2019 Edition

MANUAL

Municipal Design Specifications

932 Highway 1
Hebron, Nova Scotia

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Definitions of Terms

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DEFINITION OF TERMS

Approval
The approval of the Engineer. The Engineer's decision will be final and binding in matters of design and construction.

Base Course
The crushed rock and aggregate which is placed immediately upon the subgrade.

Carrier Pipe
A pipe (DR18 PVC) used to provide protection for utility services when required vertical separations from other utility services cannot be achieved.

Casing Pipe
A pipe designed by a Professional 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 The Municipality of the District of Yarmouth.

Commissioning
A process by which equipment, facility or plant is tested to verify if it functions according to its design or specifications prior to acceptance by The Municipality of the District of Yarmouth.

Department of the Environment
The Nova Scotia Department of Environment.

Department of Transportation
The Nova Scotia Department of Transportation and Infrastructure Renewal.

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 The Municipality of the District of Yarmouth.

Diameter
The nominal internal diameter of the pipe – unless otherwise noted.

Engineer
The Engineer of the Municipality of the District of Yarmouth and includes a person acting under the supervision and direction of the Municipality of the District of Yarmouth.

Feeder Main
A water main which typically receives flow from transmission mains or from pressure control facilities (i.e. booster pumping 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.

Hyetograph

A graph showing average rainfall, rainfall intensities or volume over specified areas with respect to time.

ICI

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.

MANUAL

The Municipal Design Specifications Manual for the Municipality of the District of Yarmouth.

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 in 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.

Minor Drainage System

The system which is used for initial stormwater flows, or for flows generated in high-frequency rainfalls.

Minor Storm

The 1 in 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.

MODY

The Municipality of the District of Yarmouth.

Multi-Unit Dwellings

Also known as a MUD is a building which contains four or more residential dwelling units.

Municipality

The Municipality of the District of Yarmouth.

Municipal Service Systems

Includes sanitary sewerage systems, storm drainage and control systems, road/street systems, street lights, signal lights, sidewalk, curb and gutter, etc. Note that all municipal water services located within the municipality fall under the jurisdiction of the Municipality of the District of Yarmouth.

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.

Professional Engineer

A registered member in good standing, of the Association of Professional Engineers of Nova Scotia (Engineers of Nova Scotia) or; one who is licensed to practice in the Province of Nova Scotia.

Runoff
That part of the precipitation which travels by surface flow.

SDI
Surface Distress Index.

Service
Water Service, Wastewater Service or Stormwater Service or any combination of each of them.

Service Connection
Water Service Connection, Wastewater Service Connection, or Stormwater Service Connection, or any combination of each of them.

Start-Up
A process where equipment, facility or utility plant is installed and tested by the contractor and certified complete by the designer / consultant 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
A system carrying Stormwater and vested in or under the control of The Municipality of the District of Yarmouth.

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.

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.

Street
Any public road, street or highway owned and maintained by the Municipality or by TIR.

The Municipality of the District of Yarmouth (MODY)
The Regional Municipality established by the Council of the Municipality of Yarmouth and includes the area over which that body corporate has jurisdiction.

TIR
The Nova Scotia Department of Transportation and Infrastructure Renewal.

Travel Surface
The durable surface material laid down on a road or street intended to sustain vehicular or foot traffic as compared to the width of the roadway surface which may include shoulders.

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

Urban Street
An urban road is one which is characterized as having a paved surface, curbs, a piped storm sewer system, sidewalk and street lights.

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 a 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 The Municipality of the District of Yarmouth.

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 The Municipality of the District of Yarmouth.

Watercourse
As defined by The Environment Act – Revised Statutes of Nova Scotia.

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

Water Utility
The source, 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 **The Town of Yarmouth Water Utility.**

GENERAL REQUIREMENTS

1 INTRODUCTION

This document was developed to provide uniform standards for the construction of infrastructure within the Municipality of the District of Yarmouth (MODY). This is the first edition of this document.

Please send comments or proposed changes for future consideration to the Development Office at dev@district.yarmouth.ns.ca or (902) 742-9691 (Phone) or (902) 742-7557 (Fax).

This document is subject to change without notice and the onus is on users to ensure that they are in possession of all revisions. Please refer to this document and any subsequent revisions for accurate and complete information. Users can purchase a hard copy at The Municipality of the District of Yarmouth Offices, 932 Highway 1, Hebron, NS, Canada, B5A 5Z5.

These design guidelines have been prepared for setting minimum design and construction standards for Municipal Service Systems within the Municipality; to list and suggest limiting values for items upon which an evaluation of such designs will be reviewed and to establish uniformity of practice in the Municipality. They are to be used as a guideline of minimum standards to be met in the design and construction of municipal services systems within the MODY, and to list and suggest limiting values for items upon which an evaluation of such designs will be made by the reviewing authority. A complete documentation of all parameters relating to the design and construction of municipal services 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 MODY.

Design criteria, guidelines and specifications contained in this document will be revised periodically to conform to advances and improvement in the practice of Municipal Engineering.

These changes shall be noted in a revision record and will be available to users of this document. It is the responsibility of the designer to remain current with revisions to this document.

2 GENERAL

The designer shall provide for Municipal Service Systems meeting these criteria but also consistent with cost-effective installation, operation and maintenance costs. The design of municipal services is to be under the seal of a Professional Engineer.

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 MODY to stifle innovation. Where, in the judgment of the design engineer, variations from this document are justified or required, and where the designer 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 shall take into consideration such factors as safety, nuisance, system maintenance, operational costs, life cycle costs, environmental issues, natural topography, configuration of the bulk land, etc. Where the designer uses standards other than those outlined in this document, all appropriate documents and plans shall clearly indicate those areas of difference.

Where the designer proposes variations from this document and where the designer can show that alternate approaches will produce the desired results, such approaches may be considered for approval. The designer shall in the first instance consider such factors as safety, nuisance, system maintenance, operational costs, life cycle costs, environmental issues, natural topography, configuration of the bulk land, etc. The designer shall provide the Engineer a rationalization of these same factors in considering alternate approaches.

The Engineer's decision shall be final and binding in matters of design and construction.

Each submission shall be accompanied by a statement from a Professional Engineer that the submission is in accordance with the Design Guidelines, except, if there are variations, the designer shall indicate clearly, in all appropriate documents and plans, included with the submission, the specific variances from the Design Guidelines.

The acceptance by the Municipality of the design of proposed Municipal Services Systems does not relieve the design engineer of the responsibility for proper design nor does it imply that the Municipality has checked the design exhaustively for compliance with this document.

Where the Municipality has accepted a design which does not comply with this guideline 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.

In addition to these design criteria, all systems shall conform to any more stringent requirements established by other authorities having jurisdiction. No systems shall be constructed until the design has been approved by the Engineer, the approval process followed and a permit to construct obtained from Nova Scotia Environment and the necessary street opening permits.

All plans, submissions, and calculations shall be in metric units.

All contract documents prepared for municipal service systems works within the MODY shall 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.

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 Nova Scotia Consulting Engineers Association.
- American Water Works Association Standards.
- “Nova Scotia Standards and Guidelines Manual for the Collection, Treatment, and Disposal of Sanitary Sewage”, prepared by Nova Scotia Environment.

3 CONSTRUCTION

No systems shall be constructed until the design has been approved by the Engineer, the approval process followed and a permit to construct obtained from NSE and the necessary street opening permits, and related municipal approvals.

All construction shall meet the requirements of MODY, together with the Standard Specifications for Municipal Services, as developed by the Nova Scotia Road Builders Association and Consulting Engineers Nova Scotia Joint Committee on Contract Documents.

PART A – SITE DESIGN GUIDELINES

1 EROSION AND SEDIMENTATION CONTROL

Stormwater management systems shall be an integral part of overall site design and development.

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

The designer shall 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 the following:

- Interception and diversion ditches to direct clear water around the construction site;
- 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;
- 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 Erosion and Sediment Control Manual and Guidelines for Use on Construction Sites”.

2 OFF-STREET DRAINAGE SYSTEMS

2.1 Introduction

2.1.1 General

A Storm Drainage System can be described as a group of interacting, interrelated, and interdependent elements carrying discharges in response to rain and snow. These discharges include overland flow, subsurface flow, groundwater flow, and snowmelt.

A complete and properly functioning Storm Drainage System includes a variety of components which may be grouped into two categories:

- "Community Systems" being those elements which serve two or more lots. For example, roadside ditches, culverts, roadways, curbs and gutters, street and backyard catch basins, pipes or conduits, retention ponds, watercourses, floodplains, and drainage swales and ground elevations along common lot lines or in easements.
- "Individual Lot Systems" being those elements which serve a single lot and are contained within its limits. For example, swales contained within lot limits, gently graded lot areas, slopes, roof downspouts, individual seepage pits, french drains, building lateral, parking lot catch basins and conduits.

The Municipality is the administrator of subdivision and building construction for the

Municipality. Within this context, and as empowered by the MODY Charter, the Building Code Act, and the Planning Act, it is an objective of the Municipality to facilitate and regulate the establishment of a complete and properly functioning Storm Drainage System to serve new building construction within the MODY.

An important group of elements in a Storm Drainage System are the Community Systems located outside of the street limits. Poor off-street grading and drainage can lead to unsafe conditions, extensive and costly maintenance, property damage, and loss of use of lot areas.

The primary purpose of this section of the Design Guidelines is to facilitate and regulate good design and construction with respect to the Community Systems located outside of the street limits.

2.1.2 Roles and Responsibilities

Several parties are typically involved in the design, construction, and maintenance of the Community Systems providing off-street drainage. Their roles and responsibilities within the context of this section of the Design Guidelines are described as follows:

a. Designer

The Designer is responsible for the preparation of the design of the Community

Systems, such that when construction of the design takes place, the objectives of the Design Guidelines are met. In carrying out this responsibility, the Designer is to provide for adequate initial construction such that undue on-going maintenance obligations are not placed on the Homeowner or Municipality.

