system or as a result of pressurized equipment being used on the premise.

All multi-unit residential, industrial, commercial and institutional uses require a backflow prevention device on the Water Service Connection and Sprinkler Service Connection.

The design requirements for backflow prevention device arrangements can be found in the *HRWC Water Meter & Backflow Prevention Device Design & Installation Manual*.

3.3 WATER BOOSTED SYSTEM DESIGN

3.3.1 Booster Station Submission

When proposing a water booster station, include the following in the design submission:

.1 Civil drawings.
.2 Mechanical drawings.
.3 Electrical drawings
.4 Architectural drawings
.5 Pump information.
.6 Design report.
.7 Sewershed boundary serviced by pumping station.
.8 System curves.
.9 Station configuration.
.10 Program ladder.

3.3.2 Booster Station Design

As a result of difference in ground elevations or distance from the source of supply, isolated areas may require pressure boosting of the Water System to provide adequate pressure and flows to meet either domestic or fire flow requirements.

To accomplish this, a booster station is required to service a specific area of a water distribution system based on defined limits. These areas are generally isolated from the remainder of the system.

Discharge pressure from the booster station must be adequate to ensure that the pressure in the water mains in the area being serviced is within the range of 275 kPa (40 Psi) to 620 kPa (90 Psi) during peak and minimum demand periods. In the case of fire flows, the minimum pressure is 150 kPa (22 Psi) in the water main.

In an in-line booster station, the pressure on the suction side of the fire pump is to be designed not to drop below 150 kPa (22 Psi) when there are Water Service Connections on the suction side water main.

Domestic water demand will vary greatly from one area to another. For design purposes, existing records for average, maximum daily and peak rates should be used whenever possible. In the absence of such records, the Average Day Demand specified herein is to be used.

3.3.2.1 Booster Station Site Considerations

.1 The booster station is to be on its own property, deeded to HRWC prior to commissioning.

.2 Grade the booster station land to prevent ponding of water

.3 All exposed areas are to be sodded.

.4 Property may require a 2.44 metres security fence depending on site conditions. Confirm with the Engineer.

.5 Driveway subgrade is to be specified by the Design Engineer. The base gravels are to be 150 mm of Type 2 gravel, 150 mm of Type 1 gravel and 75 mm of asphalt to a minimum width of 3.5 metres, and a minimum length of 7.5 metres.

3.3.2.2 Booster Station Safety Precautions

.1 Take into account all applicable Municipal, Provincial and Federal regulations including the Occupational Health and Safety Act when designing the booster station from a safety perspective. Eliminate all confined spaces.

.2 Protect all equipment with guards to prevent accidental contact. Provide all equipment with lock-outs to confirm the equipment is out of service when maintenance is being carried out.

.3 Equip diesel generator fuel supply lines with fusible link valves. Fuel lines between the generator and the fuel supply are to be located in appropriately sized sleeves cast into the station floor.

3.3.2.3 Booster Station Building

.1 The booster station building is to be sized to accommodate the pumps, pump motors, control panel, auxiliary power supply, fuel supply tank, and other accessories. Safety and ease of maintenance are to be considered in the design.

.2 A Booster Station is categorized as a Post-Disaster Building by the National Building Code of Canada and is required to be designed accordingly.

.3 No windows in any exterior wall.

.4 Adequate ventilation for all mechanical equipment provided by vandal resistant, insulated, heavy duty type steel intake and exhaust louvers.

.5 Engine emissions are to be directed away from the building so as not to create a ventilation "short circuit".

.6 Design the louver system to prevent a negative pressure situation within the building. Make provision to support wall-mounted equipment inside the building. The building is to be designed “secure”.

.7 Thermostats are to be located away from the air intakes such that there is no conflict with exterior air. Radiators may be considered for smaller buildings with dual loops.

.8 The building floor is to be a minimum 150 mm above the finished external grade and any potential flood level. Pump house floors are to be poured reinforced concrete and sloped toward the access door.

.9 Interior wall surfaces, doors and trim colour to be approved by the Engineer. A non-metallic colored hardener is to be added to the concrete floors during the finishing process to a colors scheme as approved by the Engineer.

.10 Doors swing outward to open and panic hardware should be installed for emergency exit. All hinge pins on doors to be secured to prevent their removal and astragal's (anti-pick plates) be installed with non-removable fasteners, to cover the latch bolt area on the doors. All door locks keyed to HRWC standard system.

.11 Lifting devices of a type approved by the Engineer should be incorporated into the design of the structure so that pumps and/or motors can easily be transferred from their location within the station to an access door.

.12 The Engineer may approve an alternate architectural design to better blend in with the surrounding community.

3.3.2.4 Booster Station Electrical & Auxiliary Power

Perform an arc flash hazard analysis to determine the available arc fault currents and arc flash hazards for electrical equipment such as switchboards, panel boards, industrial control panels, meter socket enclosures and motor control centres (MCCs). The arc flash hazard warning labeling is to comply with NFPA 70E standard, *Standard for Electrical Safety in the Workplace*.

Provide three-phase power supply to the booster station. Design and installation of the power supply system to meet all applicable and relevant standards and codes.

Electrical meter base must be located outside of the building in a stainless steel enclosure with lockable hasp and comply with Nova Scotia Power Inc., Utility Service Requirements. A stand-alone main service disconnect must be available inside the building.

Each pump requires an energy efficient electric motor capable of operating the pump over the full range of load conditions. Motors should be located such that they cannot be flooded should a pipe failure occur. Each pump are required to have a separate lockable disconnect switch for isolation of the motor power supply without affecting the remaining system operation.

U.S. Motor or equivalent as approved by the Engineer.

All electrical apparatus are to be located in an accessible location above grade with a clear access of 1.0 metre around all pumps and motors. All panels and controls are to have NEMA 4 enclosures.

All floor mounted electrical equipment must be mounted on 100 mm high housekeeping pads.

Booster Station must contain at least the following:

.1 Electric unit heaters with thermostat control.
.2 Adequate vapour proof incandescent lighting.
.3 A single outside vandal proof photo-electric cell light adjacent to or over the access door.
.4 A weather proof switch and electrical outlet inside the pump house immediately adjacent to the access door.
.5 Adequate lightning arresters.
.6 A fire extinguisher.
.7 Sufficient ventilation to ensure that heat generated from the electrical equipment is sufficiently dissipated.

Full stand-by power supply to be provided utilizing a standby diesel generator set. The power generating system is to be capable of providing continuous electric power during any interruption of the normal power supply. The stand-by power unit is to be designed with adequate capacity to operate fire and domestic pumps, control and monitoring systems, and heating and lighting systems within the pump house.

The generating system is to include the following items:

.1 Diesel engine.
.2 Alternator.
.3 Control panel.
.4 Automatic change over equipment.
.5 Automatic ventilation system.

3.3.2.5 Booster Station Pumps

Domestic booster pumps, fire booster pumps and appurtenances, capacity, system sizing, control facilities, layout, installation, testing, etc. must meet all applicable and relevant standards and codes.

Since a single system head curve cannot be developed due to changing demands within the system, projected points of operating head and flow for at least the following conditions is required to be developed:

- Average Day Demand.
- Maximum Day Demand.
- Peak Hour Demand (p.m.).
- Peak Hour Demand (a.m.).
- Minimum Hour Day.

Pumps must be selected which will operate satisfactorily over the necessary pumping ranges expected at the station, from a minimum total dynamic head to a maximum total dynamic head. In general, the pumps must be capable of meeting the following criteria:

- The rated point corresponding to the Maximum Day consumption rate.
- The rated point for efficiency evaluation (the point at which the pump would normally run and at which the pump should be selected for best efficiency).
- The possible operating range (the range over which the pump must operate from a minimum total dynamic head to a maximum total dynamic head).
- The available Net Positive Suction Head (NPSH) must be specified.

All four of these criteria must be evaluated when a pump is selected. Typically, the unit will operate at a total dynamic head considerably less than the ultimate rated point. Therefore, the maximum efficiency point should be specified as that point at which the pump will normally run.

The rated point must be selected as the point for which the pump will have to overcome the greatest amount of head with a specified flow rate.

Pumps should be selected to avoid the following conditions:

- Pumps subject to destructive low-head, high–flow cavitation.
- High power consumption while handling low loads.
- Noise levels audible beyond the station.

Select pumping equipment to perform at maximum efficiencies under normal operating conditions. Provide soft start and variable speed drives under the following conditions:

• Soft start	7.5 kW and larger (10 HP).
• Variable Speed Drive	15 kW and larger (20 HP), in consultation with the Engineer.

All pumps with mechanical couplings must be aligned on site by a manufacturer's representative, prior to being placed in service.

Prior to any pump being placed in service, have the manufacturer's representative certify the pump was correctly installed.

.1 Booster Station Domestic Pumps

Each booster station will have a minimum of three (3) domestic pumps (one lead/jockey pump and two lag pumps). Size the pumps such that the capacity of the booster station is calculated with the largest domestic pump out of service and full build-out of the development achieved:

- 80% of Peak Hour Demand for pumped systems.
- 100% of Maximum Day Demand for systems with elevated storage.

Pumps are to have the following service capability:

- Lead pumps provide a maximum of 25 percent of Peak Hour Demand and provide an adequate supply during normal periods of domestic demand.

- Lag pumps are to provide a maximum of 55 percent of peak demand, provide an adequate supply to meet Peak Hour Demand periods, and provide an adequate supply in the event of failure of the lead pump.

.2 Booster Station Fire Pumps

The fire booster pump are required to have adequate capacity to supply the necessary fire flow demand as indicated in 3.2.2 of this Specification.

Split case horizontal pumps only are to be used for fire pumps.

3.3.2.6 Booster Station Mechanical

Suction and discharge piping are to be designed and arranged to provide easy access for maintenance.

All piping and tubing is to be stainless steel, Type 304 or 304L, 11 gauge. For piping larger than 100 mm diameter, ductile iron, class 54, cement lined with asphaltic seal coat may be used as an alternative. Threaded flanges are to be utilized for all joints, fittings and connections within the station.

All piping within the booster station is to be properly supported and designed with appropriate fittings to allow for expansion and contraction, thrust restraint, etc. All exposed surfaces and pipes, other than stainless steel, are to be finished, treated and painted to prevent rusting. Colour scheme and paint types are to be approved by the Engineer.

Piping systems are to include couplings where required to provide sufficient flexibility to allow removal of equipment and valves. A self-closing check valve must be incorporated in the discharge of each unit in the booster station and designed that if pump flow is lost, the valve will close automatically. The type and arrangement of check valves and discharge valves is dependent on the potential hydraulic transients that might be experienced in the booster station.

A hydraulic transient analysis is to be undertaken to ensure that transients (water hammer) resulting from pumps starting, stopping, full load rejection during power failure, etc., do not adversely affect either the customers on the Water System, or the water distribution system including the booster station. Typical methods of surge protection that can be used to protect the booster station and equipment include the following:

- Surge anticipator systems that dissipate over-pressure from the discharge lines.
- Slow closing and opening control valves on pump discharges.
- Hydro-pneumatic surge tanks on discharge headers.
- Variable speed pumping units.

An adequate number of isolation valves must be provided to allow maintenance of pumps and/or control valves.

3.3.2.7 Booster Station SCADA & Controls

Booster station functions are to monitored by the HRWC supervisory control and data acquisition (SCADA) system to ensure that the station by is performing satisfactorily. Monitoring signals and alarms are to be transmitted to the HRWC SCADA system by a separate communication remote terminal unit (RTU). Programmable logic controller (PLC) is to have eight extra digital points and eight extra analog points and will transmit the following signals and alarms to the HRWC central monitoring system:

- Station flow.
- Suction and discharge pressure.
- Domestic booster pump information (overload, motor current, pump status and phase monitoring).
- Fire pump information (overload, motor current and pump status).
- Power generating system (overload, battery status, fuel tank level, etc.).
- Output control through SCADA system.
- Hand-off-automatic selector switch status.
- Low discharge pressure alarm.
- High discharge pressure alarm.
- Power failure alarm.
- Illegal entry alarm.
- Surge valve alarm.
- Building temperature alarm (high, low).
- Building flood .

The control panel is to include a means of protecting the pump motors from the following potential conditions:

- Under-load.
- Overload.
- Phase loss.
- Current imbalance.
- Overvoltage.
- Undervoltage.

Pump control panel to include the following items:

- PLC based pump controller.
- Minimum 200 mm TFT colour LCD touch screen display panel, 256 colours, 32MB RAM and removable storage media port. Acceptable products: Allen Bradley Panelview, Maple Systems Graphic HMI or approved equivalent.
- Uninterruptible power supply properly sized to maintain PLC in powered state during generator transfer to and from emergency power.
- Status indicator lights to signify the following conditions for each pump:
  - Red - Pump Running.
  - Green - Pump in Standby Mode.
  - Yellow - Pump Alarm Active.
- The pump controller is to be PLC based and programmed in a manner that the required I/O (Input / Output) be organized in blocks such that the I/O will transfer the HRWC communication panel in a single read via Modbus RTU protocol. All PLC programming and operator interface screen programming must be coordinated with HRWC Technical Services. All PLC and OIT programming complete with documentation must be provided to HRWC Technical Services on electronic storage media to be included in the operation and maintenance manuals.
- Acceptable Products: Schneider Electric ScadaPack, Allen Bradley MicroLogix, CompactLogix or approved equivalent

The control system is to be capable of providing:

- Uninterrupted fully automatic operation of the booster station to meet the various demand requirements of the area being serviced.
- Protection against equipment damage for failure during extreme hydraulic or electrical conditions.
- A flow meter providing both local and remote flow indication. Pressure gauges, complete with isolation ball valves, installed on the suction side and on the discharge side of the pumps.

3.3.2.8 Booster Station Pipe Testing

All station process piping (from the pumps to the distribution system connections) is to be hydrostatically tested. Piping must maintain a minimum pressure of 1035 kPa (150 Psi), for two hours in accordance with AWWA C600. No leakage or loss of pressure is permitted. If leakage or loss of pressure occurs, make repairs and re-test. This iterative process should be continued until a successful test is achieved.

3.3.2.9 Booster Station Start-Up

During the start-up period, the contractor starts, operates and tests all equipment and control and communication systems to ensure proper function in accordance with the project documents. The contractor is responsible for leading and directing the start-up process and calling to the site any subcontractors and suppliers necessary to start, test and certify equipment. The contractor will liaise with the Design Engineer and HRWC Technical Services as necessary. The SCADA tag list is to be provided to HRWC Technical Services at least two weeks prior to booster station start-up to allow HRWC Technical Services sufficient time to program SCADA.

During the start-up period, all technical issues related to the operation of the booster station and all requests for information (RFI's) are to be resolved. Once the start-up period has been completed, the booster station should be functioning in accordance with the contract documents. In order to progress to booster station commissioning, the Design Engineer is to provide:

.1 a full itemized list of equipment accompanied by vendor installation verification and certification indicating that the equipment has been started, tested, is functioning within specified parameters and is ready for intended use and;

.2 a full itemized list of technical difficulties encountered during start-up and their resolutions.

The following personnel are to be present at the booster station start-up:

- Contractor (Lead)
- Subcontractors
- Suppliers
- Design Engineer
- HRWC Technical Services
- HRWC Water Service (as necessary)

3.3.2.10 Booster Station Commissioning

Booster Station commissioning occurs after successful completion of booster station start-up and provision of a full itemized list of equipment, installation verification, certification and a full itemized list of technical difficulties/resolutions. Once the Design Engineer has reviewed and accepted this information, provide the Engineer with formal confirmation the booster station is ready for commissioning. The Design Engineer is to schedule commissioning dates a minimum of two weeks in advance, subject to availability of all parties.

During booster station commissioning, the contractor demonstrates to the Design Engineer and HRWC Technical Services that all equipment and systems function properly and in accordance with the project documents. The Design Engineer is responsible for providing a commissioning officer to lead the commissioning process, creating the commissioning plan, creating site acceptance testing protocols, and leading and directing the commissioning process. As a minimum the commissioning plan is to cover the following:

- Full Input / Output listing and their function;
- Full list of equipment and system set points;
- Test or simulate all Input / Output;
- Test and verify that all equipment and systems function in accordance with the Process Control Narrative (PCN);
- Check, verify and record all parameters of pump performance (including electrical parameters) under all possible operating configurations. These values will be used to check performance throughout pump lifecycle;
- Test (or simulate) and verify functionality of all alarms and ensure that response is in accordance with PCN;
- Check and verify functionality of all mechanical systems (i.e. ventilation, pump lifts, heating, hatches and accessories, valving, etc.);
- Demonstrate removal and reinstallation of all removable/serviceable mechanical equipment;
- If an auxiliary power supply system (“generator”) is installed, confirm functionality by:
    - simulating a power interruption at full demand, i.e. open the line power main disconnect switch;
    - conducting a load bank test - 100% load for 6 hours.

The Contractor is to have an appropriate number of staff available on-site to operate all equipment as directed by the commissioning officer and in accordance with the commissioning plan and site acceptance testing protocols. The Applicant’s Design Engineer and HRWC Technical Services will be present to witness booster station commissioning and will liaise with, and call to the site, other HRWC staff as necessary.

It is fully expected that all equipment and systems have been started successfully during booster station start-up and operate in accordance with the project documents. This ensures efficient use of resources during commissioning (i.e. HRWC Technical Services and Design Engineer time and expenses). If it is determined that all equipment has not been started and does not operate properly during the first attempt at commissioning, the Design Engineer may, at their discretion, terminate the commissioning process and instruct the contractor to complete the booster station start-up and re-schedule booster station commissioning.

The following personnel are to be present at booster station commissioning:

- Design Engineer (Commissioning officer as lead)
- Contractor
- Subcontractors
- Suppliers
- HRWC Technical Services
- Other HRWC Staff (as necessary)

3.3.2.11 Booster Station SCADA Commissioning

SCADA commissioning occurs after successful completion of booster station commissioning. During SCADA commissioning, all communications will be verified between the local PLC and RTU and between the local RTU and HRWC's HMI. Under direction from the HRWC Technical Services, the Contractor is to trigger, modulate or simulate all system tags to confirm communications and to ensure consistent nomenclature and units throughout. It is expected that the contractor will have the appropriate technical staff on-site for a full day to complete the SCADA Commissioning.

The following personnel are to be present at SCADA Commissioning:

- HRWC Technical Services (lead)
- Contractor
- Subcontractors (as necessary)
- Suppliers (as necessary)
- Design Engineer

3.3.2.12 Booster Station Training

After successful commissioning, the contractor or the Design Engineer provides training for HRWC Water Services in the proper operation of the booster station. Training includes: safety orientation, system description, identification of all individual pieces of equipment and explanation of their purpose; review of control logic, sequencing and set points for all equipment and systems; review and demonstration of operator interfaces; identification and demonstration of unique maintenance activities necessary to ensure proper operation of the booster station; identification and explanation of equipment and system limitations; identification and explanation of spare parts and special tools.

Following booster station training, the contractor is to allow for additional programming adjustments to operator interfaces as directed by the Engineer.

The following personnel are to be present at booster station training:

- Contractor (may act as lead)
- Design Engineer (may act as lead)
- Subcontractors (as necessary)
- Suppliers (as necessary)
- HRWC Water Services

3.3.2.13 Booster Station Commissioning Report

Following successful completion of commissioning and training, the Design Engineer is to provide a detailed booster station commissioning report complete with certification that the booster station has been constructed and operates in accordance with the design intent and project specifications.

- Executive summary, including:
    - Observations
    - Conclusions
    - Outstanding Items
    - Recommendations
- Performance verification checklists (test results and evaluation);
- System deficiencies that were discovered and measures taken to correct them;
- Outstanding deficiencies;
- Plan for resolution of outstanding deficiencies;
- Summary of training process;

- Certification from the Design Engineer that the booster station meet design intent, are operating within specified parameters and are ready for intended use;

3.3.2.14 Booster Station Operations & Maintenance Manual

The Design Engineer is to provide three (3) paper copies each bound in a heavy duty "catalog" binder with expanding posts and one (1) digital copy of the booster station operation and maintenance manual, in a form acceptable to HRWC Water Services. The manual must contain the following items in same general order:

- Title Page including:
    - identification of document as an operations & maintenance manual;
    - booster station name;
    - booster station Contractor;
    - booster station Design Engineer;
    - date of issuance.