The Designer is fully responsible for the design regardless of the acceptance of the design by the Municipality.

b. Contractor

The Contractor is responsible for constructing the Community Systems in accordance with the design and in a good and workmanlike manner. It is required that the Contractor not deviate from the design without prior consultation with the Designer. If unusual or unanticipated site conditions are encountered during construction, the Contractor shall advise the Designer immediately.

c. Subdivider

The Subdivider is the owner of the land proposed to be subdivided, and includes anyone acting with his consent. With respect to lot grading and drainage, the Subdivider is responsible for construction of the Community Systems identified by the Engineer as being the Subdivider's responsibility. This will include construction works within easements, be they public or private, and in certain instances will involve pre-grading of entire lot areas to prevent ponding of water or other drainage problems. Construction of grades along common lot lines and grading of entire lots where community grading concerns do not exist will generally not be required.

d. Municipality

The Municipality is the administrator of the process associated with design, construction, and certification of the Community Systems. As part of this process, the Municipality may review, approve, and provide comment to the other parties. It is to be understood that as administrator of the process, the Municipality does not assume any responsibility for the actions or shortcomings of the other parties. In some instances, the Municipality is responsible for the maintenance of off-street Community Systems.

e. Homeowner

It is expected that the Homeowner will be responsible for the usual maintenance of the Individual Lot Systems, and in some instances, of the Community Systems, eg.

cleaning of storm drainage inlets, maintaining drainage swales free of vegetation and debris, and maintaining suitable slope protection. It is expected that Homeowners will not block drainage routes, for example, placing excess snow at end of a driveway thereby blocking side yard drainage swales. Should the Homeowner alter any of the Community Systems, he/she is responsible for the implications of the alteration.

2.1.3 Objectives

The Community Systems designed within the context of the Design Guidelines shall achieve the following objectives:

a. to prevent loss of life and to protect structures and property from significant damage and expense, including that which is expected to be experienced during a 1 in 100 year storm event.

b. to provide for convenient and reasonable use of lot areas from overland flow during and following rain and snow events and from subsurface or groundwater flow, eg. continuously saturated backyard, significant continuous icing.

c. to provide for safe use of lot and street areas, eg. excessive depth of flow or water storage, significant continuous icing.

d. to avoid drainage problems or other conditions that result in unreasonable maintenance obligations on the Homeowner or Municipality, eg. significant or regular de-icing operations.

e. to provide protection from erosion from surface flow, subsurface flow, or groundwater, eg. slope stabilization.

f. to direct water away from buildings in order to especially prevent basement flooding and damage to the foundation drain.

g. to prevent standing water and soil saturation detrimental to buildings, driveways, walkways, landscaped areas and other use of the lot.

h. In addition to the foregoing, the Municipality requires information to demonstrate that the following overall Storm Drainage System objectives are achieved:

i. to adequately convey stormwater flow from upstream sources.

j. to prevent and/or mitigate the adverse effects of stormwater flow onto downstream or adjacent properties, such as erosion, or flooding due to inadequate downstream capacity or grading.

k. to preserve natural watercourses.

l. to minimize the long-term effect of development on receiving watercourses and groundwater.

m. to maintain pre-development drainage patterns unless some motivating factor to change the pattern exists, eg. conflict with other objectives (capacity).

In the case where Community Systems have been designed and/or constructed, it shall be an objective that the Individual Lot Systems conform to the Community Systems. Grades established at the lot limits by the Approved Subdivision Grading Plan are to be maintained, subject to variations permitted under the Lot Grading By-law.

In the preparation of a design that meets the above objectives, the Designer is encouraged to strive for an attractive living environment and give consideration to factors such as the following:

- Aesthetic conditions relating to lot grading, eg. creating space on the lot that is convenient as a play area, usually in a backyard.
- The preservation of desirable site features where practical, ie. minimizing disturbance, retaining trees.
- Providing for variance in front yard setbacks along a street and for establishing a roof line profile which is aesthetically pleasing.
- Locating slopes and boundary lines such that tops and bottoms of slopes are at property boundaries.
- Avoiding excessively deep swales.
- Where swales and french drains are contemplated at the base of a significant slope, it is recommended that the swale be located at the toe of the slope.
- Locating driveways to allow convenient and safe ingress and egress.
- Creating consistent grading lot to lot.

These above items are desirable but not addressing these factors fully will not lead to rejection or approval of a Subdivision Grading Plan.

2.2 Design Criteria – Off-Street Systems and Subdivision Grading

The Design Criteria for lot grading and drainage are to cover the more common aspects of design encountered in lot grading and drainage development. Local conditions may influence the design criteria and design requirements, for example, circumstances where soils are not free draining may require a flatter maximum permissible slope. Additional requirements affecting design are contained in other relevant documents, such as the National Building Code.

The Design Criteria reflect the experience of the Municipality as related to typical design requirements. The Criteria are provided for information and will serve as the benchmark for review of Subdivision Grading Plans in typical circumstances. However, the Design Criteria are not considered rigid. To better meet the objectives, the Designer may want to propose alternate design approaches. This will not be discouraged by the Municipality. The purpose of the Design Criteria is to provide guidance for designers in the provision of drainage systems offering acceptable service which is consistent with the lowest possible initial construction and on-going maintenance costs and effort.

2.2.1 Community Systems

In designing Community Systems, the focus is on those drainage elements which affect more than one property, eg. common backyard swales/catch basins, grading along common property boundaries. It is critical that the Designer ensure that sufficient Community Systems are in place and/or contemplated and depicted such that the Individual Lot Systems can be designed and constructed in a fashion that allows for a properly functioning overall Storm Drainage System for the Homeowner while striving for an attractive living environment. It is intended that Community Systems will not have to be altered as a consequence of design of detailed Individual Lot Systems. Therefore, it is strongly recommended that the Designer test the ability of the Community Systems to achieve the above stated objective by carrying out preliminary design of the Individual Lot Systems

serving the lots in accordance with the requirements of any Lot Grading or Grade Alteration or other By-law that regulates the grading of land.

Community Systems are to be designed in accordance with the following criteria:

a. Ground Surface
   - The area between the street right-of-way and the curb shall slope towards the curb at a minimum slope of 2% but not greater than 4%.
   - The maximum slope shall be 3:1 (H:V) unless constructed on in situ rock. A steeper slope may also be permitted by the Engineer if a geotechnical report is submitted that certifies the use of a steeper slope. The top and bottom of banks shall be rounded for convenient maintenance. Notwithstanding the foregoing, the Designer is responsible to design a suitably graded slope with appropriate surface treatment to provide for long term stability.
   - Where a cut intercepts the groundwater table creating potential drainage and icing problems, special measures will be required to address potential drainage problems.
   - Where areas are disturbed, stabilization is to be provided to prevent erosion.

b. Off-Street Swales
   - Except for individual single family and duplex dwelling lots, provision shall be made to collect on-site, and convey by pipe to a storm sewer, all runoff from off-street areas other than grassed or undisturbed areas.
   - Swales shall be blended into the landscape to the greatest degree possible in order to provide a natural appearance.
   - The minimum grade along any swale shall be 2%. Less than a 2% grade may be used where underdrains are incorporated. In cases where an underground drain is included in the swale design, the minimum grade may be reduced to 1%. Designers are encouraged to use grades, where possible, that are steeper than the minimum.
   - The flow from all swales which serve multiple properties shall be intercepted by catch basins at a maximum spacing such that the maximum depth of flow in the 5 year storm event is 100 mm or as otherwise directed by the Engineer.
   - Where the swale intercepts subsurface water, the swale shall incorporate underdrains, regardless of slope.
   - The side slope for any swale shall be flatter than 33% (3 horizontal: 1 vertical).
   - The maximum depth of flow in any swale shall be 250 mm in the 1 in 100 year storm.
   - All swales shall be designed to accommodate the 1 in 100 year stormwater flow.
   - An overflow route shall be provided to direct overflow to major storm drainage systems. The 1 in 100 year water level along such route shall be lower than the lowest opening to the adjacent dwellings.
   - Sharp corners shall be avoided in swale design.
   - Steeply sloping swales shall have appropriate surface treatment to prevent erosion.

c. Catch Basins
   - Where a swale, which serves multiple properties, intersects a street, a catch basin, located as close as practical to the curb or to the sidewalk, shall be installed to intercept flow from the swale.
   - The flow from all rear yard swales serving multiple lots shall be intercepted by a catch basin(s) installed at the rear of the property.
   - The grade of lots in the immediate vicinity of a rear yard catch basin shall be graded in a manner which will direct all water to the catch basin.
   - Catch basins shall be located entirely on one property and shall not be located on any property line.
   - Off street catch basins may be constructed using a 750 mm diameter concrete pipe, standing vertical with bell end up. An IMP R-361 (or equivalent) grate shall then be placed in the bell end. The catch basin lead shall not protrude into the catch basin by more than 75 mm and shall be grouted with a non-shrink grout and finished on the inside and outside of the structure. Note: This type of catch basin is not permitted in paved areas or areas where vehicle traffic is present.

d. Underdrains

- Underdrains are to be used to remove surface and subsurface water to drain wet areas and other areas of poor drainage, or where minimum slopes with respect to lot surface or swales cannot be achieved.
- Underdrains are not permitted to discharge onto street surfaces, walkways, private properties, or any other location where there would be an impact inconsistent with the objectives of this document
- Underdrains shall be located a sufficient distance from any part of the building foundation to avoid impacts to building foundations and/or adjacent structures when the underdrain is replaced.
- Where necessary to avoid icing problems on the street caused by water flowing over the top of the curb, the Designer shall provide an acceptable method to intercept this flow (eg. french drain installed behind the curb).

Small diameter pipe installed for "off-street" drainage such as rear yard drains, underdrains, etc., may be installed provided the following connection conditions are met:

- Off-street underdrains shall not be connected to the back or sides of an on-street catch basin.
- Off-street underdrains shall connect to the storm main via a lateral connection or to a manhole in the street ROW.
- Off-street underdrains may be considered, through the variance process, to connect to an off street catch basin.

e. Ownership

- Rear/side yard catch basins will be considered for ownership/acceptance by MODY as an exception only (variance). If a variance is accepted, it must be constructed to MODY requirements. The designer will be required to demonstrate that there are no other physical means to providing adequate and proper drainage to the property(s). The request will also be assessed to ensure the infrastructure can be accessed for cleaning and maintenance.
- Catch basins located outside of the travel way, but located within the right-of-way, will be owned and maintained by MODY.
- Underdrains and swales located outside of the right-of-way will be privately owned and maintained.

f. Easements

- Easements shall be provided for all swales which, in the opinion of the Engineer, require such legal conveyances. Generally, easements will be required when a significant number of lots depend on the swale.
- Public easements shall be provided for all catch basins and associated stormwater pipes constructed in conformance with MODY Standards.
- A minimum easement width of 6 m is required for public easements.
- A minimum easement width of 4.5 m is required for private easements.