- Index

  A quick reference table (spreadsheet to accompany electronic submission) listing the following information for each piece of equipment within the booster station:

    - make, model and serial number;
    - name, address and contact details for supplier and installer;
    - lubrication and regular maintenance intervals;
    - an index reference to the full equipment manual contained within the operations and maintenance manual;
    - spare part list, and;
    - expiry date for guarantee / warrantee.

- System description;
- Narrative on area served inclusive of mapping;
- Booster station design intent, parameters and limitations (i.e. design report);
- As constructed civil, mechanical and electrical drawings;
- System hydraulics and design calculations (including system curves);
- Pump literature (including pump curves);
- Manufacturer's operation and maintenance instructions and manuals for all equipment which includes maintenance and lubrication schedules;
- Booster station commissioning report;
- Systematic lifecycle upgrade report (if applicable);

- Process Control Narrative;
- Electronic copies of PLC and Operator Interface Terminal (OIT) projects;
- Any original software and interface cables required for programmable equipment installed within the booster station with the exception of PLC and OIT programming software, unless specified in the contract document;
- Detailed information on guarantees / warrantees for all equipment;
- Construction and post-construction color digital photos. Post-construction photos are to be taken at various angles showing the main features of the inside and outside of the booster station. A plan index is to be provided showing location and angle of each photo in relation to the booster station.

4.0 WASTEWATER SYSTEM – DESIGN REQUIREMENTS

4.1 SCOPE

A Wastewater System is a complete and properly functioning system of wastewater mains, service connections from the wastewater main to the street lines and appurtenances, including pumping stations and force mains. The design will ensure that HRWC Wastewater and Stormwater Services are not exposed to hazards when conducting operation and maintenance of the wastewater collection system.

All Wastewater Systems are to conform to any requirements established by NSE. Wastewater Systems cannot be constructed until the design has been approved by the Engineer.

Wastewater discharged into the HRWC Wastewater System must comply with HRWC Act, HRWC Regulations and applicable bylaws.

Wastewater System extensions must be carried out in conformance with a Wastewater Master Plan prepared for the wastewater sewershed in which the extension is to take place. The Wastewater Master Plan is to identify major infrastructure such as trunk sewers, wastewater mains, pumping stations, hydraulic system design calculations and operational information.

For an extension to the HRWC Wastewater Systems, the Engineer will require the Applicant to enter into a HRWC Systems Agreement which defines the rights and obligations of HRWC and the Applicant regarding construction, inspection, record collection, acceptance and warranty of the new HRWC Wastewater System.

4.2 WASTEWATER COLLECTION SYSTEM DESIGN

4.2.1 Wastewater Demand

Design the Wastewater System for wastewater flows generated from all lands within the sewershed in which the system is situated. Any lands which are, or may be anticipated to be tributary to the sewershed, either by future development are to be included in the design flow calculations.

The Wastewater System is to be designed for a gross population density based on the proposed land use. For deriving wastewater flows, a higher population density, due to the proposed land use or zoning of the tributary area may be required by the Engineer if it is determined that capacity is available in the downstream Wastewater System to accommodate the resulting increased flow.

Design the Wastewater System to accommodate the Average Dry Weather Flow:

- Average Dry Weather Flow 300 litres / person / day

Refer to the permitted land uses under the Halifax Regional Municipality Municipal Planning Strategy (MPS), Land Use Bylaw (LUB), or approved Development Agreement for a specific area. When determining site populations, refer to numbers below:

- Single unit dwellings 3.35 people / unit
- Semi-detached & townhouse 3.35 people / unit
- Multi-unit dwellings 2.25 people / unit

For site specific flows (Industrial, Commercial & Institutional) refer to the current Atlantic Canada Wastewater Guidelines Manual.

Analyze the downstream Wastewater System for capacity (giving consideration to the tributary upstream flows), septic conditions, and any other adverse effects associated with the proposed Wastewater System. The Engineer will determine the limits of the downstream analysis.

4.2.2 Hydraulic Design

The design flow q (L/s), in the wastewater sewer system is calculated as follows:

$$q = [1.25 \times (a \times M)] + b / 86400$$

$$M = 1 + \frac{14}{4 + P^{0.5}}$$

where:

1.25	is the safety factor.
a	identified here as the average dry weather flow. The allowance is 300 litres (0.30 m³) per person per day for residential development.
M	is the peaking factor as derived from the Harmon Formula. The minimum permissible peaking factor is 2.0.
b	is the future degradation of pipe long-term infiltration/inflow allowance. The allowable is 24 litres / gross hectare / day (0.28 m³ per gross hectare/second).
P	is the design population in thousands.
(a × M)	is the peak dry weather flow.
(a × M) + b	is the peak design flow to be utilized for the design of wastewater pumping stations and their force mains

4.2.2.1 Minimum Velocity

The minimum peak design flow velocity under full development or any phase of development is 0.75 m/s.

4.2.2.2 Maximum Velocity

The maximum peak design flow velocity is 4.5 m/s. A higher flow velocity (up to 6.0 m/s) may be considered if adequate energy dissipation and ventilation is achieved

4.2.2.3 Friction Factors

.1 The following are Manning Roughness Coefficients:

Table 4.1 - Manning Roughness Coefficients

PIPE MATERIAL	MANNING ROUGHNESS
Concrete	0.013
PVC	0.010
Polypropylene	0.012
HDPE (Smooth Interior Wall)	0.012

Calculate the gravity flow in Wastewater Systems using the Manning's Formula or other approved method, with allowances made for energy losses at inlets, manholes, junctions, outlets, etc.

4.2.2.4 Wastewater Main Size

- Minimum size for a wastewater main is 250 mm.
- No decrease in wastewater main size from upstream to downstream.

4.2.2.5 Wastewater Main Grade

- Minimum grade 0.6 %
- Minimum grade in cul-de-sacs 0.8%

Minimum grades must provide self-cleansing velocity of 0.6 m/s based on peak dry weather flow for the area to be serviced in the initial phase of the development.

4.2.3 Wastewater Main

4.2.3.1 Hydrogen Sulphide

.1 Design the Wastewater System to minimize hydrogen sulphide conditions. Minimize the use of drop manholes and precautions to reduce turbulence, and a reasonable retention time in pumping stations.

.2 Utilize corrosion resistant materials where hydrogen sulphide conditions are unavoidably high the Wastewater System. Refer to HRWC Regulations for limits for discharge to wastewater facilities.

4.2.3.2 Wastewater Main Material

.1 Polyvinyl Chloride (PVC) pipe and fittings type PSM to CSA B1800.

.2 Reinforced concrete pipe to ASTM C76M or CSA A257.2, used only in large diameter applications as approved by the Engineer.

.3 Polyethylene pipe and fittings to AWWA C901 or AWWA C906, used only in special circumstances as approved by the Engineer.

.4 Polypropylene pipe and fittings to AWWA C901 or AWWA C906, used only in special circumstances as approved by the Engineer.

Calculate the earth loads and the effects of concentrated and distributed superimposed (live) loads on the each installation. The approved method for calculating earth loads on pipes is the Marston Formula. The approved method for calculating the live loads on pipes is the Boussinesq Solution.

Take into account the width and depth of trench, backfill, bedding materials and a 1.5 safety factor when calculating the strength/class of pipe to be utilized.

4.2.3.3 Wastewater Main Cover

.1 Minimum cover is 1.6 metres.

.2 Maximum cover is 5.0 metres.

Measure the depth of cover from the finished surface design grade over the pipe to the crown of the wastewater main.

Under special conditions (e.g. elimination of a pumping station), the maximum depth of the pipe may be increased. Wastewater Service Connections deeper than 5.0 metres at the connection to the wastewater main are not permitted. The situations would require a wastewater rider system.

4.2.3.4 Wastewater Main Location

All Wastewater Systems are to be located within the Halifax Regional Municipality street right-of-way. Wastewater Systems on private property will be considered at time of design review, and will require an easement agreement jointly signed by the land owner and the Halifax Water Board.

A HRWC service easement shall be of sufficient width to allow safe excavation of the HRWC Systems in accordance with the requirements Occupational Health and Safety Act of Nova Scotia. Depending upon the length and location of the service easement, the Engineer may require a travel way to be provided within the HRWC service easement for access and maintenance purposes.

Where Master Planning indicates a need to accommodate future upstream lands naturally tributary to the sewershed, a service easement is to be provided from the edge of the street right-of-way to the upstream limit of the subdivision.

Refer to Section 6.0 for HRWC easement requirements.

4.2.3.5 Wastewater Main Crossing

Where any Wastewater / Stormwater System pipe crosses any other Wastewater / Stormwater System, the minimum vertical separation is 150 mm, measured from outside diameter to outside diameter.

4.2.3.6 Wastewater Main Special Bedding

A geotechnical investigation must be carried out along the proposed routes prior to the design stage. The subsurface and soils conditions must be made available to the Engineer before approval of the proposed design in order to evaluate and approve the bedding type for the given conditions. The minimum bedding requirement for Wastewater Systems is 250 mm Type 1 gravel.

4.2.4 Wastewater Manhole

4.2.4.1 Wastewater Manhole Spacing & Location

Generally, the maximum allowable horizontal spacing between wastewater manholes holes is as follows:

Table 4.2 – Wastewater Manhole Spacing

Wastewater Main Size	Maximum Spacing
250 mm to 450 mm	Up to 100 metres
Greater than 525 mm	Up to 150 metres

.1 Locate wastewater manholes at each change in alignment, pipe size, grade or material, and at all junctions with Wastewater Service Connections 250 mm and larger.

.2 Larger diameter wastewater mains may be permitted to utilize a greater spacing.

.3 Do not locate wastewater manholes in areas subject to flooding or roadway low points.

.4 Where wastewater manholes are located outside of the paved street limits, or in a gravel shoulder provide an asphalt apron.

4.2.4.2 Wastewater Manhole Sizing

.1 All sizing of precast wastewater manholes holes are based on inlet and outlet pipe sizes and will be sized as per the Standard Detail. The minimum diameter for wastewater manhole is 1050 mm.

.2 Specify the type and size of wastewater manhole on the profile drawing.

.3 When any dimension of a wastewater manhole hole differs from the specification, the wastewater manhole will be individually designed and detailed.

4.2.4.3 Wastewater Manhole Frame and Cover

.1 Wastewater manholes require adjustable manhole frames when placed within asphalt and concrete surfaces. Manhole covers, with HRWC logo, require one vent hole for air testing and removal of cover.

.2 Wastewater manholes not located within asphalt and concrete surfaces require a cover, with HRWC logo, equipped with a locking system.

.3 Wastewater manhole frame and cover will be clear of curb and gutters and clear of bends in the road for new construction.

.4 All wastewater manhole chamber openings will be located on the upstream side of the wastewater manhole.

4.2.4.4 Wastewater Manhole Drop Structure

A drop wastewater manhole is required when the vertical drop between any inlet pipe invert and the outlet pipe invert exceeds 1000 mm. Minimum inside width clearance within internal drop wastewater manholes is 1000 mm. When the inlet pipe exceeds 375 mm us an external drop wastewater manhole. Refer to the Supplementary Standard Specifications for the standard details related to both of these arrangements.

4.2.4.5 Wastewater Manhole Benching

Wastewater manholes are required to be benched. Benching starts two thirds the height of the pipe and slope upwards at a slope of 4:1. Benching within wastewater manholes is to incorporate half pipe channels to direct the flow from inlet pipes or connections to the outlet pipe with as long a radius bend as possible.

4.2.4.6 Wastewater Manhole Hydraulic Losses

Suitable drops are to be provided through the wastewater manhole to compensate for the energy losses due to the change in flow velocity and to accommodate the difference in depth of flow in the upstream and downstream pipes. When the pipe size does not change through a wastewater manhole and the upstream flow velocity does not exceed 1.5 m/s, the following allowances will be made to compensate for hydraulic losses.

Table 4.3 – Hydraulic Losses

Wastewater Main Deflection	Inlet / Outlet Invert Difference
0°	50 mm
1° to 45°	60 mm
46° to 90°	75 mm
Junctions and Transitions	Minimum 100 mm
91° and Greater	Not Permitted

[a] For all junctions and transition maintenance holes and when the upstream flow velocity exceeds 1.5 m/s, the drop required will need to be calculated. Calculations for hydraulic losses will be included in the design submission.

4.2.4.7 Wastewater Manhole Connections

.1 Connections to wastewater manholes are permitted to be a maximum depth of 3.0 metres.

.2 A maximum of two (2) Wastewater Service Connections are permitted to connect to a wastewater manhole

.3 Flexible rubber connectors can used for connecting pipe to wastewater manholes. Rubber connectors are either cast-in-place during manufacture of the pre-cast product or installed into a cored or preformed hole in the finished wastewater manhole.

4.2.5 Wastewater Service Connection

4.2.5.1 Wastewater Service Connection General Requirements

The following are the requirements for Wastewater Service Connections:

.1 Every building is required to be connected separately to the mains from any other building, except that an ancillary building on the same property may be serviced by the same Wastewater Service Connection (National Plumbing Code of Canada).

.2 A single Wastewater Service Connection to each lot is required when extending HRWC Systems. Extend the Wastewater Service Connection at least 1.5 metres inside the property line. Cap the bell end of the Wastewater Service Connection with a PVC cap.

.3 Break the rock 3.0 metres beyond the plugged end of the Wastewater Service Connections.

.4 Minimum 2% grade.

.5 Maximum 8% grade.

.6 Minimum 1.2 metres cover.

.7 Wastewater Service Connection 200 mm or smaller are to connect to the wastewater main utilizing a factory tee or wye fittings. Saddle Connections utilizing flexible rubber connectors may also be used. Utilize vertical long radius bend of 45° at the wastewater main.

.8 Wastewater Service Connection 250 mm or greater connect to the wastewater main utilizing a precast wastewater manhole.

.9 Wastewater Service Connections are not permitted to be connected to a dead end wastewater manhole. Make connection into the wastewater main or a wastewater manhole downstream of the dead end wastewater manhole.

.10 One horizontal, long radius 22½° bend is permitted along the length of a Wastewater Service Connection. If more than one bend or a bend greater than 22½° is required, an access type structure is to be installed at each additional bend.

.11 Wastewater Service Connections smaller than 200 mm and an overall length greater than 25.0 metres require an access type structure every 25.0 metres. Place a 300 mm x 300 mm x 6 mm steel plate above the structure 150 mm below the ground surface to allow for detection by a metal detector.

.12 Wastewater Service Connections 200 mm or greater require manholes for changes in direction and maximum spacing of 100 metres.

.13 Wastewater Service Connections are not permitted to decrease in size from the building connection to the main.

.14 Minimum 300 mm horizontal and vertical separation distance from a Water Service Connection.

.15 Minimum 450 mm vertical separation when crossing below a Water Service Connection.

.16 Minimum 3.0 metres horizontal separation from an outdoor fuel tank and septic tank.

.17 Minimum 2.0 metres horizontal separation from gas lines, underground electrical / telephone conduit, steam or hot water piping, transformer pads, utility poles or other utilities.

4.2.5.2 Wastewater Service Connection Residential

In addition to the general requirements, Wastewater Service Connection Residential requires the following:

.1 Minimum 125 mm diameter.

.2 Wastewater Service Connections PVC DR28 (white).

.3 Locate the public portion of Wastewater Service Connections 1.5 metres from driveways.

4.2.5.3 Wastewater Service Connection Multi-Unit & ICI

In addition to the general requirements, Wastewater Service Connection Multi-Unit & ICI requires the following:

.1 Minimum 150 mm diameter

.2 Grade less than 2% permitted under the stamp of the Design Engineer.

.3 Wastewater Service Connections PVC DR35 (white).

.4 Locate the public portion of Wastewater Service Connections 1.5 metres from driveways, if possible.

.5 Monitoring Access Point wastewater manhole is required and is to be located on private property, adjacent to the right-of-way.

4.2.5.4 Wastewater Service Connection to a Combined System

For proposed Wastewater Service Connections discharging into a Combined System the Applicant is to provide Combined System capacity analysis to the Engineer.

A meeting between the Engineer, the Applicant and the Design Engineer will take place at which the Design Engineer will provide a development briefing. This meeting will identify the limits of the downstream system that will be part of the Combined System capacity assessment. The downstream system is considered from the site to the nearest regional infrastructure, or a point agreed to by the Engineer.

The Design Engineer is to use the following six times dry weather flow (6DWF) methodology to estimate the theoretical Combined System flow, which will include existing combined flows and the proposed combined development flows, for Combined System being analyzed.

a. If flow monitoring data is not available:

*Design Flow (q) = 6 * (1.25 * P * a) + I*

where:

1.25 is the safety factor.

P is the Total Population (existing upstream population + proposed development population)

a identified here as the average dry weather flow. The allowance is 300 litres (0.30 m^3) per person per day for residential development.

I is the Infiltration (10% of P*a)

b. If flow monitoring data is available, it is to be used to determine existing Combined System flows and infiltration:

*Design Flow (q) = 6 * (1.25 * (ECSF + P_d * a)) + I*

where:

1.25 is the safety factor.

ECSF is the Existing Combined System Flow Recorded, calculated by ADWF – I

P_d is the proposed development population

a identified here as the average dry weather flow. The allowance is 300 litres (0.30 m^3) per person per day for residential development.

I is the Infiltration (80% of minimum night time flows from flow monitoring data)

c. If the estimated q/Q (Q is the capacity of the main) is ≥ 80% for any main identified, and flow monitoring data was not used (step a), flow monitoring data will be collected and used to re-calculate the total design flows (Step b). The ideal flow monitoring period is April to November.

NB: The 80% trigger represents the confidence associated with an analysis.

d. If the estimated q/Q is ≥ 80% for any sewer identified in “Step a”, and flow monitoring data was used (Step b), the hydraulic model is to be updated with additional infrastructure (as required) and calibrated with new flow monitoring data (as required). The model is then used to assess the design flows for each main identified in “Step a”, using a 1:5 year storm.

e. If the estimated q/Q is ≥ 95% for any main identified with the use of the model, then a capacity deficiency plan of action is required. This study is to be completed by the Design Engineer, and is to consider LID, sewer separation, and main upsizing with respect to feasibility, effectiveness, and cost.

   NB: The 95% trigger represents the confidence associated with a modelling analysis.

f. If the q/Q is sufficient in either “Step c, d, or e”, for all sewers identified in “Step a”, and the downstream system is not identified as being environmentally sensitive or having existing known constraints (at the discretion of the Engineer), then the application can be accepted.

   It should be further clarified that for the application to be accepted, a desktop assessment must yield a q/Q < 80% and a modelling assessment must yield a q/Q < 95%. The difference is due to the more reliable and confident results produced by the model in comparison to the desktop review.

A basic Stormwater System design report must be included with each application to demonstrate that the post-development peak stormwater runoff rate for a 1:5 year storm is less than or equal to that under pre-development conditions, or the existing capacity of the receiving sewer, whichever is less. Pre-development conditions are based on actual pre-development land use, not ‘natural’ conditions. Any increase in post-development runoff, and how it will be addressed, must be included in the report.

The Design Engineer is required to provide all capacity and flow projection calculations in a form approved by the Engineer. The validity period for building commencement is to be two years from the date of application approval.

4.2.5.5 Wastewater Service Connection Pressurized

.1 Pressurized Wastewater Service Connections minimum of 50 mm PVC DR26 or DR11 (series 160) HDPE.

.2 Connect the pressurized Wastewater Service Connection to a wastewater manhole at the property line. This wastewater manhole can also serve as the monitoring access point wastewater manhole. Connect the wastewater manhole to the wastewater main utilizing a gravity connection.

.3 Connection of the pressurized Wastewater Service Connection directly to the wastewater main may be considered by the Engineer. In those cases a 300 mm isolation valve is to be installed in the right-of-way adjacent to the property boundary.

.4 Install a trace wire on the pressurized Wastewater Service Connections for location purposes.

4.2.5.6 Wastewater Service Connection Abandonment

Wastewater Service Connections are required to be abandoned at the wastewater main for all Halifax Regional Municipality Demolition Permits. The method for abandonment is dependent on the site conditions specific to the Wastewater Service Connection in question. HRWC Wastewater Services will dictate the abandonment method to be used.

4.2.5.7 Wastewater Service Connection Reutilization

An existing Wastewater Service Connection may be reused subject to all of the following conditions being met:

.1 The proposed land use and building size is known.

.2 The Wastewater Service Connection is of adequate size and meets current pipe material specifications.

.3 A Closed Circuit Television video is to be provided to HRWC Engineering Approvals confirming the Wastewater Service Connection condition warrants reuse.

4.3 WASTEWATER PUMPED SYSTEM DESIGN (UP TO 30 L/S)

Wastewater pumping stations and force mains represent a long-term financial burden to HRWC in terms of operational, maintenance and replacement costs. Designs are to preclude the need for pumping stations. Pumping stations will be permitted only when a gravity system is not physically possible or when the life cycle costs of a gravity wastewater main are outweigh those of a wastewater pumping station.

These specifications pertain to submersible type pumping stations with a capacity of 30 L/s. Larger capacity pumping stations will be evaluated by the Engineer on a site specific basis. An alternative phased pump station design may be considered if practical.

The design is to consider safety of operations, in accordance with all applicable municipal, provincial and federal regulations including the Occupational Health and Safety Act and CSA.

Equipment which starts automatically is required to be labelled with warning signage to notify operators of this feature. Protect all equipment with guards to prevent accidental contact. Provide all equipment with lock-outs to confirm the equipment is out of service when maintenance is being carried out.

4.3.1 Pumping Station Submission

When proposing a wastewater pumping station, include the following in the design submission:

.1 Civil drawings.
.2 Mechanical drawings.
.3 Electrical drawings
.4 Architectural drawings
.5 Pump information.
.6 Design report.
.7 Sewershed boundary serviced by pumping station.
.8 System curves.
.9 Station configuration.
.10 Program ladder.

4.3.2 Pumping Station Design

4.3.2.1 Site Considerations

The wastewater pumping station is to be on its own property, deeded to HRWC prior to commissioning.

.1 Grade the pumping station land to prevent ponding of water

.2 All exposed areas are to be sodded.

.3 Property may require a 2.44 metres security fence depending on site conditions. Confirm with the Engineer.

.4 Driveway subgrade is to be specified by the Design Engineer. The base gravels are to be 150 mm of Type 2 gravel, 150 mm of Type 1 gravel and 75 mm of asphalt to a minimum width of 3.5 metres, and a minimum length of 7.5 metres. Do not design driveways to exceed 8% grade.

4.3.2.2 Safety Precautions

.1 Take into account all applicable Municipal, Provincial and Federal regulations including the Occupational Health and Safety Act when designing the pumping station from a safety perspective. Eliminate all confined spaces.

.2 Protect all equipment with guards to prevent accidental contact. Provide all equipment with lock-outs to confirm the equipment is out of service when maintenance is being carried out.

.3 Equip diesel generator fuel supply lines with fusible link valves. Fuel lines between the generator and the fuel supply are to be located in appropriately sized sleeves cast into the station floor.

4.3.2.3 Electrical & Auxiliary Power

Perform an arc flash hazard analysis to determine the available arc fault currents and arc flash hazards for electrical equipment such as switchboards, panel boards, industrial control panels, meter socket enclosures and motor control centres

(MCCs). The arc flash hazard warning labeling is to comply with NFPA 70E standard, Standard for Electrical Safety in the Workplace.

Provide three-phase power supply to the pumping station station. Design and installation of the power supply system to meet all applicable and relevant standards and codes. Utilize 208 volt for electric motors less than 7.5 kilowatts and 600 volt for electric motors greater than 7.5 kilowatts. All electric motors shall be premium efficiency motors.

Each pump requires an energy efficient electric motor capable of operating the pump over the full range of load conditions. Motors should be located such that they cannot be flooded should a pipe failure occur. Each pump are required to have a separate lockable disconnect switch for isolation of the motor power supply without affecting the remaining system operation.

Equip the pumping stations with a quick connect feature for a portable generator consistent with existing HRWC portable generator connections.

4.3.2.4 Wet Well Inlet Arrangements

A manhole shall be provided outside of the pumping station and only one inlet pipe shall be permitted from this manhole to the pumping station wet well. No service connections shall be connected between the last manhole and the wet-well.

The inlet of the incoming pipe shall be higher than the setting which starts the second pump.

At the invert of the incoming pipe a removable baffle or deflector plate is to be installed on the end of the incoming pipe. The baffle or deflector plate is to be constructed of 12 Gauge stainless steel (Type 316 or 316L). Other designs providing for non-turbulent flow into the station may be considered.

4.3.2.5 Wet Well Size

Size the wet well to minimize pump cycle time and in accordance with the pump manufacturer's recommendations. Design the wet well and control settings to avoid septic conditions.

Larger stations (exceeding 30 L/s) shall install a dual wet well system to control flows during maintenance activities.

4.3.2.6 Underground Concrete Structure Water Proofing

Underground concrete structures such as wet-wells, dry-wells, emergency storage tanks, holding tanks, valve and meter chambers, etc., shall incorporate the following water proofing measures:

- Underground concrete structures shall be treated with Xypex or equivalent. This may be applied to the exterior of the structure or pre-mixed with the concrete.
- The joints of precast concrete sections shall be sealed with 32 mm butyl resin flexible gasket (ConSeal CS-202 or equivalent). The outside of the joint shall also be treated with 150 mm wide butyl resin joint wrap (ConSeal CS-213 or equivalent).
- Where cold joints occur in cast in place structures, adequate waterstops shall be installed to prevent the infiltration or exfiltration of water.
- The exterior of underground concrete structures shall be covered in an approved waterproof membrane.

The Engineer may waive some or all the above requirements if an internal/external waterproof liner is used.

4.3.2.7 Benching & Flush Valve

Wet-wells shall be designed to minimize the deposition of solids. Benching is to be designed to be self-cleansing; no steps, ledges or “dead-spots” are permitted. Install one hydraulically operated flush valve per pumping station. (ITT Flygt / Xylem or approved equal).

4.3.2.8 Wet Well Ventilation

A ventilation system capable of delivering a complete air change to the wet well in ten (10) minutes (6 ACH) or delivering fresh air to the wet well at a minimum rate of 110 litres/sec at 15 mm static pressure is to be provided. The ventilation system must meet the requirements of the Canadian Electrical Code for Class 1, Div 1, Zone 1 hazardous locations. A separate circuit is to be provided for the fan with a ground fault interrupter. The ventilation fan is to be controlled by a switch at the pumping station control panel set to operate when the control panel door is opened. The ventilation fan control shall also provide for automatic operation of the fan at least 4 times during a 24 hour period. The operation duration of each time shall be adjustable and to be 10 minutes minimum. The ventilation fan is to be mounted on the pumping station control panel mounting structure adjacent to the control panel. Above-ground ventilation piping is stainless steel and is to be goose-necked with a birdscreen on the open end.

4.3.2.9 Pumping Arrangement

Pumping stations shall have a minimum of two pumps. Each pump will be sized to handle the peak design flow. Where three or more pumps are provided, they shall be of such capacity that, with any one pump out of service, the remaining pumps will have the capacity to handle the peak design flow, taking into account head losses associated with parallel operation.

The pump control circuitry shall be designed to alternate pumps for each pumping cycle automatically and if suitable, to handle cascading operation of multiple pumps based on flow demands.

Pumping arrangements shall be designed to be hydraulically, operationally and energy efficient. Analyses of system hydraulics, pump and pump system operating characteristics, energy consumption and life cycle costs shall be provided to the Engineer for review and approval and to confirm the most effective and efficient pumping solution has been selected.

4.3.2.10 Pump Selection

Pumping equipment shall be selected to perform at maximum efficiencies under normal operating conditions. Provide soft start and variable speed drives under the following conditions:

- Soft start 7.5 kW and larger (10 HP).
- Variable Speed Drive 15 kW and larger (20 HP), in consultation with the Engineer.

Pumping stations, wet well and dry wells shall be designed such that all pumps will operate under a continuous positive prime condition during the entire pump cycle.

System head calculations and pump selection curves shall be provided for the following operating conditions:

(a) C=110 and low water level in the wet well.
(b) C=120 and medium water level over the normal operating range in the wet well.
(c) C=130 and overflow water level in the wet well.

Where C is Hazen-Williams flow coefficient

Curve (b) shall be used to select the pump and motor since this most closely represents normal operating conditions. The extreme operating ranges will be given by the intersections of curves (a) and (c) with the selected pump curve. The pump and motor shall be capable of operating satisfactorily over the full range of operating conditions.

4.3.2.11 Submersible Pump

Guided into place on two guide bars or cables extending from a guide-bar/cable holder at the top of the station to a discharge connection elbow at the bottom; metal to metal pump to discharge connection; pump and motor from the same manufacturer, shall be close-coupled as a single unit, CSA approved and manufacturer certified for Class 1. Div 1 Zone 2, Groups A, B, C or D hazardous locations; air filled, squirrel cage motor with Class F windings rated for 155°C, designed for continuous duty, handling pumped media at 40°C capable of up to 15 starts per hour; service factor not less than 1.10; voltage tolerance ± 10%; protected by thermal switches, located in the windings, calibrated to open at 125°C; float type leakage sensor located in the stator housing. Thermal switches and leakage sensor are to be monitored by a unit in the control panel. Pumps to be cooled with cooling fins; pumps over 10 kW are to be cooled with a water jacket around the stator casing. The motor shall be designed to operate up to 40°C ambient with a temperature rise not to exceed 80°C.

Pumps shall have a retrieval system that allows for the ability of being removed and re-installed in a submerged state.

The pump construction will be cast iron ASTM A-48, Class 35 B with a wastewater resistant coating; exposed nuts and bolts shall be AISI type 304 stainless steel. The impeller shall be cast iron Class 35 B capable of handling solids with up to 75 mm diameter. At the discretion of the Engineer, the volute is to have provision for a Mix Flush Valve. The bearings shall be permanently greased, single roller type for the upper bearing and two row angular contact type for the lower bearing. The pump shall have a tandem mechanical seal system with two independent seals operating in a lubricant reservoir; the seal ring material shall be silicon-carbide.

The power cable to the motor shall be CSA approved, sized for service, sealed at the pump entry by a compressed grommet/washer assembly and shall be continuous from pump to electrical panel.

In order to standardize submersible pumping equipment for HRWC, only pumps from the following manufacturers are permitted:

- Flygt / Xylem.
- ABS.
- KSB.

All pumps and motors must carry a minimum of 12 months warranty from the date of acceptance of the system.

4.3.2.12 Mechanical

Pumping station internal piping shall be either ductile iron Class 54 with coal tar epoxy or glass lining, or 11 Gauge stainless steel (Type 316 or 316L). Coloured grey for DI pipe.

Threaded flanges or Victaulic couplings shall be used for ductile iron pipe joints, fittings and connections within the station. Pressed or rolled vanstone neck flanges shall be used for stainless steel pipe joints, fittings and connections. Piping within the station shall be properly supported and shall be designed with appropriate fittings to allow for expansion and contraction, thrust restraint, etc.

Hand operated rising stem gate or plug valves shall be provided on discharge piping to allow for proper maintenance. A check valve shall be provided on the discharge lines between the isolation valve and the pump. Check valves shall be accessible for maintenance. All valves, including check valves, shall be located outside of the pumping station and shall be installed in a drained concrete chamber. The minimum number of valves to be installed within the chamber shall be five (5) for a dual force main pipe arrangement. The drain shall be directed to the wet well and equipped with backflow protection.

Undertake a hydraulic transient analysis to account for water hammer resulting from rapid pressure changes. Include the transient analysis within the design brief to support the pumping station design.

Pumping stations shall have an ultrasonic level control with a local display of the station liquid level locally and an analog output into the pump controller to control pump starts and stops. Float switches may be considered in stations where ultrasonic level control is unsuitable.

In conjunction with the ultrasonic level control, the pumping stations shall have two Flygt float switches model # ENM-10 or approved equivalent. One float switch will act as a low level alarm float and lock-out the pumps if the liquid level drops 75 mm below the normal pump shut-off level. This condition is to provide a low level alarm indication but is to be self-resetting. The second float switch shall act as the high level alarm float and start both pumps if the liquid level is above the normal start level and they are not already running. This condition is to provide a high level alarm indication but is to be self-resetting.

4.3.2.13 Access

Adequate access hatchways shall be provided. Hatchways are to open in a direction which allows access from the driveway. Hatches which are flush with the surrounding grade are to be equipped with a secondary protective grating device to provide fall-through protection.

Pumping stations shall be provided with an acceptable device for the removal of pumps and motors for repair and maintenance.

Pumping station wet wells shall be provided with an approved fall arrest system. Please contact the Engineer for specific details on the requirements for this installation.

An accessible hatch must be provided for each pump installed.

Lift hatches shall have gas assisted cylinders and able to be “locked-in” in the upright position. Limit switches are required for the hatches to indicate when they are opened.

Locks shall be keyed alike to HRWC’s standard system.

4.3.2.14 SCADA and Controls

Pumping station control panel is to be a CSA approved NEMA 4X rated lockable stainless steel door-on-door style enclosure measuring 1500 mm (height) x 900 mm (width) x 250 mm (depth). The control panel must incorporate an inside hinged panel to separate the high voltage equipment from the operator interface and controls.

Pumping station utility meter socket base to be housed within the control panel enclosure with a pad lockable access door and ¼ turn closing handle mechanism attached to the main control panel door.

Control panel to include the following items:

- PLC based pump controller.
- Minimum 200 mm TFT colour daylight visible display LCD touch screen display panel, 256 colours, 32MB RAM and removable storage media port. Acceptable products: Allen Bradley Panelview, Maple Systems Graphic HMI or approved equivalent.
- Uninterruptible power supply properly sized to maintain PLC in powered state during generator transfer to and from emergency power.
- Status indicator lights to signify the following conditions for each pump:
    - Red - Pump Running.
    - Green - Pump in Standby Mode.
    - Yellow - Pump Alarm Active.
- Separate mechanical interlocked main breaker for portable generator connection.
- Mechanical run-time meters shall be provided for each pump and an additional meter shall be provided to record run-time for two pumps operating simultaneously.
- Lightning arrestors.
- Intrinsic safety barriers for all float switches.
- Appropriate space allocated in the enclosure to install communication hardware including radio, radio power supply and antenna supplied by HRWC Water Services.
- Hand-Off-Auto selector switch for each pump.
- Flow meter transmitters with MODBUS capability.

Magnetic flow meters shall be provided for each pump discharge pipe. Magnetic flow meters shall be located in the valve chamber and installed in accordance with the manufacturer's specifications allowing for sufficient straight runs of pipe for maximum accuracy.

Flow meters shall be the following approved products:

- ABB
- Siemens
- Keohne

Pump controller shall be PLC based and programmed in a manner that the required I/O (Input / Output) be organized in blocks such that the I/O will transfer to the HRWC communication panel or SCADA system in a single read via modbus RTU protocol. All PLC programming and operator interface screen programming must be coordinated with HRWC Water Services. All PLC and OIT programming complete with documentation must be provided to HRWC Water

Services on electronic storage media to be included in the operations and maintenance manuals.

Acceptable products:

- Schneider Electric SCADAPack
- Allen Bradley MicroLogix
- CompactLogix or approved equivalent.

PLC controller shall have eight extra digital points and eight extra analog points and will transmit the following signals and alarms to HRWC`s central monitoring system:

- Hand-Off-Auto selector switch status.
- Station voltage.
- Pump motor currents.
- Station level.
- Low level alarm.
- High level alarm.
- Power monitor alarm.
- Pump motor overload.
- Pump motor under-load.
- Pump status.
- Valve chamber flood alarm.
- Flow rate for each pump.
- Pump inlet pressure.
- Pump outlet pressure.
- Overflow rate.
- Entry alarms for well and chamber hatches.
- Totalizer reading for each flow meter.

Where an auxiliary power supply and building exists:

- Entry alarms for building and well hatches.
- Generator status.
- Generator fault alarm.
- Generator fuel tank analog level.
- Generator fuel tank low level alarm.
- Transfer switch status.
- Panic alarm for building.
- Fire alarm for building.
- Gas detection alarm (tied to ventilation control).
- Station thermostat status / control.

- Ventilation system status / control (tied to access control).
- Outdoor air temperature status (tied to ventilation control).

Control panel shall include a means of protecting the pump motors from the following potential conditions:

- Under-load.
- Overload.
- Phase loss.
- Current imbalance.
- Overvoltage.
- Undervoltage

Each pump shall have a separate lockable disconnect switch for isolation of the motor power supply accessible from the dead front panel.

4.3.2.15 Phased Developments

In situations of phased development the effects of minimum flow conditions shall be investigated to ensure that the retention time in the wet well will not create an odour or septic problem and that pumping equipment will not operate too infrequently based on manufacturer's recommendations.

4.3.2.16 Emergency Storage Tanks

Emergency storage tanks shall be constructed of precast or cast-in-place concrete. The tank shall be constructed using the following criteria:

- The tank is only to be used during power outages and should remain dry during normal cycling of pumps.
- The tank shall incorporate a wash-down mechanism that can be used each time the storage tank is used.
- The tank floor shall be sloped toward the outlet pipe at a slope of 5:1 (horizontal : vertical) or steeper.
- The tank shall have two access hatches.
- The tank shall be of a size adequate to accommodate peak flow for a time equivalent to the average power outage duration for the area. Refer to NSPI for duration time.

4.3.2.17 Emergency Overflows

Pumping stations shall be provided with an emergency overflow. The invert of the overflow pipe at the pumping station shall be lower than the lowest invert of any service connection at the property line. The invert of the overflow pipe shall be high enough to prevent back-flow into the pumping station from the high-water of the localized system. If this is not possible the Engineer may approve a check valve on the overflow. The Design Engineer shall provide a means to measure emergency overflows within a pumping station.

An auxiliary power supply shall be included in each pumping station unless otherwise required by the Engineer. An emergency storage tank may be considered instead of auxiliary power on pumping stations with a maximum peak flow of 30 L/s or less.

4.3.2.18 Testing Station Piping

All station process piping (from the pumps to the distribution system connections) is to be hydrostatically tested. Piping must maintain a minimum pressure of 1035 kPa (150 Psi), for two hours in accordance with AWWA C600. No leakage or loss of pressure is permitted. If leakage or loss of pressure occurs, make repairs and re-test. This iterative process should be continued until a successful test is achieved.

4.3.2.19 Wet Well Testing

Prior to installation of mechanical and electrical equipment, the wet-well shall be tested for leakage. The wet well is to be filled to the top cover level with water and after a 24 hour period, re-filled to the top cover, then monitored for 4 hours. Measured leakage after the 4 hour period must be less than 5 litres/hour/0.8 m^2 surface area/1000 mm of vertical height. If leakage is greater than allowable, make repairs and re-test. This iterative process should be continued until a successful test is achieved. Regardless of test results, repair any visible leaks, seepage or weeping.

4.3.2.20 Facility Start-Up

During the start-up period, the contractor starts, operates and tests all equipment and control and communication systems to ensure proper function in accordance with the project documents. The contractor is responsible for leading and directing the start-up process and calling to the site any subcontractors and suppliers necessary to start, test and certify equipment. The contractor will liaise with the Design Engineer and the Engineer as necessary. The SCADA tag list is to be provided to HRWC Water Services at least two weeks prior to facility start-up to allow HRWC Water Services sufficient time to program SCADA.

During the start-up period, all technical issues related to the operation of the facility and all requests for information (RFI's) shall be resolved. Once the start-up period has been completed, the facility should be functioning in accordance with the contract documents. In order to progress to facility commissioning, the contractor shall provide:

- a full itemized list of equipment accompanied by vendor installation verification and certification indicating that the equipment has been started, tested, is functioning within specified parameters and is ready for intended use, and;
- a full itemized list of technical difficulties encountered during start-up and their resolutions.

The following personnel shall be present at the facility start-up:

- **Contractor (lead)**
- Subcontractors
- Suppliers
- Design Engineer
- HRWC Water Services
- HRWC Wastewater Services

4.3.2.21 Facility Commissioning

Facility commissioning occurs after successful completion of facility start-up and provision of a full itemized list of equipment, installation verification, certification and a full itemized list of technical difficulties/resolutions. Once the Design Engineer has reviewed and accepted this information, they shall advise that the facility is ready for commissioning. The contractor shall then schedule commissioning dates a minimum of two weeks in advance, subject to availability of all parties.