3 MUNICIPAL ROADS/STREETS

3.1 Introduction

3.1.1 General

This Design Guideline provides standards for urban and rural areas and applies to new construction as well as to major reconstruction. The design of the roadway system has to respond to different constraints and possibilities depending on the situation. There are basic design concepts that apply in all situations but the expression of the objectives will necessarily vary depending on the situation.

In the ‘urban’ environment, there are many conflicting demands placed on the street system, including those of passenger cars, trucks, transit vehicles, cyclists and pedestrians. It is important to recognize that the street system must be effectively shared. Rights-of-way in the ‘urban’ environment must also serve other non-traffic needs such as utilities, lighting, environmental features, and streetscaping.

In the 'rural' areas, increased sensitivity to users other than motor vehicles is required of designers by the Municipality and by residents to meet goals of environmental quality.

When considering developments in areas now undeveloped (in either 'urban' or 'rural' contexts) the emphasis is on creation of plans that will keep traffic problems from developing while at the same time providing for convenient access and mobility. A well-conceived street system can segregate through traffic from local traffic and assure that collector and higher classed roads as well as local-serving streets are designed and constructed to standards that reinforce their intended use. Attention should be given to layouts that are suitable for bus operations (with appropriate lane widths, pavement strengths, turning radii and so forth) and to the provision of facilities that permit and encourage non-motorized travel - bikeways/walkways and sidewalks.

In general, the use of traffic laybys is not supported for various reasons. They obstruct sidewalks, they're a pedestrian crossing hazard, a maintenance problem for snow clearing and street cleaning, and a challenge for persons with disabilities. Traffic laybys should only be considered where otherwise, vehicle traffic movement will be restricted. That is, areas where high volume buildings (like hotels) can be constructed right up to the property line on high traffic volume streets.

3.1.2 Characteristics of Street Classes

Table 3.1 Characteristics of Street Classes

Characteristic	Arterial Street	Major Collector Street	Minor Collector Street	Local Industrial	Local Street
Traffic service function	First consideration	Traffic movement first consideration, land access second consideration	Traffic movement of equal importance with land access, parking permitted	Traffic movement second consideration with land access first consideration, parking permitted	Traffic movement second consideration with land access first consideration, parking permitted
Land access function	Limited access with no parking				
Range of design traffic average daily volume	More than 20,000	More than 12,000	Up to 12,000	Less than 3,000	Less than 3,000
Characteristics of traffic flow	Uninterrupted flow except at signals with pedestrian overpasses	Uninterrupted flow except at signals and crosswalks	Interrupted flow	Interrupted flow	Interrupted flow
Average running speed in off-peak conditions*	50-70 km/h	40-60 km/h	30-50 km/h	15-30 km/h	15-30 km/h
Vehicle types	All types	All types but trucks may be limited	All types with truck limitation	All types	Passenger vehicles and service vehicles; large vehicles restricted
Connects to	Expressways, arterials, major collectors, minor collectors	Expressways, arterials, major collectors, minor collectors, some locals	Arterials, major collectors, minor collectors, locals	Some major collectors, minor collectors, locals	Some major collectors, minor collectors, locals

* The average running speed represents the average speed for a complete trip on the road in question, including speed variations required by other traffic and traffic control devices. It is not the maximum speed achieved on the section, nor is it the design speed. The average running speed of traffic operating under off-peak volume conditions varies on roads of the same

classification depending on the type and condition of the surface, intensity of adjacent land development, access to the road, vehicle type, and traffic flow controls.

3.1.3 General Principles for Design of Streets

Street layout, design, and control should express and reinforce street function.

The overall street network should include streets designed to accommodate through traffic, in addition to local streets.

Local streets should be linked to higher classification streets in a way that provides good access to other parts of the community and region, and minimizes the chances of the local streets' use by through traffic.

Land uses along streets intended to carry through traffic should be selected and designed to minimize their sensitivity to adverse effects of traffic. When possible, uses that can benefit from the greater accessibility and public exposure that non-local streets provide should be the ones located on such streets.

Strategies for reducing auto dependence both by residents and by others are legitimate tools of traffic management for local streets.

3.1.4 Objectives for Design of Residential Streets and Walkways

In particular, residential or local-serving streets (in both serviced and unserviced areas) should:

- Permit comfortable and safe pedestrian and bicycle movements as well as motorized vehicular movements, and protect vulnerable users such as children, persons with disabilities, and elderly persons.
- Accommodate convenient and efficient pickups and deliveries, emergency access (fire, police, ambulance), and maintenance services, and where densities justify bus or transit services.
- Enhance the overall aesthetics of the neighborhood through well-designed street layout and street landscaping.
- Local streets should be protected from through traffic: vehicles travelling on these streets should have a trip origin or destination in the area served by them.
- Local streets should be protected from vehicles moving at excessive speeds (greater than 50 km/h).
- Residential streets should be protected from parking unrelated to residential activities.

3.2 General Design Specifications

3.2.1 General

These specifications cover the more common aspects of design encountered with roadway design. In cases where this specification needs to be expanded or additional specifications are required, the "Geometric Design Guide for Canadian Roads", the "Manual of Uniform Traffic Control Devices for Canada", prepared by the Transportation Association of Canada (TAC), and the Nova Scotia Motor Vehicle Act and Regulations shall be used.

3.2.2 Asphaltic Concrete

Asphaltic concrete is to be designed and placed in accordance with MODY's Specification for Hot mix asphaltic concrete and MODY's specification for performance graded asphalt binder.

3.2.3 Layout

Streets must be laid out wherever possible in prolongation of existing streets, either in the same subdivision or in adjacent subdivisions. In a phased development, the minimum length of street which will be considered for approval by the Municipality is 150 m, with the exception of cul-de-sacs.

An acceptable right-of-way access to adjacent properties must be provided and deeded to MODY. This right-of-way may have to be wider than normal to allow for future construction of road without disturbing adjacent land. These access roads must be located along the boundary in such a manner as to not prejudice development of adjacent land. The road must be graded to include Type 2 gravels, and services (water, sanitary, and storm), if required, must be provided to the property line. A guiderail shall then be installed at the entrance of the road.

The subsequent developer of the adjacent property is then responsible for completing the construction of the entire road, including the portion on adjacent property. This includes removal of the guiderail, removal of the temporary cul-de-sac (if one exists), installation of the remaining services (sewers, water main, curbs, etc.), grading the existing surface, and the installation of gravels and asphalt to finish the road.

In general, the use of continuous streets is encouraged and the number of cul-de-sacs shall be limited where the land can be effectively serviced by the continued extension of the road system. Where cul-de-sacs are to be provided they shall end in a cul-de-sac, have a right-of-way deeded to the Municipality, and not normally have islands. Where islands are necessary, the minimum radius of the island shall be 6 m and the minimum width shall be 9 m between curbs for urban roads and 6.4 m pavement width for rural roads. Islands shall be designed for low maintenance.

The maximum permanent cul-de-sac length where a walkway is located at the end of the cul-de-sac and connects to another street shall be 230 m for urban areas and 400m for rural roads.

Otherwise the maximum length shall be 100 m and 200 m respectively, measured from the intersection of the cul-de-sac's centerline and the street-line of the intersecting street to the centre of the cul-de-sac.

On cul-de-sacs with townhouse lots, a sidewalk may not be required unless there is a pedestrian destination on the route such as park or walkway; at the discretion of the Engineer.

3.2.4 Access

Other than cul-de-sacs meeting the requirements of section 5.2.3, any lot in a subdivision shall have at least two independent street accesses to the existing street system, and these accesses shall, where possible, be located at opposite ends of the subdivision.

Notwithstanding section 5.2.4 and other than cul-de-sacs meeting the requirements of section 5.2.3:

- Where there is an approved phasing plan and subdivision agreement in place confirming that a second street access will be provided within a specified time approved by the Engineer, up to 300 lots containing a maximum of 300 dwelling units may be approved prior to the second access being provided;
- Where, in the opinion of the Engineer, it is impractical to provide a second access, up to 100 lots containing a maximum of 100 dwelling units may be approved with a single access.

3.2.5 Right-of-Way

Minimum street rights-of-way for various roadway classifications are presented in Table 3.2. The Municipality may require a greater width of right-of-way to facilitate traffic, active transportation, construction and/or maintenance requirements.

Table 3.2 Minimum Street Rights-of-Way

Street Classification	Minimum Right-of-Way

Urban - Local	16 m
Urban - Local Industrial	20 m
Urban - Minor Collector	16 m
Urban - Major Collector	25 m
Urban - Arterial	32 m
Rural - Local	20 m
Rural - Local Industrial	23 m
Rural - Minor Collector	25 m
Rural - Major Collector	30 m
Rural - Arterials	40 m

3.2.6 Intersections

a. The maximum number of street approaches to any intersection shall be four.

b. The minimum centerline distance between intersections on the same side of the street shall be 75 m for local and minor collector streets (see Table 3.3).

c. The minimum centerline distance between adjacent opposite intersections shall be 45m for local and minor collector streets (see Table 3.3).

d. The minimum centerline distance between intersections on major collector and arterial streets shall be 150 and 500 m respectively (see Table 3.3).

e. The maximum centerline distance between intersections for local and collector streets shall not be more than 500 m and shall be laid out in such a manner as to not prejudice development of adjacent land (see Table 3.3).

f. Intersection of local & arterial roads is not permitted.

g. The minimum curb and edge of pavement radius for roads shall be in accordance with Table 3.4.

h. The angle subtended by the centre-line of intersecting streets shall be between 70 and 110 degrees.

i. The centre-line shall be a straight line for a minimum of 10 m measured from and along the intersection of the centre-line of the approach street and the edge of the shoulder/curb of the street to which it is connecting.

j. At intersections the Street Line shall be cut back from the extended street line intersection in accordance with Table 3.4.