During facility commissioning, the contractor demonstrates to the Design Engineer and HRWC Water and Wastewater Services that all equipment and systems function properly and in accordance with the project documents. The Design Engineer is responsible for providing a commissioning officer to lead the commissioning process, creating the commissioning plan, creating site acceptance testing protocols, and leading and directing the commissioning process. As a minimum the commissioning plan shall cover the following:

- Full Input / Output listing and their function;
- Full list of equipment and system setpoints;
- Test or simulate all Input/Output;
- Test and verify that all equipment and systems function in accordance with the Process Control Narrative (PCN);
- Check, verify and record all parameters of pump performance (including electrical parameters) under all possible operating configurations. These values will be used to check performance throughout pump lifecycle;
- Test (or simulate) and verify functionality of all alarms and ensure that response is in accordance with PCN;
- Check and verify functionality of all mechanical systems (i.e. ventilation, pump lifts, heating, hatches and accessories, valving, etc.);
- Demonstrate removal and reinstallation of all removable/serviceable mechanical equipment (i.e. screening baskets, pumps, etc.);
- Confirm auxiliary power supply system functionality by:
  - simulating a power interruption at full demand, i.e. open the line power main disconnect switch;
  - conducting a load bank test - 100% load for 6 hours.

The contractor shall have an appropriate number of staff available on-site to operate all equipment as directed by the commissioning officer and in accordance with the commissioning plan and site acceptance testing protocols. The Design Engineer and HRWC Wastewater Services will be present to witness facility commissioning and will liaise with, and call to the site, other HRWC staff as necessary.

It is fully expected that all equipment and systems have been started successfully during facility start-up and operate in accordance with the project documents. This ensures efficient use of resources during commissioning (i.e. HRWC staff time and Design Engineer time and expenses). If it is determined that all equipment has not been started and does not operate properly during the first attempt at commissioning, the Design Engineer may, at their discretion, terminate the commissioning process and instruct the contractor to complete the facility start-up and re-schedule facility commissioning.

The following personnel shall be present at facility commissioning:

- Design Engineer (Commissioning officer as lead)
- Contractor
- Subcontractors
- Suppliers
- HRWC Wastewater Services
- Other HRWC Staff (as necessary)

4.3.2.22 SCADA Commissioning

SCADA commissioning occurs after successful completion of facility commissioning. During SCADA commissioning, all communications will be verified between the local PLC and RTU and between the local RTU and HRWC's HMI. Under direction from the HRWC Technical Services' representative, the contractor shall trigger, modulate or simulate all system tags to confirm communications and to ensure consistent nomenclature and units throughout. It is expected that the contractor will have the appropriate technical staff on-site for a full day to complete the SCADA commissioning.

The following personnel shall be present at SCADA commissioning:

- HRWC Water Services (lead)
- Contractor
- Subcontractors (as necessary)
- Suppliers (as necessary)
- Design Engineer
- HRWC Wastewater Services

4.3.2.23 Facility Training

After successful commissioning, the contractor or the Design Engineer provides training for HRWC Water and Wastewater Services in the proper operation of the facility. Such training shall include: safety orientation, system description, identification of all individual pieces of equipment and explanation of their purpose; review of control logic, sequencing and set points for all equipment and systems; review and demonstration of operator interfaces; identification and demonstration of unique maintenance activities necessary to ensure proper operation of the facility; identification and explanation of equipment and system limitations; identification and explanation of spare parts and special tools. Facility training shall also identify all transient protection devices on the force mains, their location, the location of the discharge manhole(s) and any downstream restrictions or interlocks.

Following facility training, the contractor is to allow for additional programming adjustments to operator interfaces as directed by HRWC Water and Wastewater Services.

The following personnel shall be present at facility training:

- Contractor (may act as lead)
- Design Engineer (may act as lead)
- Subcontractors (as necessary)
- Suppliers (as necessary)
- HRWC Wastewater Services
- HRWC Water Services

4.3.2.24 Facility Commissioning Report

Following successful completion of commissioning and training, the Design Engineer shall provide a detailed facility commissioning report complete with certification that the facility has been constructed and operates in accordance with the design intent and project specifications.

- Executive summary, including:
    - Observations
    - Conclusions
    - Outstanding Items
    - Recommendations

- Performance verification checklists (test results and evaluation);
- System deficiencies that were discovered and measures taken to correct them;
- Outstanding deficiencies;
- Plan for resolution of outstanding deficiencies;
- Summary of training process;
- Certification from the Design Engineer that the facility meet design intent, are operating within specified parameters and are ready for intended use;

4.3.2.25 Operations and Maintenance Manual

The Design Engineer is to provide three (3) paper copies each bound in a heavy duty “catalog” binder with expanding posts and one (1) digital copy of the pumping station operation and maintenance manual, in a form acceptable to HRWC Wastewater Services. The manual must contain the following items in same general order:

- Title Page including:
    - identification of document as an operations & maintenance manual;
    - pumping station name;
    - pumping station Contractor;
    - pumping station Design Engineer;
    - date of issuance.

- Index

  A quick reference table (spreadsheet to accompany electronic submission) listing the following information for each piece of equipment within the pumping station:

    - make, model and serial number;
    - name, address and contact details for supplier and installer;
    - lubrication and regular maintenance intervals;
    - an index reference to the full equipment manual contained within the operations and maintenance manual;
    - spare part list, and;
    - expiry date for guarantee / warrantee.

- System description;
- Narrative on area served inclusive of mapping;

- Pumping station design intent, parameters and limitations (i.e. design report);
- As constructed civil, mechanical and electrical drawings;
- System hydraulics and design calculations (including system curves);
- Pump literature (including pump curves);
- Manufacturer's operation and maintenance instructions and manuals for all equipment which includes maintenance and lubrication schedules;
- Pumping station commissioning report;
- Systematic lifecycle upgrade report (if applicable);
- Process Control Narrative;
- Electronic copies of PLC and Operator Interface Terminal (OIT) projects;
- Any original software and interface cables required for programmable equipment installed within the pumping station with the exception of PLC and OIT programming software, unless specified in the contract document;
- Detailed information on guarantees / warrantees for all equipment;
- Construction and post-construction color digital photos. Post-construction photos are to be taken at various angles showing the main features of the inside and outside of the pumping station. A plan index is to be provided showing location and angle of each photo in relation to the pumping station.

4.3.3 Force Main Design

4.3.3.1 Force Main Material

Pumping stations shall be provided with dual force mains, each capable of handling the peak design flow. Following is a list of the types of approved force main.

Fittings are to be wrapped with an approved anti-corrosion tape such as "Denso" or approved equal.

- PVC pipe and fittings, DR18 to CSA B137 as per Standard Specifications for Municipal Services.

Non PVC Fittings used with PVC pipe installations shall be wrapped with approved anti-corrosion tape such as “Denso” or approved equal.

All PVC pipe installations shall include the installation of an approved trace wire system for pipe locating purposes.

Notwithstanding the minimum class of pipe, the pipe shall be designed taking into account, pipe pressure, transient pressure, earth pressure, etc.

The Engineer may on development specific basis approve a thinner wall of the above pipe materials if the Design Engineer presents a comprehensive design, including a complete transient pressure analysis, which has a minimum factor of safety of 2.

The approved method of calculating hydraulic losses in the force main is the Hazen-Williams Formula. Variations in the roughness coefficient (C) through the life of the pipe shall be taken into account.

The Design Engineer shall assess the force main for possible damage from sulfide generation. In sections of the force main subject to sulfide generation (sections subject to wet and dry cycle), substitute cement mortar lined ductile iron pipe with “SewperCoat” lined ductile iron pipe or equivalent.

The force main shall be identified by placing an underground warning tape at the top of the first backfill layer above the pipe. The warning tape shall be 150 mm wide polyethylene tape with green background and black lettering. The message on the warning tape shall be "Caution, Sewer Line Buried".

4.3.3.2 Force Main Minimum Diameter

The minimum diameter of the force main is 100 mm.

4.3.3.3 Force Main Cover

.1 Minimum cover is 1.6 metres.

.2 Maximum cover is 2.4 metres.

The depth of cover is measured from the finished surface design grade over the pipe to the crown of the force main.

4.3.3.4 Force Main Location

Force mains shall not be located in a common trench with a Water System. Horizontal and vertical separations from Water Systems, etc. shall be as specified by NSE.

Force mains shall terminate in a well benched manhole such that the flow is directed down the barrel of the receiving gravity Wastewater System. The downstream pipe receiving flow from a force main must be of sufficient size and grade to prevent surcharging from the force main. The force main must be mechanically restrained to the manhole and where applicable mechanically restrained within the manhole to prevent movement.

4.3.3.5 Force Main Valves

Automatic air relief and vacuum valves, suitable for wastewater applications, shall be located in a manhole at high points of the force main or as dictated by the design. The manhole is to be drained to the Wastewater System. If the venting capacity of the valve exceeds that of the manhole cover vents, provide suitably sized vent pipe ending in an above ground goose-neck at the property line (refer to *HRWC Supplementary Standard Specification* for Standard Details).

Drain valves are to be installed at low points. In such instances the drain shall be either to a Wastewater System or to a chamber from which controlled pumping to a moveable storage tank can take place.

Valving shall be provided at the pump station to allow dual force main arrangements to operate independently.

Gate valves on a force main sewer shall close clockwise (right) and open counterclockwise (left). Anodes are to be installed on all valves located outside of a chamber or pumping station where Ductile Iron (DI) pipe is utilized. Anodes are not required if PVC pipe is utilized.

4.3.3.6 Force Main Bends and Deflections

Changes in direction, in excess of the allowable joint deflection, shall require a bend fitting. Thrust blocks shall be provided at changes of direction and shall be designed considering the operating pressure, surge pressure, peak flow velocity and in-situ material against which the thrust block bears.

Thrust blocks shall be constructed of "ready mix" concrete with a minimum 28 day compressive strength of 20 MPa. In the case of vertical bends, the thrust block shall be located below the fitting and shall be connected to the force main through the use of stainless steel tie rods securely embedded in the concrete. The Engineer may approve the use of restrained joints for its use in conjunction with a thrust block.

Refer to *HRWC Supplementary Standard Specification* for Standard Details on thrust restraint requirements.

5.0 STORMWATER SYSTEM – DESIGN REQUIREMENTS

5.1 SCOPE

A Stormwater System is a complete and properly functioning system of stormwater mains, service connections from the stormwater main to the street lines and appurtenances, including stormwater ponds. The design will ensure that HRWC Wastewater and Stormwater Services are not exposed to hazards when conducting operation and maintenance of the stormwater collection system.

All Stormwater Systems are to conform to any requirements established by NSE. Stormwater Systems cannot be constructed until the design has been approved by the Engineer.

Stormwater discharged into the Stormwater System must comply with *Halifax Regional Water Commission Act*, 2007, c. 55, s. 2; 2012, c. 60, s.1., HRWC Regulations and applicable bylaws.

For an extension to the Stormwater System, the Engineer will require the Applicant to enter into a HRWC Systems Agreement which defines the rights and obligations of HRWC and the Applicant regarding construction, inspection, record collection, acceptance and warranty of the new Stormwater System.

The design criteria contained herein are included to illustrate the more common aspects encountered in the design of Stormwater Systems. Any Stormwater System within the core boundary of Halifax Regional Municipality shall be designed to achieve the following objectives:

- prevent loss of life and to protect structures and property from damage due to a major storm event.
- provide safe and convenient use of streets, lot areas and other land during and following rain and snow melt events.
- adequately convey stormwater flow from upstream sources.
- mitigate the adverse effects of stormwater flow, such as flooding and erosion, on downstream properties.
- preserve natural water courses.
- minimize the long term effect of development on receiving watercourses.
- provide safe, accessible outlet.

Table 5.1 – Stormwater System Component Ownership

Component / Feature	Responsibility/ Owner
Municipal ditch (outside core area *)	NSTIR
Cross culverts (outside core area *)	NSTIR
Driveway culverts – across municipal ditch (outside core area *)	NSTIR
Municipal ditch (within core area *)	HRWC
Cross culverts (within core area *)	HRWC
Driveway culverts – across municipal ditch (within core area *)	HRWC
Driveway culverts (outside municipal right of way)	Property Owner
Rear yard swales	Property Owner
Side yard swales located in an HRWC easement (as part of overall municipal drainage system)	HRWC / Property Owner
Subsurface interceptor drains (within the municipal right of way)	Halifax Regional Municipality
Subsurface interceptor drains (outside municipal right of way)	Property Owner
Roadways	Halifax Regional Municipality
Curb and gutter	Halifax Regional Municipality
Municipal catch basins, ditch inlets/outlets	HRWC
Catch basins on private property (rear, side or front yard **)	HRWC / Property Owner
Manholes (part of municipal system only)	HRWC
Pipes (part of municipal system only)	HRWC
Stormwater management facilities	HRWC
Stormwater Service Connections (main to street line)	HRWC
Stormwater Service Connections (street line to building)	Property Owner
Watercourses / Wetlands (as defined by NSE)	NSE
Floodplains (as defined by NSE)	NSE
Ravines (as defined by NSE)	NSE

(* Refer to Halifax Regional Municipality core area boundary drawing in *HRWC Supplementary Standard Specification* for Standard Details)

(Rear, side or front yard catch basins are by variance only)**

All Stormwater Systems that discharge to a watercourse or wetland shall conform to any requirements established by NSE. No system shall be constructed until the design has been approved by the Engineer and by NSE.

5.2 HYDROLOGY

Hydrology is the estimation of runoff produced from rainfall and/or snowmelt, and understanding the factors which influence it, and hydraulics is the determination of water flow characteristics in the channels, pipes, streams, ponds, and rivers which convey stormwater.

The selection of the method best suited for a stormwater design requires a Design Engineer. For stormwater design work, hydrologic and hydraulic modelling is required for the design of piped stormwater drainage systems, overland stormwater drainage systems, and stormwater management facilities

5.2.1 Meteorological Data

Rainfall data is used in a variety of forms including intensity-duration-frequency curves, synthetic design storms, historical design storms, and historical long-term rainfall records. Stormwater System design is based on intensity-duration-frequency curves and synthetic rainfall hyetographs only.

Figure 5.1 contains rainfall intensity – duration – frequency curves which are based on annual rainfall at the Shearwater Airport weather station as administered by the Atmospheric Environment Service (AES) of Environment Canada.

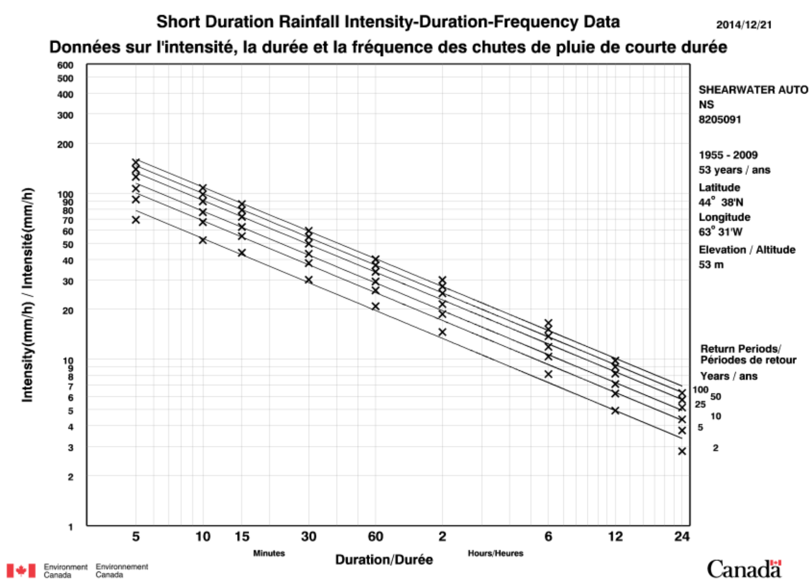

Figure 5.1 - Short Duration Rainfall Intensity-Duration Frequency Data

Storm	a	b	c
2YR	21.648	0.04959	0.578
5YR	26.893	0.03180	0.565
10YR	30.270	0.01905	0.553
25YR	34.711	0.01158	0.548
100YR	41.313	0.00590	0.544

$$i = \frac{a}{(T_d + b)^c}$$

5.2.2 Synthetic Design Storm

Advanced procedures for the design of storm drainage systems requires the input of rainfall hyetographs or unit hyetographs, which specify rainfall intensities for successive time increments during a storm event. For the purpose of design, the Engineer requires the uses the Modified Chicago Storm hyetographs derived from the rainfall intensity-duration-frequency (IFD) curves presented above. Figure 5.2 through Figure 5.6 present the 24 hours Modified Chicago Storm distribution for the 2, 5, 10, 25 and 100 year return periods.

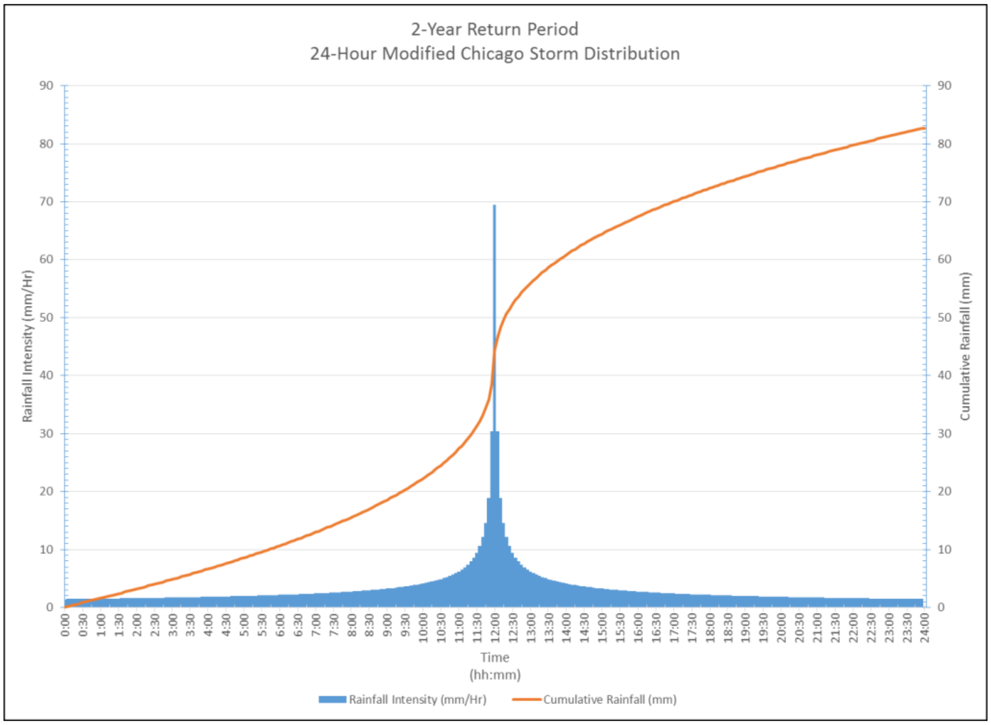

Figure 5.2 - 24 hours Modified Chicago Storm distribution for the 2 year return period

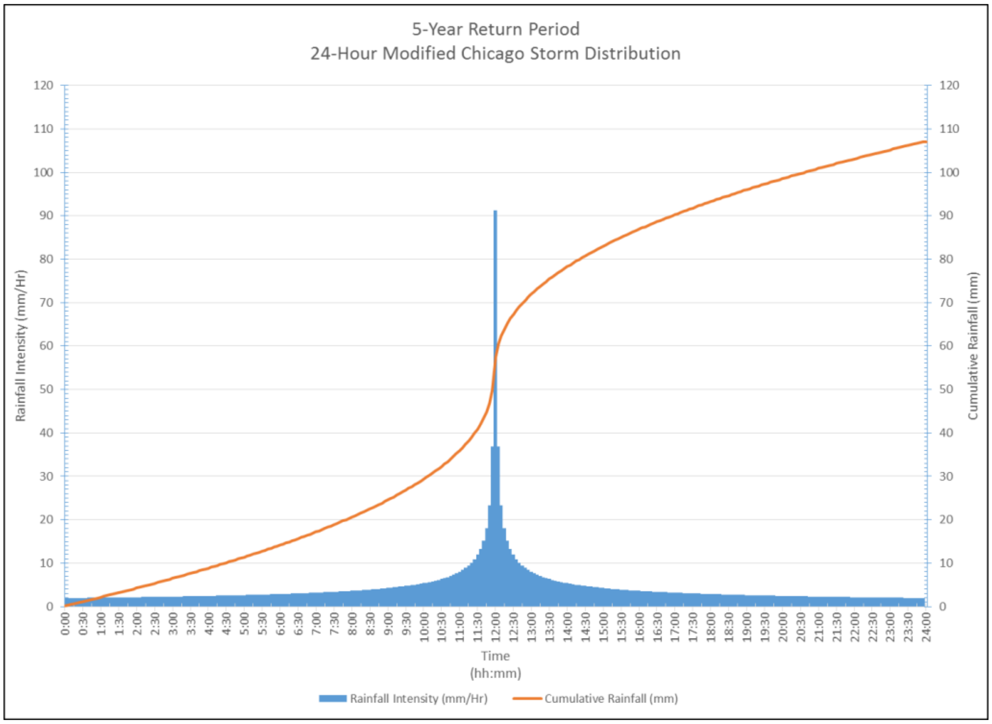

Figure 5.3 - 24 hours Modified Chicago Storm distribution for the 5 year return period