Table 3.3 Minimum & Maximum Centerline Distance Between Intersections

Intersections on this Road Class:	Minimum distance between intersections (m)	Maximum distance between intersections (m)
Arterial: Same or opposite side of road	500	

Major Collector: Same or opposite side of road	150	500
Minor Collector: Same side of road Opposite side of road	75 45	500 500
Local: Same side of road Opposite side of road	75 45	500 500

Table 3.4 Design Parameters at Intersection

Intersection Type	Curb and Edge of Pavement Radii	Street Line Cut-Back
Residential Local at Residential Local	7.5 simple radius in new areas, 5.0 minimum in older areas; fire truck and moving van turns shall be possible between curb lines	4.5 m
Residential Local or Residential Minor Collector at Residential Minor Collector	7.5 simple radius in new areas, 5.0 minimum in older areas; fire truck and moving van turns shall be possible between curb lines	4.5 m
Commercial Local / Commercial Local or Commercial Minor Collector / Commercial Minor Collector	10.0 simple radius; fire truck and moving van turns shall be possible between curb lines	7.0 m
Industrial Local / Industrial Local or Industrial Collector / Industrial Collector	15.0 simple radius, but must accommodate truck turning functions well, 3-centred curve permitted, pedestrian crossing time and distance to be considered	11.0 m
Major Collector / Major Collector or Arterial / Arterial	15.0 simple radius, but must accommodate truck turning functions well, 3-centred curve permitted, pedestrian crossing time and distance to be considered	11.0 m

3.2.7 Driveways

Driveway access shall be in accordance with By-law Number **XXXXX**, By-Law Respecting Streets.

Driveway ramps for residential driveways shall be dropped curb. Curb radius returns may be permitted on commercial, institutional and industrial properties at the discretion of the Engineer.

Driveways in rural areas shall incorporate concrete headwalls

3.2.8 Community Mailboxes

Shall be located within the right-of-way.

Community Mailboxes shall be located on local streets wherever possible. If located on urban collector streets, laybys may be required. Laybys are required on all rural local/private road applications

Community Mailbox locations shall not be located within 30 m of a street intersection controlled by traffic signals, within 30 m of the intersection of a major street and within 8 m of the intersection of a local/private street.

3.3 Geometric Design

3.3.1 Design Speed

The applicable design speed shall be in accordance with Table 3.5.

3.3.2 Vertical Alignment

The minimum grade shall be in accordance with Table 3.5.

The minimum centre line grade of any street shall not be less than 0.5 percent. The minimum centre line grade on a cul-de-sac shall be such as to provide a minimum curb or ditch grade of 0.5 percent.

The maximum grade allowed on any local/private road shall not exceed 10 percent. Under exceptional circumstances, MODY may allow a grade of 12% for local/private roads only.

The grade of a minor road at an intersection shall match the cross section of the major street at that point. The grade shall continue for a minimum of 20 m from the intersection and shall not exceed 4 percent.This will be measured along the centerline of the intersecting street, from where the centerline intersects with edge of the travelled way of the major street.

The maximum centerline grade of cul-de-sac bulbs shall not exceed 6 percent.

Cul-de-sac shall be graded to drain from the centre to the curb or ditch.

Curb elevations at intersections, critical grade locations, and bulbs of cul-de-sac shall be shown on drawings at a minimum 3 m spacing.

Driveway grades shall match the typical street cross section within the street right-of-way.

The maximum grade for a residential driveway shall be limited to 15 percent. The maximum grade for commercial and industrial driveways shall be limited to 8 percent.

Minimum K values for vertical curves shall be in accordance with Table 3.6.

For non-illuminated roadway conditions, headlight control values must be used for sag vertical curves.

For illuminated conditions, comfort control values may be used where there is adequate street lighting to better match design grades with existing grades.

Table 3.5 Geometric Design Parameters for Urban and Rural Roads

Parameter	Local/private *	Local 50	Local Industrial	Minor Collector	Major Collector	Arterial
Posted Speed (km/h)	50	50	50	60	70	80
Design Speed (km/h)	40	60	60	70	80	0
Min. Grade	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Max Grade	10%**	10%**	8%	8%	6%	6%

Superelevation	no	no	no	Optional	yes	yes
Min. ℄ Curve Radius	20 m	100 m	100 m	see TAC	see TAC	See TAC
Sight Distance Requirements	45 m	65 m	65 m	85 m	TSD	TSD

TAC Transportation Association of Canada Geometric Design Guide for Canadian Roads
TSD Turning Sight Distance
(*) Local cul-de-sacs, p-loops or crescents which are less than 400 m in length.
(**) A 12 percent grade may be allowed under exceptional circumstances.

3.3.3 Super Elevation

Collectors and arterials shall be superelevated in accordance with the TAC Geometric Design Guide. The maximum superelevation rate used (eg. 0.04 m/m) shall be approved by the Municipality.

Local/private streets generally shall not be superelevated unless there are safety or drainage concerns. Where superelevation is used on a local/private street it shall be carried out in accordance with the TAC Geometric Design Guide.

3.3.4 Horizontal Alignment

The minimum curve radius to be used for collectors and arterials will be directly related to the design speed and the maximum superelevation rate used, and shall be in accordance with the TAC Geometric Design Guide.

The minimum centerline curve radius shall be in accordance with Table 3.5.

Tangent distances between horizontal reverse curves shall not be less than 20 m.

Tangent distances between horizontal curves turning the same way should not be less than 40 m.

3.3.5 Stopping and Intersection Sight Distance

Minimum stopping sight distance as defined by the TAC Geometric Design Guide shall be provided for all driveways on all streets in accordance with Table 3.5.

Minimum stopping sight distance shall also be provided at intersections in accordance with TAC Geometric Design Guide.

Minimum turning sight distance, shall be as defined by the TAC Geometric Design Guide.

Table 3.6 Minimum K Factors to Provide Stopping Sight Distances on Vertical Curves

Design Speed (km/h)	**Crest Vertical Curves Rate of Vertical Curvature (K)**	**Sag Vertical Curves Rate of Vertical Curvature (K)**	
		Headlight	Comfort
30	2	4	2
40	4	7	4
50	7	12	6
60	13	18	9
70	23	25	12

80	36	32	16
90	see TAC	see TAC	see TAC
100	see TAC	see TAC	see TAC
110	see TAC	see TAC	see TAC
120	see TAC	see TAC	see TAC
30	see TAC	see TAC	see TAC

TAC: Transportation Association of Canada Geometric Design Guide for Canadian Roads

3.4 Cross Section Elements

3.4.1 Roadbed

Roads shall be centred within the right-of-way and shall have a cross-slope as indicated on the standard details.

The travel way and road surface widths for public roads shall be in accordance with the standard details.

On sections where a guide rail is required, the roadbed width shall be increased by one metre on the side where the guide rail is to be installed.

A geotechnical report prepared by a professional engineer is to be submitted to the Engineer for review with the design drawings or after grubbing operations but prior to subgrade construction. The geotechnical report shall address the geological and hydrological aspects of the development and shall determine soil types.

The geological section of the report shall include but not be limited to:

- slope stability;
- buried landfill;
- sieve analysis representative of road subgrade;
- identification of poor subgrade materials such as quick soils, swelling soils, deep fills and highly organic deposits;
- highly erodible soils;
- identifying frost susceptible soils;
- proposing solutions to mitigate their effect.

The hydrological section of the report shall include but not be limited to the identification of groundwater level and underground streams, notwithstanding that allowances have to be made for groundwater levels determined during dry weather conditions. If it is probable that the existing subgrade to a depth of 1.5 m below finished grade may be subject to frost heave, the engineer shall identify solutions to prevent frost damage.

The street roadbed shall include as a minimum, the asphalt and gravel base structure shown on the standard detail for the classification of road required. Additional granular materials may be required depending upon the subgrade type, which are defined as follows:

- Silt/Clay Option 1: refers to materials with more than 25 percent silt/clay size particles
- Silt/Clay Option 2: refers to materials with more than 25 percent silt/clay size particles and are above optimum moisture content
- Granular Till: refers to materials with less than 25 percent silt/clay size.
- Rock Fill: refers to blasted rock fill.
- Rock Fill, 100mm: refers to blasted rock fill meeting the following gradation:

Sieve Size (mm)	Percent Passing
100	100
5	25 - 80
0.08	0 - 10

3.4.2 Lane Width

The lane widths for locals, collectors and arterials shall be in accordance with the standard details. Lane widths adjacent to concrete curb and gutter shall be measured from the face of curb.

The minimum parking lane width shall be 2.4 m. On-street parking is permitted on at least one side of local streets. The decision on the street category and the parking allowances rests with the Engineer.

3.4.3 Shoulders (Roads with Rural Cross Sections)

The minimum shoulder width (inclusive of shoulder rounding) for all rural roads shall be 2.0 m.

On sections where a sidewalk may be required in the future, the shoulder width shall be increased by a minimum of 1 m, or as otherwise required by the Engineer.

Where the grade of the road exceeds 7%, an asphalt swale is to be installed along each side of the road (abutting the asphalt travelled way) with a runoff to the ditch every 30 m. At the discretion of the Engineer, and considering certain circumstances (ie. superelevation), the swale may be omitted from one side of the road (see standard detail in Part B).

3.4.4 Ditches

Roadside ditches shall be constructed as per the rural road standard details and MODY requirements.

When a false roadside ditch is required, construct as per MODY guidelines and provide any required false ditch easements in favour of MODY.

3.4.5 Medians and Boulevards

The standard width for a raised concrete median shall be 4.5 m. Under special circumstances, this may be reduced to 1.2 m. Median width shall be measured from face of curb to face of curb.

The minimum boulevard width for an urban local and minor collector road shall be 1.5 m and shall be measured from face of curb to edge of sidewalk. The minimum boulevard width for major collectors and arterials shall be 2.0 and 2.85 m respectively.

3.4.6 Cut and Fill Slopes

For common excavation, side slopes in cuts shall be no steeper than 3:1 (horizontal to vertical) with the following exceptions: If the cut slope is 1.5 m or less in height (measured from top of ditch or top of curb), a 2:1 slope may be permitted. If the cut slope is greater than 1.5 m in height, a 2:1 slope may be permitted if a geotechnical report is provided.