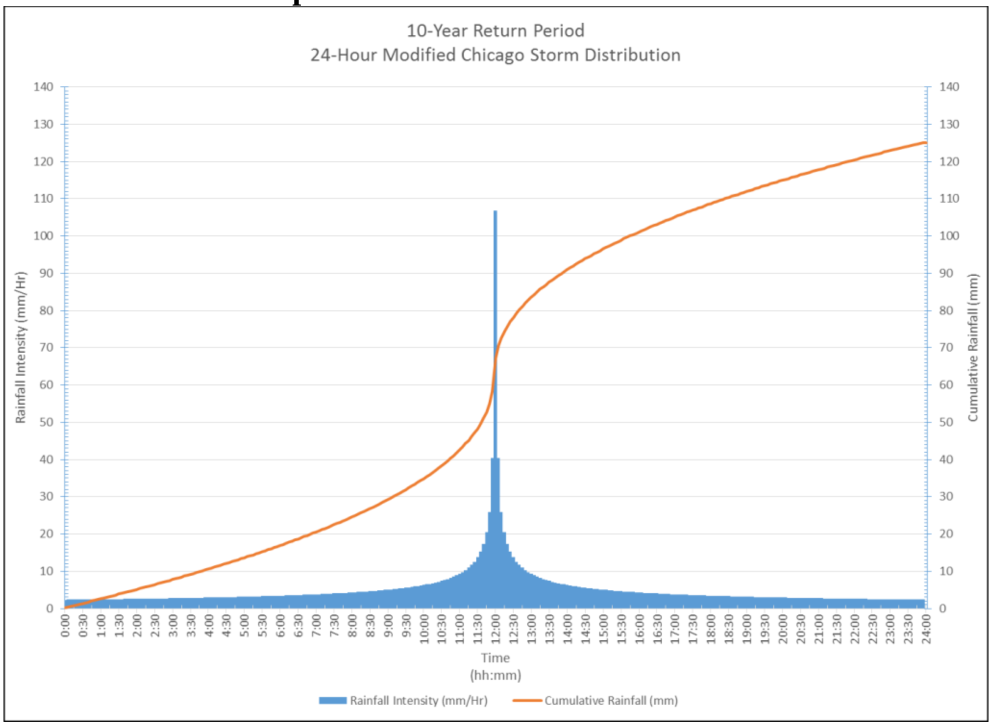

Figure 5.4 - 24 hours Modified Chicago Storm distribution for the 10 year return period

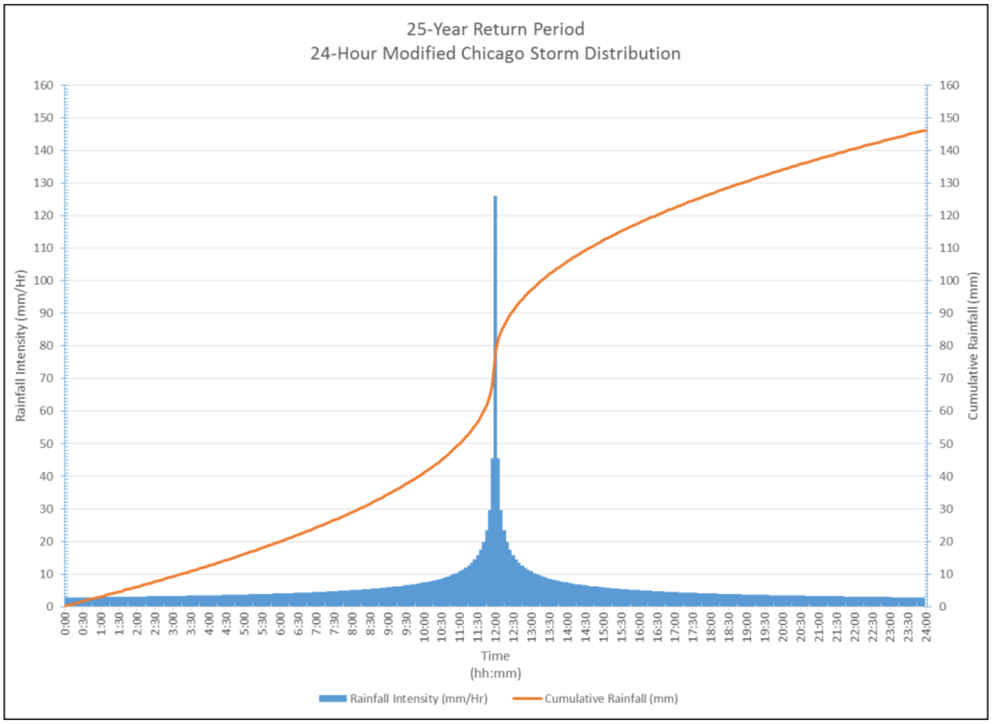

Figure 5.5 - 24 hours Modified Chicago Storm distribution for the 25 year return period

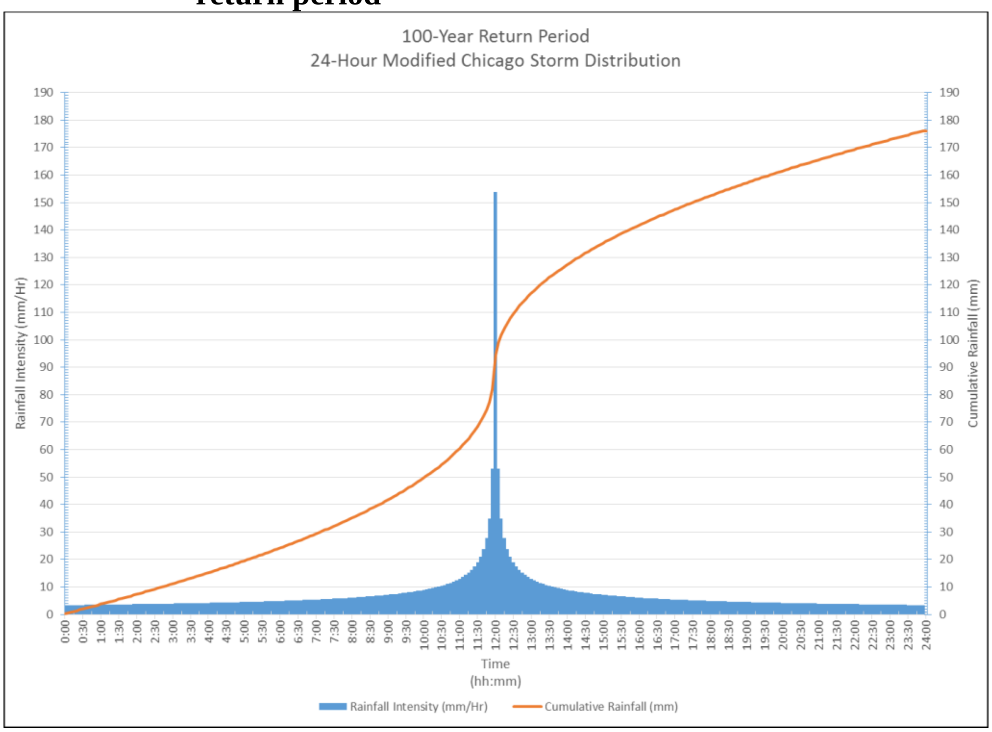

Figure 5.6 - 24 hours Modified Chicago Storm distribution for the 100 year return period

5.2.3 Runoff Methodology

The quantity and rate of flow of stormwater to the piped system is influenced by the characteristics of the surface on which the rain falls. There are numerous techniques and models available to the Design Engineer based on both empirical investigations and theoretical calculations. HRWC will accept only the following methods for applications:

- USDA Natural Resources Conservation Service (NRCS)
- Horton Method
- Green-Ampt Method

Depending on the methodology chosen by the Design Engineer, the following variables are to be reported in the Stormwater System design for each sub-area (pre-development and post-development)

5.2.3.1 USDA Natural Resources Conservation Service

Formerly known as the Soil Conservation Service (SCS), the USDA Natural Resources Conservation Service (NRCS) developed the runoff curve number to predict direct runoff and infiltration from rainfall. It is widely used and is an efficient method for determining the approximate amount of direct runoff from a rainfall event in a particular area.

The Stormwater System design plan must show the following:

- Ia/S - Initial Abstraction Ration (if different than 0.2)
- Antecedent Runoff Condition (Also referred to as Antecedent Moisture Condition)
- Area (Ha)
- CN – Curve Number
- Short Description of cover type/hydrologic condition
- Tc – Time of Concentration
- Peak Flow (L/s)

5.2.3.2 Horton Method

The Horton method utilizes an empirical formula which states infiltration begins at a constant rate and then decreases exponentially with time. When the soil saturation level reaches a certain value the rate of infiltration levels off.

The Stormwater System design plan must show the following:

- Area (Ha)
- Maximum Infiltration Rate (mm/hour)
- Minimum Infiltration Rate (mm/hour)
- Decay Constant (1/hour)
- Maximum Infiltration Volume (mm)
- Surface Depression Storage Depth (mm)
- n - Manning's Roughness Coefficient
- Peak Flow (L/s)

5.2.3.3 Green-Ampt Method

The Horton equation captures the basic behavior of infiltration but the physical interpretation of the exponential constant is uncertain. The Green-Ampt method is based on fundamental physics and is a function of the soil suction head, porosity, hydraulic conductivity and time.

The Stormwater System design plan must show the following:

- Area (Ha)
- Suction Head (mm)
- Conductivity (mm/hour)
- Initial Deficit
- Surface Depression Storage Depth (mm)
- n - Manning's Roughness Coefficient
- Peak Flow (L/s)

5.3 DOWNSTREAM EFFECTS

The downstream Stormwater System must have the capacity to convey discharge from its fully developed watershed. Upgrades may be required to the downstream Stormwater System to reduce adverse impacts.

Explicit consideration shall be given to public safety, NSE regulations, NSTIR regulations, nuisance, and maintenance implications of ditches, open channels, and drainage courses. Attempts shall be made to limit the number of partial enclosures of a ditch, open channel, or drainage course by driveways, roadways, and other crossings.

5.3.1 Stormwater Control Facilities

Investigation of requirements to mitigate the downstream effects of a proposed development shall be carried out to determine the requirements for and feasibility of the utilization of a storage facility for stormwater runoff control. If a determination is made that a storage facility is required, its design shall be carried out using appropriate methods and sound engineering principles. The design shall take into consideration various factors including, but not limited to, watercourse protection, erosion and sediment control, impact on adjacent property, maintenance requirements, public safety, access, liability, and nuisance.

Such storage facilities shall be designed to control the peak runoff conditions for multi-storm events up to the 100 year return period storm.

5.3.2 Stormwater System

No stormwater runoff is to be carried onto, thru, or over private property, within a subdivision, other than by a natural watercourse or Stormwater System. To guarantee access to the Stormwater System, a HRWC service easement agreement between the land owner and HRWC is necessary in the following cases:

- Stormwater Systems within the boundary of the subdivision.

- Where a need is identified by the Engineer and Halifax Regional Municipality to accommodate future upstream drainage, a HRWC service easement agreement is to be provided from the right-of-way boundary to the upstream limits of the subdivision.

- May be required for Stormwater Systems or designed overland flow routes adjacent to and immediately downstream of the subdivision.

- Natural watercourses are not to be carried in roadside ditches or minor storm drainage systems.

5.3.3 Discharge to Adjacent Properties

All stormwater drainage is to be self-contained within the subdivision limits, except for natural drainage associated with runoff from undeveloped areas. However, runoff from within the subdivision may be directed to a watercourse, or storm drainage system owned by HRWC, Halifax Regional Municipality or NSTIR.

In all cases, concentration and conveyance of stormwater to adjacent properties outside the subdivision limits is prohibited unless the Applicant obtains permission from the adjacent property owners, and unless private drainage or HRWC service easement are provided.

The subdivision grading along the limits of the subdivision is to avoid disturbance of adjacent properties or increase the discharge of stormwater to those properties.

The subdivision grading is to provide for drainage from adjacent properties where no other alternative exists, this may be achieved by utilizing an interceptor swale or other system components.

The subdivision grading is to provide for temporary drainage of all blocks of land within the subdivision that are intended for future development.

5.4 ANALYSIS OF EXISTING STORMWATER SYSTEM

In the absence of existing Master Planning, it may be necessary to analyze the capacity of existing Stormwater System. This may be required due to the fact that a proposed development may increase stormwater runoff to an existing system, and the existing system needs to be analyzed to confirm its capacity. It may also be necessary to analyze an existing Stormwater System due to complaints of flooding or problems within the system. Where an existing stormwater drainage system within the core boundary of Halifax Regional Municipality is to be analyzed, the Design Engineer is to submit the following.

5.4.1 Hydrologic Analysis

Where existing Stormwater Systems are being analyzed, it is crucial to determine the peak stormwater runoff to a given point in a system caused by severe rainfall events and snowmelt events. Where storage facilities are included in the study, it may be necessary to determine the hydrograph of the stormwater runoff to a particular point; that is, the simple instantaneous peak flow will not be adequate to analyze storage facilities. In determining the stormwater runoff or hydrographs, the methods as described herein are to be used.

In preparing the hydrologic and hydraulic model, it may be necessary to determine the drainage area to each individual storm manhole and each individual storm catch basin. This information should be compiled on a master drawing of the area being studied with appropriate labels for the areas, manholes, and catch basins such that calculations can be easily compared to the plan. For minor stormwater drainage systems (stormwater mains and catch basins), the 1:5 year return period storm shall be checked for the points of interest. For open channels, watercourses, and major drains on streets, the 1:100 year return period storm shall be checked for the points of interest.

5.4.2 Hydraulic Analysis

For each component of the existing Stormwater System such as a stormwater main, open channel, watercourse, or culvert, the hydraulic capacity of that portion of the system needs to be determined and compared to the flow determined from the hydrologic calculations. Follow these procedures in determining the hydraulic capacity of Stormwater Systems.

5.4.2.1 Open Ditches, Channels, and Watercourses

To determine the capacity of open channels, ditches, and watercourses, the Manning equation may be used where grades are relatively steep, greater than 1%. Where grades are less than 1%, it may be necessary to account for backwater effects using the energy equation and the direct-step or standard-step methodologies. Also to be considered in these calculations is the water surface elevation at the outlet of the ditch, watercourse, or channel.

5.4.2.2 Culverts

To calculate the hydraulic capacity of a culvert, the inlet capacity of the culvert and the outlet capacity should be checked taking into consideration maximum tailwater elevation at the outlet of the culvert. Also to be checked is the barrel capacity of the culverts using the Manning equation. In general, the inlet capacity of the culvert will be the limiting factor in determining the capacity.

5.4.2.3 Stormwater System

The piped Stormwater System consists of stormwater mains, manholes, catch basins, inlets and outlets. The capacity of a Stormwater System is to be checked as follows:

- Preliminary sizing of pipe diameter assuming full flow conditions for each pipe in the minor storm drainage system using the Manning equation for the 1:5 year return period storm. Manning's roughness coefficients (n) have been tabulated in Table 5.2. The ratio of the 1:5 year design flow (Q_5) to full flow pipe capacity (Q_{cap}) should not exceed 80%.

$$\frac{Q_5}{Q_{cap}} \leq 0.80$$

  where:

  Q_5 1:5 year design flow (L/s)
  Q_{cap} full flow pipe capacity (L/s))

- A determination of the hydraulic grade line for the 1:5 year return period storm should be conducted assuming the actual captured flow (Q_c) is 100% of the 1:5 year design flow (Q_5). Analysis should account for pipe friction losses, junction and bend losses, outlet tailwater elevation, and capacity constraints of the downstream system. Hydraulic grade line profiles may be determined by the standard-step method, the direct-step method, or acceptable energy equation principles. The hydraulic grade line profile should be plotted on the plan and profile drawing to ensure that the water surface profile is contained the pipe. An elevated hydraulic grade line may require a pipe diameter larger than that which is determined by the Manning equation in order to avoid surcharging of the minor storm sewer system.

- A determination of the hydraulic grade line for the 1:100 year return period should be conducted assuming the actual captured flow (Q_c) is some percentage of the 1:100 year design flow (Q_{100}). The actual captured flow should be the lesser of the maximum catch basin inlet capacity, the maximum catch basin lead capacity, or the 1:100 year design flow (Q_{100}). Analysis should account for pipe friction losses, junction and bend losses, outlet tailwater elevation, and capacity constraints of the downstream system. Hydraulic grade line profiles may be determined by the standard-step method, the direct-step method, or acceptable energy equation principles. The hydraulic grade line profile should be plotted on the plan and profile drawing to ensure that the water surface profile is at an acceptable level. The elevated hydraulic grade line profile should not threaten back-up into service laterals, or basements.

5.5 STORMWATER SYSTEM DESIGN

A Stormwater System design is to be prepared and included as part of the submission for any proposed Stormwater System extension. At a minimum the Stormwater System design must contain the design criteria for the 1:5, 1:10, 1:25, 1:50 and 1:100 year events. The stormwater design is also to address watercourse protection, erosion and sediment control, impact on adjacent property, maintenance requirements, public safety, access, liability and nuisance.

Pre-development lands have a combination of natural stormwater infiltration and overland stormwater flow. NSE requires proposed publically owned development submissions to balance pre-development and post-development stormwater runoff, within ± 10%, except where there is a pre-existing flooding condition, in which case the post-development flow cannot exceed the pre-development flow. The method of balancing is left up to the Design Engineer, these may include, but not limited to stormwater ponds and artificial wetlands. Balancing of all stormwater flows up to, and including the 1:100 year storm is required.

The detailed design submission is to include a stormwater drainage plan which will include pre-development runoff calculations and post-development runoff calculations. Make effort to contain this information on a single sheet.

The stormwater drainage plan will show the key runoff variable described in section 5.2.3 for each sub-watersheds for pre-development and post-development. The plan will also show all stormwater management alternatives; and output information demonstrating the main steps of the calculations and the peak discharge at key points in the system. Peak flow must be shown at the points of discharge from the proposed development. The flow route of the major drainage path shall be indicated.

The Stormwater System design must show:

- the location of the proposed development within the topographic drainage area,
- the drainage area tributary to the proposed and existing storm drainage system(s)
- the boundaries of all drainage sub-areas,
- contours at intervals not exceeding 2.0 m,
- site layout including proposed streets and lots,
- locations of proposed storm drainage system(s) and stormwater management facilities,
- location of outfalls or connections into existing services,
- hydrologic and hydraulic data tables and any other information required by the Engineer.

5.5.1 Minor Stormwater System

The minor Stormwater System consists of lot grading, ditches, swales, roof leaders, foundation drains, Stormwater Service Connections, curbs & gutters, mains, catch basins and culverts. The piped Stormwater System is designed to convey the 1:5 year storm without surcharge. The 1:10 year storm is conveyed within the curb & gutter and cross culverts of the Halifax Regional Municipality street system unless otherwise approved by the Engineer and Halifax Regional Municipality.

5.5.1.1 Minor System Design

The capacity of a proposed Stormwater System or an existing Stormwater System shall be confirmed by accounting for the head loss through the pipe system and through any junctions including manholes and bends. The Manning's Equation may be utilized to calculate the capacity of the piped Stormwater System. A detailed analysis of the Stormwater System as a whole will be required. This analysis will determine the hydraulic grade line when the Stormwater System is conveying the 1:5 year flows, and will take into account losses at manholes and other junctions, the head loss through the pipes, and any backwater conditions at the outlet of the Stormwater System.

The Design Engineer is required to calculate the inlet capacity at each entry point to the Stormwater System.

5.5.1.2 Minimum Velocity

Under peak design flow conditions from the tributary area, when fully developed, stormwater flow velocities must be a minimum of 0.75 m/s.

5.5.1.3 Maximum Velocity

Under peak design flow conditions from the tributary area, when fully developed, stormwater flow velocities must be a maximum of 7.5 m/s.

5.5.1.4 Stormwater Main Material & Fittings

.1 Reinforced concrete pipe meeting the requirements of the latest CSA Standard A257.2 or ASTM Standard C76.

.2 PSM Polyvinyl Chloride pipe and fittings meeting the requirements of the latest CAN /CSA B1800.

.3 Profile Polyvinyl Chloride pipe and fittings meeting the requirements of the latest CAN /CSA B1800.