For rock excavation, side slopes in cuts shall be no steeper than 1:2 (horizontal to vertical). On rock cuts over 1.2 m high (measured from top of ditch or top of curb), a safety fence, as per the standard details, shall be provided on private property. On cuts greater than 1.2 m in height, a 1:1 slope may be permitted to waive the requirement for a safety fence.

Embankment slopes shall be a maximum of 2:1. More gentle slopes shall be required for less stable material.

Cut slopes for rural roads that do not intercept existing grade within the street right-of-way shall be benched beginning at street line for a distance of 3 m before the cut slope continues.

All overhanging and loose rocks shall be removed from the slope. The Engineer may require slope stabilization of rock faces (e.g. wire mesh, shotcrete, etc) if unsafe conditions exist or the rock is susceptible to weathering.

The Engineer may require certification from a Geotechnical Engineer that areas adjacent to streets or easements are and will remain stable.

3.4.7 Guide Rails

In general, guide rails are to be provided on all local/private, collector and arterial roads where fill heights exceed 3 m unless a slope of 6:1 can be provided.

Guide rails may also be required to provide protection from other hazardous areas such as bridge piers, overhead signs, bodies of water, rock cuts, transformers, etc.

3.4.8 Utilities

All sewers, watermains, natural gas pipelines, electrical, communication and other such utilities located within the right-of-way must have Municipality approval with respect to location, prior to their installation.

The minimum pole setback shall be 450 mm from face of curb to near side face of pole for local urban roads and 600 mm for urban collectors and arterials. On rural roads, the pole shall be set at least 1 m beyond the outside edge of the ditch where a ditch exists, otherwise set poles 600 mm inside street line.

3.4.9 Sodded Areas

Sodded areas shall consist of a minimum of 150 mm of topsoil and sod. Hydroseed will be permitted on slopes beyond the right-of-way.

3.5 Retaining Walls

Retaining walls are not normally accepted as a means of handling grade differentials associated with streets or services in the Municipality.

Retaining walls can create a hazardous situation and an on-going maintenance cost as well as a future capital cost when the wall needs to be replaced. The street and service systems are to be designed such that retaining walls are avoided if possible.

In the extreme circumstances that a retaining wall is acceptable to the Municipality, the wall shall be designed by a Professional Engineer with due consideration given to soundness of material, stabilization, safety, maintenance and other relevant features. As a minimum, retaining walls over 1 m in height must have a handrail or safety fence incorporated into the design. The handrail or safety fence must be a minimum of 1.05 m in height (see standard detail in Part B).

Where retaining walls support any portion of the right-of-way, wall type and material to be to the satisfaction of the Engineer. Retaining walls, including footings, shall be located on private property unless approved by the Engineer.

3.6 Signs

The developer is responsible to supply and install sign bases and posts, the Municipality will then supply and install the sign. At the discretion of the Engineer, utility poles may be used for signs if they are in the appropriate location.

Street name signs shall be erected at each intersection with one sign for each leg of the intersection and one post for each approach street. Street name signs shall be to the Municipality's Standard.

Regulatory signs shall be included in the Engineering Design.

3.7 Construction

All clearing, grubbing, pipe work, roadwork, etc. is to be carried out in carefully planned phases in conjunction with the erosion and sediment control measure to minimize the environmental impact of construction.

All construction shall meet the requirements of MODY Specifications together with the Standard Specifications for Municipal Services, as developed by the Nova Scotia Road Builders Association and Consulting Engineers Nova Scotia Joint Committee on Contract Documents.

Echelon paving shall be used for all lifts of asphaltic concrete on new street construction which exceed 300 metres in length.

4 WALKWAYS, SIDEWALKS AND CURB AND GUTTER

4.1 Walkways

The design criteria presented herein applies, for the most part, to walkways located on urban roads. Other facilities such as walkways located in developments outside of the urban areas and nature trails located in conservation zones or park areas shall be designed to suit the natural condition of the area and shall be in consultation with the Engineer and other appropriate Departments of the Municipality.

Selection of locations for walkways shall take into account the requirements for pedestrian circulation for the neighbourhood. For example, if a walkway ends on a street with a single sidewalk, the sidewalk should be located on the side of the road to meet the walkway. If the layout of the development would require a walkway to terminate opposite a single sidewalk, then a second sidewalk from the walkway to the nearest appropriate roadway intersection shall be required.

The walkway shall have a minimum right-of-way width of 4.5 m. At the discretion of the Engineer, additional easement or right-of-way width may be required to facilitate construction and maintenance of Municipal infrastructure. Where the wastewater and stormwater easement is within a walkway, the easement shall be a minimum width of 6.0 m as per MODY guidelines, and the easement shall be granted to MODY prior to the transfer of ownership of the walkway to MODY.

The travelled portion of a walkway shall be centered within the right-of-way unless approved otherwise and shall have a minimum width of 1.8 m.

A minimum of 150 mm of topsoil and sod shall be placed on each side of the travelled portion and shall extend for the full width and length of the walkway right-of-way. In locations where maintenance of the sod may be difficult, mulch or other ground cover may be accepted or required.

Walkways shall be located and designed whenever possible so that the grade of the walkway shall not exceed 8%. Steeper grades may be permitted only where the topography makes it impractical for grades to be less than 8%, or to avoid the installation of stairs. On streets where the maximum grade is 10%, the maximum walkway grade is 10%.

A pedestrian ramp shall be constructed at the ends of walkways where curb and gutter is present. Pedestrian ramps shall be placed at all crosswalk locations.

Each side of a walkway right-of-way shall be fenced. The fence shall be commercial grade galvanized chain link material, 50 mm wire mesh, No. 9 Gauge, shall be 1.2 m high and shall be as specified by the National Standards of Canada CAN2-138.1-M80, CAN2-138.2-M80, CAN2-138.3-M80.

The right-of-way shall be graded to control surface water and major drainage within the right-of-way. Landscaped and sodded swales, catch basins, pipe and drains shall be provided to control erosion and maintain a safe surface. Swales, where required, shall not be located closer than 600 mm from the edge of the travelled portion.

Walkways shall be lighted and shall be oriented as to benefit from street lighting where possible. The maximum distance between lights on a walkway shall be 75 m.

4.2 Sidewalks

The minimum width of sidewalks shall be in accordance with the standard details. Sidewalks shall be provided on both sides of collectors and arterial roads. Sidewalks shall have a 1.5 m clear zone around all utility poles, sign posts, etc., to accommodate winter maintenance vehicles.

See the Municipal Roads/Streets section for landscaped median widths between curb and sidewalk.

In locations with curbs, pedestrian ramps shall be installed on both sides of each road at all roadway intersections, and at Canada Post Community Mail Box locations. A pedestrian ramp is not to be installed at the end of a sidewalk unless the sidewalk ends at a roadway intersection.

No concrete sidewalk shall be placed between October 15 and May 1 unless approved by the Engineer and under an approved Quality Management Plan.

4.3 Concrete Curb and Gutter

No concrete curb and gutter shall be placed between October 31 and May 1 unless approved by the Engineer and under an approved Quality Management Plan.

4.4 Construction

All construction shall meet the requirements of MODY Specifications together with the Standard Specifications for Municipal Services, as developed by the Nova Scotia Road Builders Association and Consulting Engineers Nova Scotia Joint Committee on Contract Documents.

5 TRENCH REINSTATEMENT

5.1 Introduction

This section documents the requirements for reinstatement of trenches within the MODY.

Rights-of-Way. This document does not address trench excavation procedures, trench design, or associated safety related issues.

5.2 Backfill Materials

The backfilling of trenches within roadways requires placement of the following material types:

a. Embedment Materials

Embedment material is designed to provide a protective layer surrounding the utility and is comprised of the bedding layer, the haunch layer, and the cover layer. Bedding material shall be Type 1 gravel, or under limited conditions sand or clear stone (for example, around natural gas pipelines). Type 1 gravel shall meet all specification requirements of the Standard Specifications for Municipal Services.

Bedding material separating the trench base and service utility shall have a minimum compacted thickness of 100 mm. Haunch and cover layers shall be placed at a maximum thickness of 200 mm prior to compaction. All embedment material shall be compacted to a minimum density equal to 95% of Standard Proctor density. Sand used as embedment around natural gas pipelines does not require the same level of compaction; however, the compaction requirements must be achieved for all other layers and the expectation is that the sand layer does not negatively impact on the street and sidewalk related infrastructure. The use of clear stone shall be restricted to those conditions where the trench base holds excessive free water or conditions that prohibit the use of specified materials. The clear stone shall be surrounded with geotextile fabric to prevent migration of fines into voids in the clear stone.

b. Structural Fill

Structural fill shall be placed immediately over the embedment material and extend to the subgrade for street gravels. Structural fill shall be placed in uniform layers not to exceed 300 mm before compaction. The top 300 mm of structural fill shall be compacted to a minimum density equal to 98% of Standard Proctor density with the underlying structural fill compacted to a minimum of 95% Standard Proctor density.

Structural fill may be suitable naturally occurring material or imported fill similar in composition to naturally occurring material. In either case the material shall be free of excessive organics or deleterious materials and be moisture conditioned to within ± 3% of the optimal moisture content as determined by the Standard Proctor test. Where natural occurring clayey soils are utilized as structural fill moisture conditioning in the form of drying may be required. The determination of "suitable natural occurring material" will be at the discretion of MODY. Controlled density fill or unshrinkable fill may be approved by MODY for use in small quantities in tight or restricted-access areas where placing and compacting of fill or gravel is difficult. Controlled density fill shall not interfere with natural subsurface drainage patterns and be located a minimum of 600 mm below ground level to prevent differential frost movement. Controlled density fill shall meet the requirements of the Standard Specifications for Municipal Services.

c. Type 1 and Type 2 Gravel

Type 1 and Type 2 gravels shall be placed between the structural fill and the asphaltic concrete at the thickness specified in the street classification standard details. Type 2 gravel may be replaced with Type 1 gravel on shallow trenches. Gravels shall be compacted to a minimum density equal to 100% of Standard Proctor density.

5.3 Asphaltic Concrete

Asphaltic concrete shall meet MODY's specification. The asphaltic concrete shall be placed over a Type 1 gravel base. The thickness, number of lifts and type of asphaltic concrete placed in any trench excavation shall be in accordance with the standard detail for the street classification. Asphaltic concrete shall be compacted to a minimum of 92% of the theoretical density based on comparative loose mix samples recovered from the project.

Specific requirements pertaining to the remediation of pavements are provided below;

- The pavement thickness shall not exceed that specified for the street classification in the standard detail for the street classification irrespective of pavement types (rigid, flexible, cobble stone).
- Asphaltic concrete shall be placed with an asphalt spreader on streets where the SDI is greater than 6.0; the trenches are longitudinal and wider than 1.5 meters

- Where a concrete layer directly underlies the asphaltic concrete the concrete shall be replaced with asphalt, and the replacement thickness of asphalt shall be the lesser of 250 mm or the combined thickness of the existing concrete and asphalt structure.
- Shallow Trenches are those with a maximum depth of 1.2 m, and are typically for gas lines, telecommunication or electrical conduits and other utilities.
- Deep Trenches are those deeper than 1.2 m, and are typically for sewer and water pipes, but may include other utility pipes or conduits.
- Except for local/private streets, the asphaltic concrete joint shall be located outside the wheel path of vehicles.
- On streets that have an SDI greater than 4.0 the existing asphaltic concrete shall be cut back far enough that the edge is above gravel and soil that has not been disturbed by the excavation. The minimum cut back shall be 200 mm for shallow trenches and 300 mm for deep trenches.
- Prior to placement of asphaltic concrete, the edges of the existing asphalt shall display smooth vertical cuts (full depth asphalt cut is required; however, if asphalt is greater than 250 mm a variance may be approved) which are in a straight line along the outside of the trench and parallel to the pavement cut on the opposite side of the trench. For longitudinal trenches the minimum distance between jogs (approximate 90 degrees to the edge of the pavement) shall be 5 meters, with no more than 4 jogs along any 50 meter section of trench. Jogs are normally not permitted for transverse cuts. Asphalt cuts are not to end at manholes or valves, and shall be a minimum of 1 meter from these structures.
- The asphalt edges shall be clean and dry prior to applying a uniform application of tack coat which should be allowed sufficient time to cure prior to the placement of joint sealant and asphaltic concrete.
- Adhesive joint sealants such as Denso Reinstatement Tape or equivalent shall be used on construction joints on roadways which have an SDI greater than 4.0. This requirement may be waived in isolated areas where the existing asphalt is in such poor condition that placement of joint sealant is not practical.
- At the discretion of the MODY representative Type C-HF asphalt may be utilized for the full depth of reinstatement, and for Local/private roads Type C-HF may be replaced with Special Type C. Individual lift thicknesses shall not exceed 75 mm for Type B-HF and 50 mm for Type C-HF asphaltic concrete. The Engineer may consider one lift up to 125 mm for narrow and shallow utility trenches with the expectation that the compaction requirements are met. In addition, the surface course shall not exceed the design thickness as specified in the standard detail for the street classification.
- The proposed trench asphalt cut on a street with an SDI greater than 4.0 shall be moved to the following locations if within one meter of the:
    - edge of existing pavement.
    - edge of concrete curb or curb and gutter.
    - existing asphalt joint (provide a new clean cut).
- Where more than 75% of the street asphaltic concrete pavement width is removed for a trench and the SDI of the street pavement is greater than 6.0 the existing asphaltic concrete on each side of the trench (to the full width of the street pavement) shall be milled and paved to a thickness of 50 mm. Where the street asphaltic concrete pavement width removed is between 50% and 75% and the SDI of the street pavement is greater than 6.0, the existing asphaltic concrete on each side of the trench shall be milled and paved to a thickness of 50 mm to the nearest existing longitudinal asphalt joint. If the existing asphaltic concrete in the above two cases is less than 75 mm, the full depth of the asphalt shall be removed and replaced.
- The surface of the asphalt patch shall conform to the cross-section of the street surface to within 6 mm when checked with a 3 meter straightedge placed in any direction. There shall be no noticeable pavement marks or “ripples” caused by rolling and compaction of the asphalt.
- Trench reinstatement between October 31 and May 1 shall be considered temporary (unless under an approved Quality Management Plan), and shall be replaced to these specifications the following construction season (between May 1 and June 15). Temporary reinstatement shall include a minimum thickness of 300 mm for gravel and 50 mm for asphaltic concrete.
- Trenches that are open to vehicle or pedestrian traffic shall be reinstated with permanent or temporary asphalt (minimum of 50 mm thick) within 5 business days for Local/private Streets and 3 business days for Collector and

Arterial Streets. Temporary asphalt placed between May 1 and October 31 shall be replaced with permanent asphalt within 45 days or by October 31, whichever comes first. Temporary asphalt placed between October 31 and May 1 shall be replaced with permanent asphalt by June 15.

5.4 Concrete Curb, Sidewalk and Driveways

Concrete curb, sidewalk, and driveways shall meet the requirements of the MODY specifications.

Concrete curb shall be placed such that the minimum distance between any joints in the existing or proposed curb is 1.2m.

5.5 Testing and Engineer's Report

An Engineer's Report is required to certify that the requirements of the Trench Reinstatement specification have been met.

The requirements for bedding, haunch, cover, and structural backfill are included in the standard detail for Trench Backfill and Reinstatement – Testing; however, the Engineer's Report for these materials will only be required when the total length of trench for the project exceeds 100 meters, or when the MODY inspector has reason to believe that the specifications for those materials is not being met by the contractor. Compaction tests may not be required on the Type 2 gravel in emergency situations.

The Engineer shall be a registered professional engineer licensed to practice in the Province of Nova Scotia who is in good standing with Engineers Nova Scotia and experienced in the testing requirements of this specification. The Engineers report shall be submitted to MODY within 2 weeks of completion. Maintain copies of all test results for a period of 2 years after the test date and if requested, make them available to MODY.

5.6 Warranty Period

Any Contractor carrying out work under an MODY Streets and Services Permit is deemed to have become familiar with this specification and hereby agrees to carry out the trench reinstatement in accordance with this document. The utility cut shall have a warranty for a period of 2 years as stipulated in By-law Number S-300. Any deficiencies identified by MODY shall be rectified within the time requested by MODY.

6 STREETS AND SERVICES ACCEPTANCE REQUIREMENTS

6.1 General Requirement

Prior to MODY accepting streets and services, the applicant must submit the following:

- Record drawings, certified by a Professional Engineer, in 3 mil Mylar and electronic AutoCAD format prepared in accordance with the record drawing procedures contained in this document and a digital ASCII file containing three dimensional coordinates for all critical points, ie. manholes, inverts, valves, water mains, sewers, underground utilities, sign posts, curbs, sidewalk, trees, etc.;
- Detailed records of all actual construction costs and quantities breakdown for each street;
- All warranty deeds for streets, walkways, easements, parkland, and any other property being conveyed to the Municipality to be conveyed to the Municipality, in the specified form, at no cost to the Municipality;
- Three copies of the final plan of subdivision showing the entire constructed Municipal street and all drainage easements or rights-of-way outlined in red; road reserves, walkways and parks outlined in yellow and easements outlined in green.
- A certificate of title prepared by a solicitor, in the specified form, certifying that the conveyed lands are free from encumbrances;

- Certification by a Nova Scotia Land Surveyor stating that all services have been installed within the boundaries of the streets, easements, walkways and any other land(s) reserved for public purposes; and that the as-constructed centre line of the public street coincides with the final legal subdivision plans of the public street;
- Certificate of Compliance from a Professional Engineer certifying that all works have been inspected and are completed according to the approved engineering drawings and specifications;
- Copy of the Certificate to Construct from NSE and Professional Engineer's Certification of Compliance with NSE requirements for site stabilization and erosion control.
- A final copy of the Geotechnical Materials Testing Report prepared by a certified Professional Engineer including confirmation of materials, the thickness, and compaction of subgrade, and in accordance with section 4.4.1.4.
- Warranty Security for one year in the amount of 10% of the actual costs of the streets and services.
- Where services such as power-lines, communications, gas mains, etc., are placed within MODY right-of-way, MODY requires certification from the service provider that infrastructure has been designed and installed to their requirements.

6.2 Storm Drainage System Requirements

- Submission and acceptance requirements to MODY and Construction Specifications.
- Video inspection (CCTV) and report, including catch basin leads (required again immediately prior to end of the warranty security period.) CCTV reports shall require; at a minimum, the date, weather, material, pipe size, length of pipe, location, direction of flow and include an overall plan illustrating the location. Pan and tilt cameras shall be used for all connections.
- Pipe test report, including laterals to the property lines.
- Manhole and catch basin report.
- Sewer lateral cards in MODY format. Non-erasable pen shall be used in all fields.
- Pipe lateral bedding, materials testing, and compaction results.

6.3 Street Requirements

- Professional Engineer's Certification of Inspection and Completion at the following stages of street construction:
- after clearing (pre-construction).
- after grubbing (before culvert and drain installation).
- at subgrade prior to application of any gravels.
- prior to surfacing gravel being applied.
- prior to paving.
- Final (prior to acceptance of services by the Municipality).
- Copies of laboratory and field tests of materials (sieve analysis, density tests, concrete compressive strength tests, etc.), confirming that the specified standards for the materials were achieved;
- Professional Engineer's Certification of asphalt mix, materials and plant placement are in compliance with MODY asphaltic concrete specification requirements.
- Testing and Engineer’s Report as per the Trench Reinstatement section.

PART B – SERVICES DESIGN GUIDELINES

1 WATER SYSTEM

Design and construction of all water systems must comply with the Town of Yarmouth standards.

2 WASTEWATER AND STORMWATER SYSTEM – COMMON ELEMENTS

Elements exist which are common to both Wastewater and Stormwater systems. This section deals with the requirements for those elements.

2.1 Pipe

Refer to Section 3.0 and Section 4.0 for pipe material. The Engineer will determine the type of pipe to be used in rehabilitation work on a case by case basis.

Earth loads and the effects of concentrated and distributed superimposed (live) loads on the pipe shall be calculated for 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.

The strength of the pipe in place divided by a factor of safety of 1.5 shall be equal to or exceed the loads imposed upon it by the weight of the backfill and any superimposed loads, taking into account the class of pipe bedding and depth and width of trench.

2.2 Maximum/Minimum Depth

When determining the depth of the pipe, the design shall facilitate gravity connections for future extensions to wastewater and stormwater systems to service adjoining lands by gravity and also to facilitate gravity service connections from buildings on adjoining lots.