.4 Profile High Density Polyethylene (HDPE) pipe and fittings (up to 900 mm) meeting the requirements of the latest CAN /CSA B1800, with a minimum pipe stiffness of 320 KPa (46 Psi) and Type 1 (Water-tight) joints with integrated bells/welded joints.

.5 Profile Polypropylene (PP) pipe and fittings, corrugated dual-wall (300 - 750 mm) and corrugated triple wall (750 – 1500 mm) meeting the requirements of the latest CSA Standard B1800.

Pipe gaskets are to be utilized for all stormwater main installations.

5.5.1.5 Stormwater Main Friction Factors

.1 The following are Manning Roughness Coefficients:

Table 5.2 - Manning Roughness Coefficients

PIPE MATERIAL	MANNING ROUGHNESS
Concrete	0.013
PVC	0.010
Polypropylene	0.012
HDPE (Smooth Interior Wall)	0.012

5.5.1.6 Minimum Diameter

.1 Stormwater main – minimum diameter is 300 mm
.2 Catch basin lead – minimum diameter is 200 mm
.3 Cross culvert – minimum diameter is 525 mm
.4 Driveway culvert – minimum diameter is 450 mm
.5 Inlet to a stormwater structure – minimum diameter is 450 mm

5.5.1.7 Changes in Diameter

Stormwater main diameter must not decrease in the downstream direction. The exception is an intake pipe being oversized to overcome the effects of inlet control and then, only if the mainline to which the inlet is connected is greater than 600 mm diameter. Manholes are to be provided where the stormwater main diameter changes.

5.5.1.8 Minimum Slope

.1 Stormwater main – minimum slope is 0.4%
.2 Stormwater main dead-end – minimum slope is 0.6%
.3 Catch basin lead – minimum slope is 1.0%
.4 Ditch or open channel – minimum slope is 2.0%

Under special conditions, if full and justifiable reasons are given, slopes less than 0.4% and 0.6% may be permitted provided that self-cleansing velocities under full flow conditions are maintained.

5.5.1.9 Minimum Depth

.1 Stormwater main – minimum depth is 1.6 metres
.2 Cross culvert – minimum depth is 0.5 metres

Measure the depth of cover from the finished surface to the top of the pipe.

However, in order to service full residential basements, the depth of stormwater main must be adequate to service the dwelling by gravity and maintain a Stormwater Service Connection minimum cover of 1.2 metres.

5.5.1.10 Maximum Depth

The depth of stormwater mains, from the finished surface to the top of the pipe must not exceed 5.0 metres. However, under special conditions, if full and justifiable reasons are given, the maximum depth of stormwater mains may be increased such that the depth to the crown of the pipe at any manhole location shall not exceed 8.0 metres.

5.5.1.11 Stormwater Main Location

All Stormwater Systems are to be located within the Halifax Regional Municipality street right-of-way. Stormwater Systems on private property will be considered at time of design review, and will require an easement agreement jointly signed by the land owner and the Halifax Water Board. All stormwater drainage outfalls are to be located within an easement agreement in favour of the Halifax Regional Water Commission.

HRWC service easement shall be of sufficient width to allow safe excavation of the HRWC Systems in accordance with the requirements Occupational Health and Safety Act of Nova Scotia. Depending upon the length and location of the service easement, the Engineer may require a travel way to be provided within the HRWC service easement for access and maintenance purposes.

Where Master Planning indicates a need to accommodate future upstream lands naturally tributary to the drainage area, a service easement is to be provided from the edge of the street right-of-way to the upstream limit of the subdivision.

Refer to Section 6.0 for HRWC easement requirements.

5.5.1.12 Stormwater Manhole

Provide a stormwater manhole where:

.1 A Stormwater System begins in a street right-of-way.

.2 There is a change in horizontal or vertical alignment.

.3 There is a change in diameter.

.4 There is a change in stormwater main material.

.5 Where a catch basin is to be connected to the Stormwater System.

.6 Where two stormwater mains come together.

Where a stormwater main diameter is less than 1500 mm, manhole spacing shall not exceed 100 metres. Where a storm sewer main diameter is equal to or greater than 1500 mm, manhole spacing will be determined in consultation with the Engineer.

The following criteria shall be used for pipe elevation and alignment in stormwater manholes to account for energy losses through the manhole:

.1 An invert drop equal to the difference in pipe diameter shall be provided unless a different drop is determined by appropriate calculations.

.2 The obvert of a downstream pipe shall not be higher than the obvert of an upstream pipe.

.3 An internal drop manhole shall be constructed where the vertical drop between pipe inverts in the manhole exceeds 1.0 metre.

.4 The Design Engineer is to take into consideration energy losses at manholes during peak flow conditions to ensure that surcharging of the system does not occur.

.5 The minimum internal diameter of a manhole shall be 1050 mm. The internal diameter is required to accommodate all pipe and appurtenances in accordance with manufacturer's installation recommendations. Manhole ladders are not permitted.

5.5.1.13 Stormwater Catch Basin

The following are the requirements for stormwater catch basins:

.1 The capping ring of a catch basin shall be CPC 175 and the frame and grating IMP S-361 (or S-441/411 if mountable curb and gutter approved). Catch basins shall be ASTM C-478 precast concrete complete with “A-LOK” or O- ring gaskets for catch basin leads, 1050 mm diameter with a 450 mm sump. Final grade adjustments shall be in accordance with that for manholes.

.2 Catch basins shall be located in the gutter line of the street with the front edge of the capping ring opening a minimum of 350 mm and a maximum of 500 mm from the face of the curb.

.3 Up to two (2) catch basins can be connected in series, provided, that the downstream (second) catch basin is connected to a manhole.

.4 Catch basins spacing shall minimize ice accumulation and ponding on the street and prevent water from flowing in the travel lanes during the minor system but shall not exceed 120 metres.

.5 Area catch basins with pyramid grates shall be installed in off street locations where concentrated flow would otherwise cross a sidewalk or walkway or to collect rear lot drainage from private or publically owned swales.

.6 Catch basins or double catch basins are required at the uphill radius point of curb returns on intersections.

.7 The interception capacity of the catch basins shall be compatible with the capacity of the Stormwater System. The stormwater management report shall illustrate the hydraulic grade line produced during the minor and major storm events.

.8 In areas where there is a potential for contamination of stormwater (e.g. near service stations) the Engineer may require inverted siphons in catch basins or other specialized catch basins (e.g. “Stormceptor CDS Units”).

5.5.1.14 Stormwater Catch Basins Lead

The following are the requirements for catch basin leads:

.1 Be 200 mm diameter or larger manufactured from concrete or PVC DR35.

.2 Be connected to manholes and catch basins using “A-LOK” or O-ring gaskets. (For connection to an existing manhole, use “Kor-N-Seal” or “INSERTA TEE” fittings.).

.3 Have a minimum cover of 1.3 metres at construction completion.

.4 Have a minimum slope of 1%.

.5 Be included in the CCTV report.

.6 Be connected to the manhole with an invert no higher than the obvert of the outgoing pipe or 1.0 metre above the invert of the outgoing pipe whichever is higher.

.7 Shall protrude not more than 75 mm into the catch basin or manhole

.8 Incorporate a flexible joint within 450 mm of the O.D of the manhole.

5.5.1.15 Groundwater Migration

The Design Engineer shall assess the possibility of groundwater migration through mains, service connections, and service connection trenches resulting from the use of pervious bedding material. Corrective measures, including provision of impermeable collars or plugs, to reduce the potential for basement flooding resulting from groundwater migration should be employed.

5.5.2 Minor Stormwater System Connection

5.5.2.1 Stormwater Service Connection

The following are the requirements for Stormwater Service Connections:

.1 Every building is required to be connected separately to the mains from any other building, except that an ancillary building on the same property may be serviced by the same Stormwater Service Connection (National Plumbing Code of Canada).

.2 Semi-detached are permitted to share foundation drains.

.3 A single Stormwater Service Connection to each lot is required when extending HRWC Systems. Extend the Wastewater Service Connection at least 1.5 metres inside the property line. Cap the bell end of the Stormwater Service Connection with a PVC cap.

.4 Break the rock 3.0 metres beyond the plugged end of the Stormwater Service Connections.

.5 Stormwater Service Connection 200 mm or smaller are to connect to the wastewater main utilizing a factory tee or wye fittings. Saddle Connections utilizing flexible rubber connectors may also be used. Utilize vertical long radius bend of 45° at the stormwater main.

.6 Stormwater Service Connection 250 mm or greater connect to the stormwater main utilizing a precast wastewater manhole.

.7 One horizontal, long radius 22½° bend is permitted along the length of a Stormwater Service Connection. If more than one bend or a bend greater than 22½° is required, an access type structure is to be installed at each additional bend.

.8 Stormwater Service Connections smaller than 200 mm and an overall length greater than 25 metres require an access type structure every 25 metres. Place a 300 mm x 300 mm x 6 mm steel plate above the structure 150 mm below the ground surface to allow for detection by a metal detector.

.9 Stormwater Service Connections 200 mm or greater require manholes for changes in direction and maximum spacing of 100 metres.

.10 Stormwater Service Connections are not permitted to decrease in size from the building connection to the main.

.11 Minimum 2% grade.

.12 Maximum 8% grade.

.13 Minimum 1.2 metres cover.

.14 Minimum 300 mm horizontal and vertical separation distance from a Water Service Connection.

.15 Minimum 450 mm vertical separation when crossing below a Water Service Connection.

.16 Minimum 3.0 metre horizontal separation from an outdoor fuel tank and septic tank.

.17 Minimum 2.0 metre horizontal separation from gas lines, underground electrical / telephone conduit, steam or hot water piping, transformer pads, utility poles or other utilities.

5.5.2.2 Stormwater Service Connection Residential

In addition to the general requirements, Stormwater Service Connection Residential requires the following:

.1 Minimum 100 mm diameter.

.2 Stormwater Service Connections PVC DR28 (green).

.3 Locate the public portion of Stormwater Service Connections 1.5 metres from driveways.

5.5.2.3 Stormwater Service Connection Multi-Unit & ICI

In addition to the general requirements, Stormwater Service Connection Multi-Unit & ICI requires the following:

.1 Minimum 150 mm diameter

.2 Grade less than 2% permitted under the stamp of the Design Engineer.

.3 Stormwater Service Connections PVC DR35 (green).

.4 Locate the public portion of Stormwater Service Connections 1.5 metres from driveways, if possible.

.5 A Monitoring Access Point stormwater manhole is required and is to be located on private property, adjacent to the right-of-way.

.6 These developments are required to manage stormwater on site in order to balance the pre-development and post-development to the Stormwater System. The minor storm event shall be balanced for connections to the Stormwater System (piped and/or ditches). The retention must consider the major overland flow route and the major storm shall be detained.

5.5.2.4 Stormwater Service Connection Abandonment

Stormwater Service Connections are required to be abandoned at the stormwater main for all Halifax Regional Municipality Demolition Permits. The method for abandonment is dependent on the site conditions specific to the Stormwater Service Connection in question. HRWC Wastewater Services will dictate the abandonment method to be used.

5.5.2.5 Stormwater Service Connection Reutilization

An existing Stormwater Service Connection may be reused subject to all of the following conditions being met:

.1 The proposed land use and building size is known.

.2 The Stormwater Service Connection is of adequate size and meets current pipe material specifications.

.3 A Closed Circuit Television video is to be provided to HRWC Engineering Approvals confirming the Stormwater Service Connection condition warrants reuse.

5.5.2.6 Foundation Drains

Foundation drains shall be connected by gravity to the piped Stormwater System. Foundation drains are not permitted to connect to a catch basin. Relative elevations of the Stormwater System main and foundation drains shall be such that foundation drains are above the hydraulic grade line of the major storm.

Where the piped Stormwater System discharges into a watercourse, ditch or drainage corridor, foundation drains connected to this piped Stormwater System shall be above the major storm flood elevation at the point of discharge.

Foundation drains where directed to an HRWC Ditch system shall be designed to be above the minor storm elevation unless the ditch functions as the major overland storm route. Foundation drains are not permitted to make a direct connection to an HRWC Ditch system and must be terminated at the property line. Discharge to the ditch system shall be achieved using clear stone or rock drain.

Where a minor storm drainage system does not exist, other options are permitted as specified in the National Building Code.

5.5.2.7 Roof Drains

Residential

Roof drains are not permitted to be connected to Stormwater System mains and shall be managed onsite. Appropriate lot grading measures shall be provided as per Halifax Regional Municipality requirements.

Multi-Unit, Industrial, Commercial & Institutional

Roof drains may be connected to the internal private stormwater arrangement, provided that the rainwater flows are incorporated into the pre-development and post-development flows for this site.

5.5.3 Major Stormwater System

5.5.3.1 Minor Storms

The minor system consists of lot grading, ditches, swales, roof leaders, foundation drains, curb & gutters and the Stormwater System. The piped Stormwater System is designed to convey the 1:5 year storm without surcharge. The depth of flow in gutter cannot exceed 50 mm in the minor storm.

The 1:10 year storm is to be conveyed within the curb & gutter and cross culverts of the Halifax Regional Municipality street system unless otherwise approved by the Engineer and Halifax Regional Municipality.

5.5.3.2 Major Storms

For curb & gutter applications, storm drainage design shall provide that the depth and spread of flow in a 1:10 year storm shall be contained within the right-of-way.

For mountable-type curb applications, the area located directly behind the curb must be graded in order channel the flow and prevent discharge from the right-of-way except within an HRWC service easement designed to convey the overland flow.

All low points in the roadway profile must be designed to collect and convey stormwater runoff off the roadway via a HRWC service easement designed to convey the overland flow.

Provision shall be made to remove runoff into drainage channels, watercourses, and pipe systems at low points and at intervals that will assure that this criteria is observed.

5.5.3.3 Ditches and Open Channels

Roadway ditches, where curb and gutter systems are not required, shall be designed to conform to the typical cross section for rural roads as prescribed by the Municipal Design Guidelines by Halifax Regional Municipality. Ditches shall be designed with adequate capacity to carry the flow expected from the 1:100 year return period storm.

5.5.3.4 Maximum Velocity

To prevent erosion, maximum velocities in a 1:100 year return period storm in ditches or open channels that convey stormwater runoff shall not exceed values set forth in Table 5.3 unless the channel is lined or acceptable energy dissipation facilities are provided.

Table 5.3 presents maximum permissible mean channel velocities for swales, ditches, open channels, and drainage courses.

Table 5.3 – Maximum Permissible Mean Channel Velocity

Channel Material	Maximum Permissible Mean Channel Velocity (m/s)
Fine Sand	0.45
Coarse Sand	0.75
Fine Gravel	1.85
Earth – Sandy Silt	0.60
Earth – Silty Clay	1.05
Earth – Clay	1.20
Bermuda Grass Lined – Earth – Sandy Silt	1.85
Bermuda Grass Lined – Earth – Silty Clay	2.45
Kentucky Blue Grass Lined – Earth – Sandy Silt	1.50
Kentucky Blue Grass Lined – Earth – Silty Clay	2.15
Sedimentary Bedrock – Poor	3.05
Sedimentary Bedrock – Sandstone	2.45
Sedimentary Bedrock – Shale	1.05
Igneous Bedrock	6.10
Metamorphic Bedrock	6.10

5.5.4 Culvert

5.5.4.1 Minimum Diameter

.1 Driveway culvert – minimum 450 mm, nor smaller than the upstream driveway culvert.

.2 Cross culvert – minimum 525 mm, minimum 500 mm cover.

.3 The stormwater system servicing plan submitted to the Engineer in support of system extension projects are to include a driveway culvert table and a cross culvert table indicting pipe size and material.

5.5.4.2 Minimum Depth

Minimum cover for culverts under roadways is 500 mm.

5.5.4.3 Maximum Depth

The Design Engineer may be required to submit pipe strength calculations including earth loading, line loading, and induced loading, accounting for site conditions and construction practices.

5.5.4.4 Hydraulic Capacity

Culverts are to be sized to convey instantaneous peak flows with a headwater depth to culvert diameter ratio of 1.0 accounting for both inlet control and outlet control.

Culverts located under driveways and roadways are to be designed to accommodate the 1:10 year return period storm, unless otherwise directed by the Engineer.

Culverts located in drainage courses or natural watercourses are to be designed to accommodate the 1:100 year return period storm, unless otherwise directed by the Engineer.

5.5.4.5 Maximum Headwater Depth

Maximum headwater elevation for both inlet control and outlet control should be checked relative to adjacent ground surface and adjacent structures for compatibility. The Design Engineer may reduce maximum headwater elevations for culverts under inlet control by improving inlet hydraulics. Table 5.4 present entrance loss coefficients for reinforced concrete pipe.

The values presented in Table 5.4 should be used for the determination of required headwater from the energy equation, or a nomograph solution of the energy equation.

Table 5.4 - Entrance Loss Coefficients for Reinforced Concrete Pipe Culverts Under Inlet Control

Inlet Geometry	Inlet Type	Entrance Loss Coefficient (k_e)
Projecting from fill (bell end)	1a	0.2
Projecting from fill (square cut end)	1b	0.5
Mitered to conform to slope	2	0.7
Headwall or headwall and wing walls (bell end)	3a	0.2
Headwall or headwall and wing walls (square cut end)	3b	0.5
Flared inlet conforming to slope	4	0.5
Headwall or headwall and wing walls (rounded edge)	5	0.1
Beveled ring	6	0.25

5.5.4.6 Inlet & Outlet

The design must address hydraulic criteria, energy dissipation, head losses, embankment stability, erosion, public safety, appearance and the effect of the grating (if required) has on restricting the stormwater flow into the pipe.

Inlet and outlet control methods shall be utilized in determining the hydraulic capacity of culverts in conjunction with the Manning's Formula. Pipe shall be designed to carry peak design flow with a head-water depth not greater than the diameter of the pipe. At pipe inlets, upstream water levels of the major storm shall be shown on the drainage plan in relation to expected elevations of structures and the ground surface at the boundary of the inundation. Buildings should not be located within the area of inundation. Final plans of development shall show watercourses, wetlands and any areas subject to flooding resulting from the proposed development.

Inlet & Outlet Pipe 300 mm to 1500 mm

- precast concrete headwall, wing walls and apron
- Grates are required on inlets of culverts or piped systems greater than 30 metres in length and great than 425 mm in diameter.
- The inlet grate shall have a minimum area 6 times the inlet pipe area (this does not negate the Design Engineer's responsibility to investigate the possibility that a ratio higher than 6 may be required).
- Inlet grates shall be constructed of vertically oriented bars.
- Grates are not required on outlets
- Inlet and outlet pipes shall extend at least 600 mm beyond the toe of slope of the road embankment unless an intake/outlet structure is provided. The inlet and outlet of pipes shall be located inside the street right-of-way with the right-of-way jogged if necessary. In certain locations, the pipe inlet and outlet may be required to be extended to the backs of adjacent lots with the surrounding area being infill and an easement provided to HRWC.

Inlet & Outlet Pipe greater than 1500 mm

- precast concrete headwall, wing walls and apron
- The inlet structure shall include a debris rack/risers and placement of rip rap for scour protection upstream of the concrete apron. The debris rack/risers can be constructed of concrete or galvanized steel.
- Handrail on the headwall shall be constructed in two separate, hinged sections.
- Grates are required on inlets of culverts or piped systems greater than 30 metres in length and great than 425 mm in diameter.
- The inlet grate shall have a minimum area 6 times the inlet pipe area (this does not negate the Design Engineer's responsibility to investigate the possibility that a ratio higher than 6 may be required).
- Inlet grates shall be constructed of vertically oriented bars.
- Fixed (non-hinged, non-removable) steel grating system designed for anticipated dead and live loads. The maximum slope on the grate shall be 45°.
- The grate system shall be constructed with a lockable personnel door for access to the inlet pipe. The door shall have the same design as the surrounding grate.
- Grates are not required on outlets

- Inlet and outlet pipes shall extend at least 600 mm beyond the toe of slope of the road embankment unless an intake/outlet structure is provided. The inlet and outlet of pipes shall be located inside the street right-of-way with the right-of-way jogged if necessary. In certain locations, the pipe inlet and outlet may be required to be extended to the backs of adjacent lots with the surrounding area being infill and an easement provided to HRWC.