The depth of the pipe, measured from the finished surface to the crown of the pipe, shall not exceed 5.0 m. However, under special conditions (e.g. elimination of a pumping station), the maximum depth of the pipe may be increased. However, service connections deeper than 5.0 m at the main are not permitted and shall be addressed by installing a rider wastewater or stormwater system.

The minimum depth, to the crown of the pipe, shall be:

- 1.6 m for the wastewater or stormwater main
- 1.2 m for wastewater or stormwater service connections

At the discretion of the Engineer, if a shallower depth is approved the pipes shall have insulation placed above them.

2.3 Pipe Bedding

The bedding shall be engineered based on soil condition, depth of bury and type of pipe.

Special bedding requirements must be met in certain wastewater situations (see Section 3.0 (Wastewater System)).

At minimum, bedding material shall be Type 1 gravel compacted to 95% Standard Proctor density. Under some conditions, the Engineer may approve clear stone substituted for Type 1 gravel.

The bedding shall be engineered so as not to affect the ground water adversely.

2.4 Location

All wastewater and stormwater systems shall be constructed within a street traveled way of the MODY and shall be installed closest to the crown or center line of the street. Easements shall 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.

Where a need is identified to facilitate continued / future development on adjacent lands, wastewater and stormwater systems and easements shall be extended to the limit of the property boundary of the subdivision / development.

Easement widths are determined by the depth from the centerline elevation of the road or ground to the inverts of the wastewater, stormwater or water systems. MODY will determine the placement of the underground infrastructure – on centre or offset – within the easement. The minimum easement widths required for wastewater and stormwater systems and water systems is as follows:

If system size and depth is	The minimum easement width is…
Single wastewater / stormwater system or water system equal or less than 600 mm diameter and less than 3.7 m deep	6.0 m
Two wastewater / stormwater systems in the same trench	7.5 m
Single wastewater / stormwater system in excess of 3.7 m deep or single water system equal or larger than 750 mm diameter	9.0 m
A combination of two mains, either wastewater / stormwater system or water system less than 3.7 m deep	9.0 m
A combination of two mains, either wastewater / stormwater systems or water system, in excess of 3.7 m deep and no closer than 3.0 m to easement limit	12.0 m
Major trunk wastewater / stormwater systems or transmission water system	20.0 m
Three or more mains, no closer than 3.0 m to easement limits	Add 3.0 m for each additional wastewater/ stormwater system or water system

A cross section shall 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 wastewater and stormwater systems shall 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 shall be a gravel surface for grades up to 6% and asphalt for grades 6% to 8%.

Where the wastewater and stormwater systems easement is within a walkway, the easement shall be granted to the MODY prior to the transfer of ownership of the walkway to the MODY.

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

2.5 Manholes

Refer to SECTION 3.2.1 for requirements specific to wastewater manholes.

Manholes shall be constructed from precast sections meeting ASTM C-478 with Oring gaskets, or approved equal. The top of the precast manhole shall be a flat top cover conforming to CS 700 loading requirements of the Canadian Highway Bridge Design Code. The manhole capping section shall be Shaw GC series or equivalent. The grade adjustment section of the manhole, measured from the top of the flat top cover to the bottom of the frame shall be a minimum of 300 mm and a maximum of 600 mm. The wastewater system manhole inclusive of the grade rings, shaft, precast sections and base shall be constructed with a Blueskin waterproofing membrane and gaskets.

Stormwater system manholes are not required to be constructed with a waterproofing membrane.

Manhole frame and covers shall be IMP R10 or equivalent with MODY logo. Manhole covers shall have one vent hole for air testing and removal of cover. Adjustable manhole frames and R-10 covers shall be used in asphalt and concrete surfaces. Approved products are as follows:

- IMP C-56N.
- Mueller Model AJ600.

All manholes not located in the street right of way are to have an IMP R12 frame and cover (with locking system).

Manholes shall be tested from the concrete cover if an adjustable manhole frame is to be utilized.

Final grade adjustment shall be completed utilizing the following methods.

- Air entrained 35 MPa concrete or an approved non-shrink grout. If final grade adjustment exceeds 150 mm in height then circular 15M rebar must be incorporated in the raised section.
- Pre-cast concrete grade rings (max. 2 rings), with a minimum grade ring size of 150 mm.

Manholes shall be benched. Benching shall start two thirds the height of the pipe and slope upwards at a slope of 4:1 (horizontal : vertical). Benching within manholes shall incorporate half pipe channels to direct the flow from incoming pipes or connections to the outgoing pipe with as long a radius bend as possible. There shall be no void or gap between the pipe and benching.

Manholes shall be provided as follows:

- at all main intersections.
- at any change in:
- ipe size.
- pipe material.
- grade.
- horizontal alignment.

For connection of mains or service connections to manholes, use “A-LOK” gasket or approved O-ring gasket. “A-LOK” or approved O-ring gaskets shall be thoroughly cleaned then generously covered with lubricant specified by the pipe manufacturer.

For connection of mains or service connections to existing manholes, “Kor-N-Seal” or “INSERTA TEE” fittings may be used in place of “A-LOK” or O-ring gaskets. If “Kor-N-Seal” or “INSERTA TEE” fittings cannot be used, new manhole sections shall be installed incorporating “A-LOK” or O-ring gaskets.

The excavation below the mains or service connections shall be backfilled with unshrinkable fill.

“Kor-N-Seal” or “INSERTA TEE” fittings are to be installed according to manufacturer’s specifications.

Epoxy/sand coated stubs grouted into the manhole or main are not permitted. Stubs with a grouted in O-ring are also not permitted.

The maximum spacing between manholes shall be 100 m.

Drops through manholes shall be set so that:

- the drop through the manhole shall be equal to the head loss through the manhole.
- the drop shall be a minimum of:
    - Straight run - 50 mm.
    - Deflections up to 45° - 60 mm.
    - Deflections 46° to 90° - 75 mm.
    - In coming legs of tees or cross junctions - 100 mm.

- Pipe deflections through a manhole base greater than 90° are not permitted.

A drop manhole shall be constructed when the vertical drop between any inlet pipe invert and the outlet pipe invert exceeds 1.0 m. External drop manholes shall be used when the inlet pipe exceeds 375 mm in diameter. Internal drop manholes shall be sized to provide a minimum clear width inside the manhole of 1000 mm.

The benching area shall be properly formed and channeled, on a vertical radius, to direct the dropped sewage to the outlet pipe without turbulence. Drop manholes are only to be used when necessary.

The minimum internal diameter of a manhole shall be 1050 mm. Larger diameter manholes shall be provided for larger diameter pipes. Precast units shall also meet the manufacturer's recommendations for manhole sizing.

A connection to an existing manhole, unless driven by servicing considerations and approved by the Engineer, shall be limited to a 3.0 m depth from finished grade to crown of pipe and the internal section shall be constructed with a drop pipe. The excavation below the pipe at the manhole wall shall be backfilled with unshrinkable fill.

Where two manholes are closer together than 300 mm, the space between is to be filled with unshrinkable fill.

Backfill around manholes shall be Type 2 gravel extending a minimum of 300 mm outward from the exterior face of the manhole and vertically from bedding material to the bottom of roadbed gravels.

Where a manhole is located outside of the paved street limits or in a gravel shoulder than it shall be provided with an asphalt apron as per MODY requirements.

2.6 Service Connections (wastewater and stormwater)

2.6.1 Residential

In those areas where service connections have already been installed, the connections shall be extended into the lot at the same diameter as those found in the ground.

Wastewater Service Connections

New residential Single Unit Dwelling service connections shall be a minimum of 125 mm in diameter.

Gravity wastewater service connections of 150 mm diameter or less shall be PVC DR28 (white) from the main to the building foundation.

Wastewater service connections shall not connect to a dead end manhole. All service connections are to be made directly to the pipe downstream of the dead end manhole.

Stormwater Service Connections

New residential Single Unit Dwelling service connections are to be a minimum of 100 mm in diameter.

Stormwater service connections are to be PVC DR35 (green) from the main to the building foundation.

Pressurized Wastewater Service Connections (Privately Pumped Systems)

Pressurized wastewater service connections (leading from a private pumped system) shall be a minimum of 50 mm in diameter and shall be PVC DR26 or DR11 (series 160) HDPE from the building to the gravity wastewater service connection. Where a gravity wastewater service connection cannot be installed from the main to the property line, the Engineer may consider a direct connection of the pressurized wastewater service connection to the wastewater system. The pressurized wastewater service

connection shall be firmly connected to the gravity wastewater service connection or wastewater system by the use of a watertight prefabricated fitting.

A shut off valve shall be provided 300 mm inside the street right-of-way for a pressurized wastewater service connection installation if connecting to a forcemain wastewater system.

A trace wire shall be installed on pressurized wastewater service connections for location.

Where private or on-site low head pumps are required, such installations shall be designed by a qualified person and installed as per manufacturers requirements. Indicate on the drawings those locations requiring private pumping installations and private pressurized wastewater service connections.

2.6.2 Industrial / Commercial and Institutional (ICI)

In those areas where service connections have already been installed, the service connections shall be extended into the lot at the same diameter as those found in the ground.

Wastewater Service Connections

New wastewater service connections for ICI projects shall be a minimum of 150 mm in diameter.

Wastewater service connections shall be sized by an Engineer and submitted for approval by MODY.

Gravity wastewater service connections greater than 150 mm shall be PVC DR35 (white).

Monitoring access point manholes shall be installed for all ICI wastewater service connections.

Wastewater service connections shall not connect to a dead end manhole. All service connections are to be made directly to the pipe downstream of the dead end manhole.

Stormwater Service Connections

New stormwater service connections for ICI projects shall be a minimum of 150 mm in diameter.

Stormwater service connections shall be sized by a professional engineer and submitted for approval by MODY.

Stormwater service connections are to be PVC DR35 (green) from the main to the building foundation.

Monitoring Access Point manholes shall be installed for all ICI stormwater service connections.