5.5.4.7 Outlet Velocity

The maximum culvert outlet velocity is 4.0 m/s. A rip rap splash pad and apron must be designed to transition the culvert outlet velocity to the mean downstream channel velocity. Rip rap should be sized in accordance with the following equation.

$$D_{mean} = 0.019 * V^2$$

where:

D_{mean} is the diameter of rip rap (m)

V is the culvert outlet velocity (m/s)

Culvert outlet velocities must not exceed the maximum permissible mean channel velocities for a given channel material as presented in Table 5.3

5.5.4.8 Culvert Material

.1 Reinforced concrete pipe meeting the requirements of the latest CSA Standard A257.2 or ASTM Standard C76.

.2 Profile High Density Polyethylene (HDPE) pipe and fittings (up to 900 mm) meeting the requirements of the latest CAN /CSA B1800, with a minimum pipe stiffness of 320 KPa (46 Psi) and Type 1 (Water-tight) joints with integrated bells/welded joints.

.3 Profile Polypropylene (PP) pipe and fittings, corrugated dual-wall (300 - 750 mm) and corrugated triple wall (750 – 1500 mm) meeting the requirements of the latest CSA Standard B1800.

Pipe gaskets are to be utilized for all culvert installations.

5.6 EROSION AND SEDIMENT CONTROL

Stormwater management systems shall be an integral part of overall site design and development. The Design Engineer is to submit an erosion and sediment control plan in conformity with all applicable municipal and provincial regulations and guidelines. The plan shall include both short-term measures applicable during construction and long-term measures after completion of development.

Site design shall make optimum use of existing topography and vegetation and minimize cut and fill operations. During construction, site design shall prevent/ minimize surface water flows across or from the construction site. Development of the site shall be based on exposing a minimum area of the site for the minimum time.

The control plan shall include, to a minimum, the following:

- Interception & diversion ditches to direct clear water around the construction site.
- Stable diversion berms.
- Sediment traps.
- Covering or seeding of topsoil or other soil stockpiles.
- Isolated stripping of land being developed.
- Vegetation screens or buffers.
- Filter bags in catch basins (during construction only).
- Settling ponds.

Long-term environmental protection measures shall include designs to minimize erosion and sediment flow, protect outfall areas, minimize disruption of natural watercourses, utilize wetlands for natural filtration, and provide for ground water recharge when possible.

Protection methods shall be based on but not limited to the Province of Nova Scotia’s *Erosion and Sediment Control Handbook for Construction Sites*.

5.7 STORMWATER MANAGEMENT FACILITES

Stormwater management facilities (including all ponds, drainage channels forming part of the overland flow system, outfalls, etc.) shall be located on separate parcels within the plan of subdivision and shall be conveyed to HRWC as part of the subdivision acceptance process. The Engineer may consider easements under special circumstances, at the discretion of the Engineer.

The required storage volume for stormwater quantity control will be based on maintaining peak post-development runoff rates to peak pre-development runoff rates for the 1:2, 1:5, 1:10 and 1:100 year storm events. Simulation software shall be used to quantify pre- and post-development runoff rates and the necessary storage volumes. A range of design storms shall be analyzed to confirm system operation over a range of flows.

5.7.1 Design Submission

Stormwater management facilities report shall be submitted with the stormwater and subdivision design package. The report shall include:

.1 Design calculations for both quantity and quality control including runoff rates and storage volumes.
.2 Proposed landscaping plan.
.3 Erosion and sedimentation control (both during and after construction).
.4 Drawings of the stormwater management facilities.

As an alternative to constructing stormwater management ponds, the Engineer may consider the use of alternate measures, such as oversized inline pipe storage. The Design Engineer shall submit all relevant information and supporting documentation to the Engineer in order to allow a thorough review of the proposed design. Any proposed design shall take into account operational and maintenance requirements of the system, life cycle costs and impacts on the surrounding areas.

5.7.2 Stormwater Management Ponds

5.7.2.1 Location

Stormwater management facilities shall be sited with consideration of the following factors:

- Topography.
- Soil type.
- Depth to bedrock.
- Depth to seasonally high water table.
- Drainage area.
- Location outside of floodplain and above the 100 year elevation.
- Off-line from the natural watercourse.
- Minimizes risk to the public and adjacent properties.
- Should complement the proposed or existing land uses.

5.7.2.2 Dry Ponds

Properly constructed and maintained wet ponds provide the additional befit of stormwater treatment and improved stormwater quality over that of a dry pond. However, current restrictions governing the maintenance of wet ponds limit their acceptance by the Engineer for stormwater management ponds that are to be owned and operated by HRWC.

In cases where stormwater management ponds are to be owned and operated by private owners, wet ponds will be considered on a case-by-case basis.

5.7.2.3 Design Volume

Stormwater management ponds are to be sized in order to provide adequate storage volume necessary to limit post-development peak discharge rates to pre-development peak discharge rates for the 2, 5, 10, 25, 50 and 100 design storm events.

An additional volume allowance must be made so that a 300 mm freeboard is available for the 100 design storm event.

5.7.2.4 Inlet & Outlet

Inlets and outlets are to following the same requirements as those listed in the Culverts section of this Specification.

Energy dissipation measures should be employed to reduce velocities through the pond and reduce the likelihood or re-suspending settled solids.

5.7.2.5 Flow Control Structures

Typical flow control structures include large diameter manholes with a concrete bulkhead separating the inlet and outlet sides of the structure. A series if circular orifices and weirs are arranged in the bulkhead to restrict peak discharge rates to pre-development levels.

An access manhole frame and cover or an access hatch must be provided on both the inlet and the outlet sides of the flow control structure in order to facilitate inspection and maintenance.

5.7.2.6 Low Flow Channel

Low flow channels serve two purposes. Firstly, a low flow channel prevents erosion as runoff enters the stormwater management ponds during a storm event. Secondly, a low flow channel conveys the last remaining runoff to the outlet control structure ensuring that the pond dries completely.

Stormwater management ponds must provide a low flow channel from the inlet structure to the flow control structure, or the outlet structure. Low flow channels may consist of a concrete channel, half-pipe, or perforated pipe within a granular drain.

5.7.2.7 Emergency Spillway

Stormwater management ponds must have an emergency spillway to manage excess flows that may exceed the 1:100 design storm event, or manage overflows in the event that the outlet structure fails.

The emergency spillway elevation should be set at 300 mm above the 1:100 flood elevation in order the meet minimum freeboard requirements.

The emergency spillway must be integrated into the major drain system so that nor property damage results from an overflow event.

5.7.2.8 Drawdown Time

Stormwater management ponds should empty within 48 hours of the design storm event to avoid creating vector breeding habitat.

5.7.2.9 Maximum Side Slope

Stormwater management ponds must be constructed with maximum side slope of 4:1 (H:V). Side slopes of 5:1 (H:V) are preferred where condition permit.

5.7.2.10 Minimum Floor Slope

Stormwater management ponds must be constructed with minimum floor slope of 1.0% to ensure positive drainage from the pond margins to the low flow channel.

5.7.2.11 Under Drains

In some instances, the excavation of the stormwater management pond may intercept the groundwater table. In such instances, seepage into the pond may become problematic if no additional means are employed to address the issue.

In areas of with a high groundwater table, or in areas of high seepage potential, under drains consisting of perforated pipes and granules may be required to intercept seepage from within the stormwater management ponds and direct it to the low flow channel.

5.7.2.12 Access Road

Maintenance access roads shall be provided to access the stormwater management pond including all inlet structures, outlet control structures and emergency spillway structures.

The access road is to be specified by the Design Engineer. The base gravels are to be a minimum of 150 mm of Type 2 gravel and 150 mm of Type 1 gravel to a minimum width of 4.0 metres. In some instances, additional drivable surface width must be provided if sharp turns are to be negotiated. Where grades exceed 6%, the surface shall be paved with asphalt.

If a full loop road is not proposed, a turning circle, or a turning-tee must be provided so that maintenance vehicles may exit the facility without requiring reverse maneuvers. Turning movement analysis may be required in support of the proposed access road.

5.7.2.13 Fencing

In general, stormwater management ponds do not require fencing. Construction using maximum side slopes of 4:1 (H:V), and preferably 5:1 (H:V) where conditions permit should allow for safe egress from the stormwater management pond. However, fencing may be required at inlet structures and outlet control structures in some instances.

Select planting and other landscaping features are a preferred deterrent to access and a means of providing natural screening of the stormwater management pond.

Contingent upon location and proximity to private properties or lands for public purposes, fencing may be required as a matter of public safety.

In instances where fencing is required, fencing shall be as per the requirements contained in the *Standard Specification for Municipal Services*.

5.7.2.14 Standard Operating Procedure

A Standard Operating Procedure must be provided to the Engineer as an appendix to the Engineering Design Brief. The Standard Operating Procedure should address all recommended inspection and maintenance for the stormwater management pond. Consult the Engineer for the Standard Operating Procedure layout and template.

5.7.2.15 Hydraulic Grade Line Effects

The water elevation in the stormwater management pond will directly influence the hydraulic grade line in the upstream piped storm drainage system. Typically, piped storm drainage systems are subjected to hydraulic grade lines associated with the 1:5 year design storm. With the piped storm drainage system discharging to a stormwater management pond, the piped storm drainage system will be subjected to hydraulic grade lines associated with the 1:100 design storm.

Elevated hydraulic grade lines in the piped storm drainage system for the 100 design storm must be taken into consideration when setting minimum basement floor elevations on Subdivision Grading and Drainage Plans. As a result, dwellings within close proximity to stormwater management ponds may only be able to accommodate a half-basement, or a slab-on-grade foundation design.

5.7.2.16 As-Constructed Certification

Prior to acceptance of the subdivision and any associated stormwater infrastructure, the stormwater management pond shall be certified by a Professional Engineer including but not limited to:

- Storage volumes and elevations.
- Permanent pool and extended detention requirements.
- Control structure sizes and inverts.
- All stormwater pipe sizes and inverts.
- Any hydrologic modeling used in the design of the pond shall be updated to reflect as-built conditions.
- Sediment accumulations shall be removed to the original pond design volume and shall be disposed of off-site to an approved disposal facility.
- A certification report confirming all as-built information related to the stormwater management design.
- Operations and maintenance manual.

5.7.3 Stormwater Inline Storage

The Engineer may consider the use of oversized in-line pipe storage for stormwater management. If this approach is taken a rider stormwater system will be required to be installed for stormwater service connections for adjacent lots. Street drainage would be directed to the oversized inline pipe storage.

6.0 EASEMENTS

All Water, Wastewater and Stormwater Systems are to be constructed within a Halifax Regional Municipality street right-of-way and installed closest to the crown or center line of the street. Easements agreements are only permitted when there are no alternative servicing routes and the option of locating a street over a servicing corridor has been precluded.

Easement widths are governed by pipe separations set by Nova Scotia Environment and this Specification as well as the ability to excavate, remove and replace HRWC Systems utilizing a safe trench to the requirements of the Nova Scotia Department of Labor and Advanced Education.

The Engineer will determine the placement of the underground infrastructure, on centre or offset, within the easement. The minimum easement widths required for Water, Wastewater and Stormwater Systems is as follows:

Table 6.1 – Minimum Easement Widths

HRWC Systems	Minimum Easement Width
One main < 3.7 metres in depth	6.0 metres
Two mains < 3.7 metres in depth	7.5 metres
One mains > 3.7 metres in depth	7.5 metres
Two mains > 3.7 metres in depth	9.0 metres
Trunk wastewater / stormwater mains or transmission water main	12 metres
Three or more mains, no closer than 3.0 metres to easement limits	Add 3.0 metres for each additional main

All applications that include HRWC Systems proposed to be within an easement are to be accompanied with a profile (cross-section) of the arrangement demonstrating conformance to separations and the ability to excavate a safe trench. Any excavation within the proposed easement cannot undermine other structure outside the easement boundary.

Depending upon the length and location of the easement, a travel way within the easement may be required for maintenance. This travel way is to be a gravel surface for grades up to 6% and asphalt for grades 6% to 8%.

HRWC Systems within an easement in a walkway, will be granted to the HRWC prior to the transfer of ownership of the walkway to the Halifax Regional Municipality.

Where a need is identified to accommodate future upstream lands naturally tributary to the drainage area, a right-of-way or an easement will be provided from the edge of the street right-of-way to the upstream limit of development.

All HRWC easements are Easement Agreements that require the signature and seal of both the Grantor and the Grantee.

7.0 DRAWING REQUIREMENTS

All surveys in Nova Scotia effective December 31, 2017 will be required to be referenced to horizontal datum NAD83 (CSRS) Epoch 2010.0 and vertical datum Canadian Geodetic Vertical Datum 2013. (Referred to as NAD83 and CGVD2013).

7.1 SCOPE

The purpose of this section is to standardize the preparation and delivery of all hardcopy & digital drawings submitted to the Engineer.

7.2 DESIGN DRAWINGS

The engineering design drawing shall include:

- Plan
- Profile
- Details as required (project specific)
- Overall development plan

7.2.1 Presentation

The presentation of the plan and profile views of the engineering design drawing shall be as follows:

7.2.1.1 Units

All drawings submitted for approval shall be prepared using metric units. Drawings submitted in imperial units will not be accepted.

7.2.1.2 Scale

The plan shall be drawn to a scale of 1:500 (metric). The profile shall be drawn with a horizontal scale of 1:500 and a vertical scale of 1:50. The Engineer will permit plans drawn to a scale of 1:250 with the profile drawn to a horizontal scale of 1:250 and a vertical scale of 1:25, provided that the maximum sheet size is not exceeded.

7.2.1.3 Title Block

The title block, located on the right side of the sheet shall include a key plan, legend, notes, revisions, dates, scales, drawing number, approving signatures, drawing title, and company name. The key plan on each sheet will indicate the section of the project covered by the sheet.

7.2.1.4 Sheet Size

The drawing size shall be within the following minimum and maximum sizes:

- Minimum – 580 mm wide x 840 mm long.
- Maximum – 610 mm wide x 915 mm long.

7.2.1.5 North Arrow

Drawing plan view is to include a grid north arrow in the upper right corner. Where possible, the plan view should be orientated so that direction of north points to the top half of the sheet.

7.2.1.6 Stations

The plan and profile view stations shall be aligned vertically at one end of the sheet. Stations should increase from left to right and when possible, from lowest elevation to highest elevation. When it is not possible to achieve both increasing stations and increasing elevation from left to right, then the requirement for increasing stations will take precedence.

7.2.2 Detail Requirements

Details are to be included as necessary or as directed by the Engineer.

7.2.3 Plan

The plan of the engineering design drawing shall include:

.1 The existing and proposed location and horizontal alignment of:

- The water distribution system including all valves, Water Service Connections, hydrants, hydrant branches, tees, bends and appurtenances (i.e. chambers, reducers, couplings), and pipe with the length, size, material and class.
- Sprinkler Service Connections and large diameter Water Service Connections (>50 mm) with the length, size, material and class, to the street lines.
- The Wastewater System, Stormwater System, manholes, catch basins and culverts, with offsets from the Water System.
- All other public services and their appurtenances including any underground power, telecommunication system, or gas lines.

.2 All topographic features.

.3 The street and its dimensions and name and also intersecting street names.

.4 Curbs and gutters, sidewalks, and driveways.

.5 The boundary lines of each lot, lot number, and property identification (PID) numbers and civic numbers if available.

.6 The chainage at 10 metres intervals with labels every 50 metres along the centerline of the street, and the chainage of all intersecting street center lines.

.7 Any control monuments and bench marks that are within the area of the plan.

.8 Limits of the construction.

.9 At least two points of known chainage on the centerline of the street, to be related to the Nova Scotia Coordinate Survey System (ATS77). **All surveys in Nova Scotia effective December 31, 2017 will be required to be referenced to horizontal datum NAD83 (CSRS) Epoch 2010.0 and vertical datum Canadian Geodetic Vertical Datum 2013. (Referred to as NAD83 and CGVD2013).**

.10 Match Lines: Where a Water, Wastewater or Stormwater System extends over more than one drawing sheet corresponding match lines with labels shall be provided with sufficient overlap on each drawing to include all information on fronting properties.

.11 Hydrologic features: watercourses, ditches, swales, oceans, lakes, rivers, wetlands, direction of flow.

.12 Contours.

7.2.4 Profile

The profile of the engineering design drawing shall include the existing and proposed location and vertical alignment of:

.1 The Water, Wastewater and Stormwater Systems, including length, size, material and class of pipe, and the chainage and size of all fittings corresponding directly to the plan. Pipe shall be shown as a two-dimensional figure indicating pipe invert and obvert.

.2 The proposed centerline street grade. Where the water line is offset from the street centre line, the elevation of the water main must maintain the minimum depth of cover with consideration for the street cross slope.

.3 The finished grade above the water, wastewater and / or stormwater main where the pipe(s) are not under a street.

.4 The Wastewater and Stormwater Systems, including pipe inverts at manholes (inlet/outlet), manhole cover elevations and catch basin lead invert information. Show all Water, Wastewater and Stormwater System /culvert crossings in profile.

.5 Any other underground services and appurtenances.

7.2.5 Professional Engineer’s Stamp

The engineering design drawing shall be stamped and signed by the Design Engineer

7.2.6 Format

The format of design drawing submission shall be:

.1 Hard copy on 20 lb (minimum) bond paper and a DWG or PDF file for each drawing sheet. The DWG or PDF file for each drawing shall be actual size (1:1) and not scaled to fit a page size.

.2 Digital design drawing files shall be delivered in an electronic format compatible with AutoCAD or Civil 3D. The minimum requirement for CAD file submission (for final design drawings only) shall include the plan & profile portion of the drawing to facilitate GIS updating. This CAD file shall include the location of proposed water, wastewater and stormwater appurtenances. In addition to the Water System, the CAD file shall include any proposed buildings (outline) and property parcels.

7.3 RECORD DRAWINGS

The record drawing shall include all information on the "Design Drawing", revised to reflect the actual installation of the infrastructure or "as recorded" information. As a minimum the field coordinates of the following shall be obtained for the purpose of producing record drawings:

- Water mains
- Pipe bells
- Fittings
- Tees
- Bends
- Valves
- Hydrants
- Corporation stops
- Curb stops
- ARV & PRV drains
- ARV vent pipe
- Wastewater mains
- Stormwater mains
- Manholes (tops)
- Manhole (inverts / outverts)
- Catch basins (tops)
- Catch basin (outverts)
- Stormwater System inlet / outlets
- Stormwater System ditches
- Finish grade

7.3.1 Additional Information

Additional information which must be included on the record drawings includes:

.1 Swing ties from permanent above ground fixtures (i.e. buildings, power poles, hydrants) to locate main line valves, manholes, catch basins, large service and sprinkler valves, and other servicing appurtenances.

.2 The location of all service connections from main to property boundary.

.3 Dimensions to locate tees, bends, and other below ground fixtures.

.4 Hydrant leads to include measurement from:

- Centre of hydrant valve to center of hydrant.
- Centre of hydrant valve to main.

.5 Start and end of rock profile (feature codes Section 7.5).

.6 Start and end of insulation (feature codes Section 7.5).

.7 Start and end of Water, Wastewater and Stormwater System encasement pipes.

.8 The location of restrained joints / pipe.

7.3.2 Format

The format of the record information submission shall be both:

.1 Hard copy record drawing on reproducible .075 mm (3 Mil) matte polyester film.

.2 Electronic format as per Section 7.4.

7.3.3 Sheet Size

The drawing size shall be within the following minimum and maximum sizes:

.1 Minimum – 580 mm wide x 840 mm long.

.2 Maximum – 610 mm wide x 915 mm long.

7.4 COORDINATE REFERENCING

7.4.1 General

The purpose of this section is to identify the technical requirements for electronic information supplied to the Engineer.

7.4.2 Geo-Referencing

All surveys in Nova Scotia effective December 31, 2017 will be required to be referenced to horizontal datum NAD83 (CSRS) Epoch 2010.0 and vertical datum Canadian Geodetic Vertical Datum 2013. (Referred to as NAD83 and CGVD2013).

.1 All work shall be referenced using the Nova Scotia Coordinate Survey System (ATS77).

.2 Map projection: the Nova Scotia Modified Transverse Mercator projection and grid system (MTM Zone 4 and Zone 5) shall be used for referencing data.

.3 Datum: the horizontal datum for all coordinates shall be ATS77 adjustment.

.4 Units: all coordinates and dimensions shall be supplied in metric units.

7.4.3 Coordinate Accuracy

.1 Measurements and distances shall be collected to an accuracy of ± 50 mm.

.2 Real world coordinates shall be shown correctly with no front end truncation of the coordinate values.

7.4.4 Delivery Format

.1 Data and text files shall be delivered in ASCII PNEZDID2 format (comma delimited).

.2 ASCII PNEZDID2 files shall contain fields in the following order: Point #, Northing, Easting, Elevation, Description 1 (feature codes), Description 2 (remarks). Description 1 shall contain HRWC designated feature codes – available online through the HRWC website (see Section 7.5).

Description 2 shall contain additional information pertinent to the infrastructure being collected; specifically around lifecycle status (abandoned infrastructure must be designated), ownership (private infrastructure must be designated), and anything else the contractor deems useful (i.e. existing versus new, size, material, relative location – civic number, etc.). If there is no additional information, the Description 2 field does not have to be populated and can be left NULL. Please refrain from including commas within the Description 2 data field since it will interfere with the CSV file behavior.

Example:

Point #, Northing, Easting, Elevation, Description 1, Description 2
167, 4940718.18902, 5569268.10332, 94.21780, WCWM400,
168, 4940716.75418, 5569266.91370, 94.33934, WCFTTE, copper
169, 4940716.09661, 5569267.76330, 94.25489, WCWM250,
170, 4940715.74929, 5569268.16287, 94.25133, WCFTRD, 400x300
171, 4940715.68923, 5569268.40306, 94.24447, WCWM150,

.3 Quotation marks shall not be used in the data file.

.4 Digital record drawing files shall be delivered in a format compatible with AutoCAD or Civil 3D. If drawing files contain images and/or externally referenced drawing files (XREFS) the use of AutoCAD’s “SHEET SET” or “ETRANSMIT” is desirable for assembling a usable CAD submittal package. Include any plot style files (STB or CTB) for plotting purposes.

.5 In addition to hard copy and digital CAD files, record drawing sheets shall be submitted in TIF and PDF format, TIF and PDF files shall be submitted for each single drawing. Layer information shall be included in the final TIF and PDF files. The TIF and PDF file for each drawing shall be actual size (1:1) and not scaled to fit a page size.

7.4.5 Delivery Media

USB flash drive media, clearly labeled with the project name, project phase, date, and Design Engineer’s name.

7.4.6 Computer Aided Drafting Standards

Design Engineers preparing submissions may obtain essential symbology (AutoCAD blocks) from the Engineer. These blocks include HRWC standard sheets & title blocks, logo, north arrow, and standard Water, Wastewater and Stormwater System symbology. For legends including existing and proposed symbology and block names for computer aided drafting (CAD) drawings, refer to HRWC website (www.halifaxwater.ca)

7.5 FEATURE CODES

.1 A feature code (description) is an alphanumeric identifier assigned to all entities. All entities of the same type (i.e. 250 mm water main) will receive the same feature code (i.e. WCWM250).

.2 Refer to HRWC website (www.halifaxwater.ca) for current feature codes, legends and CAD block names.

8.0 APPLICATION, INSPECTION & ACCEPTANCE

8.1 APPLICATION REQUIREMENTS

8.1.1 System Extension Application

The HRWC Systems can be extended through the Halifax Regional Municipality subdivision process. When no subdivision is taking place, an HRWC System can be extended by making application directly to HRWC. Both processes require a HRWC Systems Agreement with HRWC and the requirements are the same for both processes. A HRWC Systems Agreement is valid until the expiry specified in the Agreement. If construction has not commenced by the terms stipulated in the Agreement, the Applicant is required to reapply to HRWC, complying with the current specifications.

The Water, Wastewater and Stormwater Systems are to be designed to the *HRWC Design Specification* and in accordance with the *Halifax Regional Water Commission Act*, the HRWC Regulations, the *HRWC Supplementary Standard Specification*, Halifax Regional Municipality By-laws, and Halifax Regional Municipality Regional Plan.

Information provided by HRWC (Record Drawings, GIS data agreements, Service Connection cards, etc.) are for information purposes only. The Design Engineer must field check all provided information to ensure its accuracy prior to submission of new water, wastewater and stormwater projects.

The following information is to be provided with all applications involving an extension to the Water, Wastewater and Stormwater Systems, or work impacting existing plants or facilities:

.1 Water System design calculations consistent with Section 3.0.

.2 Wastewater System design calculations consistent with Section 4.0.

.3 Stormwater System design calculations consistent with Section 5.0.

.4 An overall plan indicating the existing and proposed Water, Wastewater and Stormwater Systems indicating the *HRWC Design Specification* edition.

.5 Plan, profile, cross section and detail drawings.

.6 A geotechnical report prepared by the Design Engineer. The geotechnical report is to address the geological and hydrological aspects of the development and will determine soil types for the proposed Water, Wastewater and Stormwater Systems locations.

.7 A cost estimate for the proposed Water, Wastewater and Stormwater Systems extension.

8.1.1.1 Water Boosted System

Refer to Section 3.0 for design requirements. The following information is to be provided on all review submissions involving water booster pumping stations:

.1 Minimum, average, and peak flow rates.

.2 Curves for selected pumps including curves for head, BHP and NPSH.

.3 Motor horsepower and combined electrical/mechanical efficiency.

.4 Electrical motor power factor.

.5 Details of auxiliary power supply unit and pump house building.

.6 A narrative description of the control methodology and operations for the system describing each alarm, status and control activity in both normal and emergency conditions.

8.1.1.2 Wastewater Pumped System

Refer to Section 4.0 for design requirements. The following information is to be provided on all review submissions involving wastewater pumping stations:

.1 Minimum, average, and peak flow rates.

.2 Curves for selected pumps including curves for head, BHP and NPSH.

.3 Motor horsepower and combined electrical/mechanical efficiency.

.4 Electrical motor power factor.

.5 Details of auxiliary power supply unit and pump house building.

.6 A narrative description of the control methodology and operations for the system describing each alarm, status and control activity in both normal and emergency conditions.

8.1.2 Service Connection Application

Design and construct the Water, Wastewater and Stormwater Service Connections (public and private portions) to the *HRWC Design Specification*, *HRWC Supplementary Standard Specification* and the *HRWC Water Meter & Backflow Prevention Device Design & Installation Manual* and in accordance with the *Halifax Regional Water Commission Act*, the HRWC Regulations, and Halifax Regional Municipality By-laws.

Information provided by the Engineer (record drawings, GIS data agreements, service connection cards, etc.) are for information purposes only. The Design Engineer must field check all provided information for accuracy prior to submission of new water, wastewater and stormwater projects.

Approvals to connect to the HRWC Systems are valid for two years. If construction has not commenced within two years of the approval, the Applicant is required to reapply to HRWC, complying with the current specifications.

8.1.2.1 Multi-Unit & ICI Service Connection Application

The following is to be provided will all Halifax Regional Municipality building permit applications for multi-unit residential and ICI projects:

.1 *Water Meter Sizing Calculation Sheet*

.2 *Water Service Connection, Water Meter & Backflow Prevention Device Application*

.3 *Sprinkler Service Connection & Backflow Prevention Device Application*

.4 *Pollution Prevention Program Abbreviated Discharger Information Report – Form 1*

.5 *Servicing Plan / Water Meter & Backflow Prevention / Calculation Drawing*:

a. The template for this single plan can be found in the *HRWC Water Meter & Backflow Prevention Device Design & Installation Manual*.

b. **Servicing Plan Quadrant**. Detail the proposed Water, Wastewater and Stormwater Service Connections to be installed, show:
   - street right-of-way containing the mains, sizes and material.
   - natural gas, power, electrical conduits, transformers.
   - communications, fuel tanks, and other structures.
   - all surface classifications (undisturbed natural areas, building foot print, landscaped, graveled, concrete paved and asphalt paved areas) measured areas (m^2) that are applicable to the proposed project. This information is to be provided for in tabular form and indicated on the plan.
   - indicate the square footage of industrial, commercial and institutional building space and the number of residential multi-units.
   - Irrigation systems

c. **Profile Quadrant**. A profile perspective drawing of the water meter and backflow prevention device arrangement, all components, sizing and materials are to be clearly identified, in the profile quadrant.

d. **Plan Quadrant**. Detail a plan perspective drawing of the water meter and backflow prevention device arrangement, all components, sizing and materials are to be clearly identified, in the plan quadrant. Drains

e. **Calculation Quadrant**. Detail exactly the two page *Water Meter Sizing Calculation Sheet* in the water meter sizing quadrant. Drain calculations.

f. Provide two copies of this drawing. The record drawing for the Service Connection will be presented in the same format.

.6 Design calculations of the fire flow requirements and the sizing of the Sprinkler Connection.

.7 Design calculations for the sizing of Wastewater Service Connection.

.8 Sewage generation numbers for the proposed development prepared by the Design Engineer.

.9 Wastewater System hydraulic analysis of the receiving mains and the downstream system for capacity may be necessary. The Engineer will determine in the review of the application if the analysis is a requirement prior to approval.

If it is determined that capacity does not exist in the local Combined/ Wastewater System, it is the responsibility of the Applicant to complete the required upgrades to ensure capacity exists in the System.

.10 A *Stormwater Management Site Plan* of the private stormwater management system and design calculations, in the form of a table, confirming the stormwater management system for the property either matches the post-development peak flow rate with the pre-development peak flow rate for the 1:5, 1:10, 1:25, 1:50 and 1:100 year storm events, or betters the post-development peak flow rate to a larger storm event.

8.1.2.2 New Residential Service Connection Application

New single-unit and townhouse dwellings make application to connection to the HRWC Systems via the Halifax Regional Municipality building permit process. A site plan of the proposed service connections is required.

8.1.2.3 Existing Residential Service Connection Application

Existing single-unit and townhouse dwellings are to make apply directly to HRWC to connect to the HRWC Systems. The *New Services & Renewal Application* form can be found at www.halifaxwater.ca

This type of application requires permission by the property owner. Permission is granted by the property owner's signature on the *New Services & Renewal Application*.

8.2 INSPECTION REQUIREMENTS

8.2.1 System Extension Inspection

.1 Prior to construction, and not prior to the Engineer's approval, a pre-construction meeting is to be arranged by the Applicant. Representatives from Halifax Regional Municipality, HRWC, the Applicant's Design Engineer and Contractor are required to attend. Provide the Engineer with 48 hours' notice of pre-construction meetings.

.2 Prior to the pre-construction meeting, the Applicant is to provide the Engineer three (3) hard copy sets and a digital file (PDF) of the "Issued For Construction" drawings.

.3 Applicant is required to provide **full-time** inspection, approved by a Professional Engineer. The certificate of compliance, signed by a Professional Engineer, stating all HRWC Systems and appurtenances have been installed in accordance with the Design & Supplementary Standard Specifications is required prior to acceptance by the Engineer. HRWC Engineering & IS will provide audit inspection services.

.4 Applicant is to provide HRWC Engineering & IS with 24 hours' notice of preparation of pipe bedding, pipe installation, trench backfilling, and testing. All tests are to be conducted by the Applicant's Professional Engineer or their representative, and are to be witnessed by HRWC Engineering & IS.

.5 Applicant is to provide HRWC Engineering & IS site access to the work, and to locations where products to be incorporated into the work are being prepared. HRWC Engineering & IS is required to check-in with the site superintendent for required safety orientation.

.6 Applicant is to provide inspection assistance to HRWC Engineering & IS when requested.

.7 Applicant is to provide coordinate control points at appropriate locations within the limits of construction. Control locations are to be related to the Nova Scotia Coordinate Survey System (ATS77) in the metric format. The control is to be approved by a NSLS. Control is to be established prior to commencement of trenching. **All surveys in Nova Scotia effective December 31, 2017 will be required to be referenced to horizontal datum NAD83 (CSRS) Epoch 2010.0 and vertical datum Canadian Geodetic Vertical Datum 2013. (Referred to as NAD83 and CGVD2013).**

.8 The Applicant's Professional Engineer is responsible for independently collecting and recording all of the required record drawing information. Use of the Contractor's survey information by the Applicant's Professional Engineer for Record Drawings is not permitted.

8.2.2 Service Connection Inspection

8.1.2.1 Multi-Unit & ICI Service Connection Inspection

.1 Prior to construction of Water, Wastewater and Stormwater Service Connections all permit approvals must be in place.

.2 Applicant to provide HRWC Water Services Operations Technologist with access to the work, and to locations where products are to be incorporated into the work are being prepared.

.3 Applicant is to notify HRWC Water Services Operations Technologist at least twenty-four (24) hours in advance of requirements for tests and inspections. All tests are to be conducted by the Applicant's Professional Engineer or their representative, and are to be witnessed by the HRWC Water Services Operations Technologist.

.4 HRWC Water Services Operations Technologist will visit the site at intervals appropriate to the progress of construction to become familiar with the progress and quality of the work. The Applicant is required to provide **full-time** inspection, by a Professional Engineer or their designate, for all aspects of the construction (public and private) and testing of the water, Wastewater and Stormwater Systems, including all pipe bedding, pipe laying and backfilling of trenches.

.5 The Applicant's Professional Engineer or their representative is responsible for independently collecting and recording all of the required record drawing information. Use of the construction contractor's survey notes and data by the Applicant's Professional Engineer for record drawings is not permitted.

.6 The Applicant's Professional Engineer is to provide written certification that the installed services were installed under their direction and that they are installed in accordance with the approved drawings and specifications.

8.1.2.2 Residential Service Connection Inspection

All service connections and driveway culvert installations, including renewals and repairs require inspection and approval by HRWC Water Services Operations Technologist prior to backfilling.

Inspection fees are detailed in the HRWC Regulations, and the contact information for HRWC Water Services Operations Technologist is listed in the permit approval letter from the Engineer.

8.3 ACCEPTANCE REQUIREMENTS

This section summarizes the HRWC requirements for the acceptance of HRWC Systems and service connections.

8.3.1 System Extension Acceptance

A *HRWC Systems Extension Acceptance Check Sheet* which summarizes these requirements is available at www.halifaxwater.ca. The Applicant may complete and submit the check sheet as a cover page to the systems extension acceptance package.

.1 A completed *HRWC Systems Extension Acceptance Check Sheet.*

.2 Record drawings are to be in electronic (DWG & PDF) and hardcopy (mylar) format, stamped by a Professional Engineer and in accordance with this specification.

.3 Completed service connection cards for each lot.

.4 *Professional Engineer's Certificate of Compliance for HRWC Systems Extension* stating that the HRWC Systems have been installed in accordance with the approved drawings and specifications.

.5 *Nova Scotia Land Surveyor's Certificate of Compliance* stating the HRWC Systems have been installed within the boundaries of the Halifax Regional Municipality right-of-way, within easements agreements with HRWC or on a parcel owned by HRWC.

.6 Summary of construction quantities and costs the installed Water, Wastewater and Stormwater Systems. All components of the HRWC Systems are to be broken out for quantities and unit rates.

.7 Copy of the *Certificate to Construct* from NSE.

.8 Warranty deeds including property descriptions and plans for property which is to be transferred to the HRWC.

.9 Easement agreements signed and sealed by the Grantor where HRWC Systems are located on private property.

.10 Maintenance bond in the amount of 10% of the actual cost of construction of the Water, Wastewater and Stormwater Systems to ensure the proper operation of such systems for a period of 12 months. This maintenance bond may be waived if the project is part of the Halifax Regional Municipality's subdivision process, where Halifax Regional Municipality holds maintenance security on behalf of HRWC.

.11 Where applicable, payment of a capital cost contribution, in the amount calculated by the Engineer and subject to the terms of an HRWC Systems Agreement.

8.3.1.1 Water System Requirements

.1 Records of Water System hydrostatic tests and certification of compliance.

.2 Records of bacteriological test compliance.

.3 Completed valve cards.

.4 Completed hydrant cards.

.5 Operation and maintenance manual for water booster station as outlined in Section 3.0 of this specification. Include special tools and standard spare parts for water booster station equipment.

Note: The private portion of all service connections will not be inspected, nor will water meters be issued until the Engineer has accepted the Water, Wastewater and Stormwater Systems and has been advised by Halifax Regional Municipality that all Primary Services have been accepted.

8.3.1.2 Wastewater System Requirements

.1 Closed Circuit Television (CCTV) inspection and report (also required four weeks prior to end of warranty period) of the wastewater mains, refer to the *HRWC Supplementary Standard Specification* for CCTV requirements.

.2 Wastewater main vacuum test report test report including Wastewater Service Connections to the property lines.

.3 Manholes vacuum test and inspection report.

.4 Operational and maintenance manual for wastewater pumping stations as outlined in Section 4.0 of this specification. Include any special tools and standard spare parts for pumping station equipment.

.5 A completed *Wastewater Pumping Station Inventory Sheet*.

Note: The private portion of all service connections will not be inspected, nor will water meters be issued until the Engineer has accepted the Water, Wastewater and Stormwater Systems and has been advised by Halifax Regional Municipality that all Primary Services have been accepted.

8.3.1.3 Stormwater System Requirements

.1 Closed Circuit Television (CCTV) inspection and report (also required four weeks prior to end of warranty period) of the <u>stormwater mains</u>, refer to *HRWC Supplementary Standard Specification* for CCTV requirements.

.2 Driveway culvert sizing tables.

.3 Operational and maintenance manual for stormwater management facilities as outlined in Section 5.0 of this specification. Include any special tools and standard spare parts.

Note: The private portion of all service connections will not be inspected, nor will water meters be issued until the Engineer has accepted the Water, Wastewater and Stormwater Systems and has been advised by Halifax Regional Municipality that all Primary Services have been accepted.

8.3.2 Service Connection Acceptance

Prior to a water meter installation, service connection installations require inspection by HRWC Water Services Operations Technologist. The requirements for the different types of building uses are contained in this section.

8.3.2.1 Multi-Unit & ICI Service Connection Acceptance

A *MICI Service Connection Acceptance Check Sheet* which summarizes these requirements is available at www.halifaxwater.ca. The Applicant is to complete and submit the check sheet as a cover page to the service connection acceptance package to the HRWC Water Services Operations Technologist.

.1 A completed *MICI Service Connection Acceptance Check Sheet*

.2 The *Servicing Plan / Water Meter & Backflow Prevention / Calculation Record Drawing* and *Stormwater Management Site Plan* are to be in electronic (DWG & PDF) and hardcopy (mylar) format, stamped by a Professional Engineer and in accordance with Section 7.0 of this specification.

.3 Completed service connection card.

.4 *Professional Engineer's Certificate of Compliance for Installation of MICI Service Connections* stating the service connection has been installed in accordance with the approved drawings and specifications.

.5 Inspection and approval of the Water, Wastewater and Stormwater Service Connections by HRWC Water Services Operations Technologist.

.6 Records of hydrostatic test compliance for Water Service Connections 100 mm and larger.

.7 Inspection and approval of the backflow prevention device HRWC Cross Connection Control Technologist.

.8 Records of bacteriological test compliance for Water Service Connections 100 mm and larger.

.9 Closed Circuit Television (CCTV) inspection and report of the Wastewater and Stormwater Service Connections, refer to *HRWC Supplementary Standard Specification* for CCTV requirements.

.10 Records of Wastewater Service Connection vacuum test.

.11 Records of manhole vacuum test and inspection report.

.12 Deflection gauge testing is required on the Wastewater and Stormwater Service Connections 250 mm and larger.

8.3.2.2 Residential Service Connection Acceptance

.1 Inspection and approval of the Water, Wastewater and Stormwater Service Connections by HRWC Water Services Operations Technologist.

.2 Inspection and approval of the backflow prevention device HRWC Cross Connection Control Technologist, if required.

8.4 INDEX TO HRWC FORMS

Application Forms

- New Service & Renewal Application
- Water Meter Sizing Calculation Sheet
- Water Service Connection, Water Meter & Backflow Prevention Device Application
- Sprinkler Service Connection & Backflow Prevention Device Application
- Change of Water Meter Size Application
- Temporary Water Meter Application
- Backflow Prevention Device Tester's License Application
- New Product Request Application

Inspection Forms

- Backflow Prevention Device Inspection Record
- Cross Connection Control Accuracy Verification Report

System Acceptance Forms

- Professional Engineer's Certificate of Compliance for HRWC Systems Extension
- Nova Scotia Land Surveyor's Certificate of Compliance for HRWC Systems Extension
- HRWC Systems Extension Acceptance Check Sheet
- Wastewater Pumping Station Inventory Sheet
- Service Connection Card
- Hydrant Attribute List
- Hydrant Field Form
- Valve Attribute List
- Valve Field Form

Service Connection Acceptance Forms

- Professional Engineer's Certificate of Compliance for Installation of MICI Service Connections
- MICI Service Connection Acceptance Check Sheet
- Service Connection Card

All forms are available at www.halifaxwater.ca.