Pressurized Wastewater Service Connections (Privately Pumped Systems)

Pressurized wastewater service connections (leading from a private pumped system) shall be a minimum of 50 mm in diameter and shall be PVC DR26 or DR11 (series 160) HDPE from the building to the gravity wastewater service connection. Where a gravity wastewater service connection cannot be installed from the main to the property line, the Engineer may consider a direct connection of the pressurized wastewater service connection to the wastewater system. The pressurized wastewater service connection shall be firmly connected to the gravity wastewater service connection or wastewater system by the use of a watertight prefabricated fitting.

A shut off valve shall be provided 300 mm inside the street right-of-way for a pressurized wastewater service connection installation if connecting to a forcemain wastewater system.

A trace wire shall be installed on pressurized wastewater service connections for location purposes.

Where private or on-site low head pumps are required, such installations shall be designed by a qualified person and installed as per manufacturers requirements. Indicate on the drawings those locations requiring private pumping installations and private pressurized wastewater service connections.

2.6.3 Installation of Service Connections

Service connections shall be installed according to the following provisions:

- Service connections shall be provided to each lot (including duplex and subdividable lots) or potential future lot which could be created by the zoning in place at the time of installation of services, by using in-line tees.
- The service connections (including the water service connection) shall extend from the main to at least 1.5 m outside the road right-of-way. At the discretion of the Engineer, the service connections may be allowed to terminate at the right-of-way. The service connections shall end in a bell end and be plugged with a PVC cap. The service connection from the 1.5 m at the right of way shall be made to the bell with a full length of pipe.

Residential service connections shall be laid at a minimum grade of 2%.

There shall be no decrease in size of the service connection from the building to the main.

A maximum of two service connections are permitted to connect to a manhole.

ICI service connections may be installed at a grade less than 2%, provided that the service laterals are designed and certified by a professional engineer.

ICI wastewater service connection piping shall be required to be tested.

Stormwater service connection piping shall not be required to be tested, however, it will be required to be certified by the design engineer.

Service connections with a diameter smaller than 200 mm and with an overall length greater than 25 m shall be installed with an access type structure, every 25 m, on private property. A 300 mm x 300 mm x 6 mm steel plate shall be placed above this structure, but 150 mm below the ground surface to allow for detection by a metal detector.

Service connections with a diameter of 200 mm or larger shall utilize manholes for changes in direction, shall be spaced a maximum of 100 m apart and be located on private property.

Wastewater manholes installed on a private wastewater service connection located outside of the municipal right of way are required to be vacuum tested.

Stormwater manholes installed on a private stormwater service connection located outside of the municipal right of way are not required to be vacuum tested, however, they will be required to be certified by the design engineer.

Service connections at the main shall be by one vertical long radius bend to a maximum of 45°.

One horizontal, long radius 22½° bend is permitted along the length of a service connection. If a greater bend is required, an access type structure shall be constructed at the bend on private property.

Service connections constructed in rock shall have the rock broken 3.0 m past the plugged end for the full trench width.

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.

Service connections (up to and including 200 mm in size) to new mains, use prefabricated tee or wye fittings of the same material as the pipe.

Service connections (250mm in size or greater) to new mains, a pre-cast base manhole shall be required to be installed for this connection.

Service connections (up to and including 200 mm in size) to existing mains, use cut in in-line tees coupled with a Unicoupling. “Kor-N-Tee” or “INSERTA TEE” fittings may also be used if installed according to manufacturer’s specifications.

Service connections (250 mm in size or greater) to existing mains, a cast in place base manhole will be required to be installed at the main connection.

Service connections shall maintain a minimum horizontal separation of 1.5 m from other utility infrastructure.

The public portion of a service connection are to be installed a minimum of 1.5 m from driveways.

Stormwater service connections are not permitted to connect to a catch basin.

2.6.4 Abandonment of Service Connections

An existing service connection shall be abandoned at the main under the following circumstances:

a. The service connection is undersized for the proposed use of the property. Under this circumstance, a new appropriately sized service connection is to be installed by the developer / property owner; or

b. The service connection is not going to be re-used due to the demolition of a building; or

c. The service connection does not meet current pipe material specifications. This would be determined via a CCTV video inspection of the existing service connection by the developer of the property. This CCTV video would be reviewed by MODY Operations staff, and they would make a determination of the condition of this pipe. If the service connection is deemed to be in disrepair by MODY Operations staff, a new service connection shall be installed by the developer / property owner.

d. The developer / property owner shall obtain the appropriate permit (s) from MODY in order to excavate within the street right of way to abandon the service connection.

2.6.5 Re-using of Service Connections

An existing service connection may be re-used under the following circumstances:

a. The service connection is of adequate size and meets current pipe material specifications; and

b. At the discretion of MODY, the service connection may require a CCTV video inspection to be reviewed by MODY Operations staff, and they will determine if the existing service connection can be re-used.

2.7 Unshrinkable Fill

Unshrinkable fill is approved for use as trench backfill. The specifications governing its manufacture and installation are governed by CSA A23.1 and A23.2.

The Portland Cement content shall be 25 kg/m³. The specified compressive strength at 28 days shall be a maximum of 1.0 MPa.

2.8 Pipe Crossing

Where any wastewater / stormwater system pipe crosses any other wastewater / stormwater system pipe (including other utilities), the minimum vertical separation must meet NSE requirements and in no case shall the minimum vertical separation be less than 150 mm, measured from outside diameter to outside diameter.

3 WASTEWATER SYSTEM

3.1 Scope

A wastewater system is a system of pipe lines, conduits, service connections from the pipes or conduits to street lines and appurtenances (including trunk wastewater systems, pumping stations, forcemains and treatment plants), owned, operated and maintained by MODY. The primary function of the system is to collect and convey wastewater from where it enters the public system to a disposal or treatment location. Wastewater is defined as a combination of liquid and water-carried wastes from residential, institutional, commercial and industrial establishments in a community, together with such incidental stormwater as may be present.

A well designed and properly functioning wastewater system is essential for the environmental health of any community. In the MODY, such systems are to be designed and constructed with a view to minimizing the long term operating and maintenance costs associated with the system. Wastewater systems shall be designed and constructed to minimize infiltration and inflow conditions. The design should also ensure that MODY personnel are not exposed to hazards when conducting operation and maintenance of the wastewater system.

When installing new wastewater systems, a properly functioning stormwater system is required. The stormwater system shall facilitate gravity flow for on and off street connections where full depth basements exist.

In addition to these design standards, all applicable and relevant codes and standards shall be used by the designer, including the latest editions of the following:

- National Fire Protection Association (NFPA).
- Canadian Electrical Code (CEC).
- Atlantic Canada Wastewater Guidelines Manual.
- Hydraulic Institute Standards.
- Canadian Standards Association (CSA).
- National Building Code of Canada (NBC).
- National Plumbing Code of Canada (NPC).
- Underwriters Laboratories of Canada (ULC).
- The Occupational Health and Safety Act of Nova Scotia

As well, all wastewater systems shall conform to any requirements established by NSE. No system shall be constructed until the design has been approved by the Engineer and NSE.

Wastewater shall be discharged into MODY's wastewater system in accordance with the MODY Act, MODY Schedule of Rates, Rules and Regulations for Water, Wastewater and Stormwater Services and applicable bylaws.

3.2 Gravity Systems

3.2.1 Design Loading and Contributory Sewershed

The wastewater system shall be designed 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, pumping, regrading or flow-through, shall be included in the calculated flows for the system being designed.

The wastewater system shall 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.

For design purposes, refer to the permitted land uses under the Municipal Planning Strategy (MPS) and Land use Bylaw (LUB), or approved Development Agreement. When determining site specific populations, refer to numbers below:

- Single Unit Dwellings 3.35 people / unit (ppu)
- Townhouse 3.35 people / unit (ppu)
- Multi-Unit Dwellings 2.25 people / unit (ppu)

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

The designer shall 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 limit of the downstream analysis shall be determined in consultation with the Engineer.

3.2.2 Wastewater System Pipe

The minimum wastewater system main diameter shall be 250 mm.

Approved wastewater system pipe materials shall be as follows:

- Reinforced concrete pipe meeting the requirements of the latest CAN/CSA Standard A257.2 and ASTM Standard C76.
- Polyvinyl Chloride (PVC) pipe and fittings meeting the requirements of the latest ASTM Standard D3034, DR35, and CAN /CSA Standard B182.2.
- ADS SaniTite HP - 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 ASTM Standard F273610, F 2764-10 and CSA Standard B182.13-11.

Pipes shall be tested for leakage using the low pressure air method. Hydrostatic testing is not permitted. Testing of pipes shall be done in accordance with the latest edition of the Standard Specification for Municipal Services as developed by the Nova Scotia Road Builders Association and the Nova Scotia Consulting Engineers Association Joint Committee on Contract Documents. Testing shall not be carried out until the street base course (first lift of gravel) has been placed and compacted. Pipework located outside of the street right of way (R.O.W.) (i.e. easements) shall be at finished grade prior to testing.

There shall be no decrease in pipe size from upstream to downstream.

The minimum pipe grade shall be 0.6 %, (0.8% for cul-de-sacs), provided that a self-cleansing velocity of 0.6 m/s can be achieved based on peak dry weather flow for the area to be serviced in the initial phase of the development.

Gravity flow in wastewater systems shall be calculated using the Manning's Formula or other approved method, with allowances made for energy losses at inlets, manholes, junctions, outlets, etc.

The following Manning Roughness Coefficients shall be used:

Pipe Material	Manning Roughness
Concrete	0.013
PVC	0.010
Polypropylene	0.012
HDPE (Smooth Interior Wall)	0.012

The minimum peak design flow velocity under full development or any phase of development shall be 0.75 m/s and a maximum flow velocity of 4.5 m/s. A higher flow velocity (up to 6.1 m/s) may be approved by the Engineer if adequate energy dissipation and ventilation is achieved

3.2.3 Wastewater Hydraulic Design

The flow Q (l/s), in the wastewater sewer system used for pipe sizing shall be as follows:

$$Q = [1.25 \times (a \times M)] + b$$ (For sizing gravity wastewater systems)

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

where:

1.25	is a safety factor.
(a × M) + b	is the peak design flow. (peak design flow is to be utilized for the design of pumping stations and forcemain pipes)
a × M	is the peak dry weather flow.
A	is 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 shall be 2.0.
b	is the future degradation of pipe long-term infiltration/inflow allowance. The allowable is 0.28 litres / gross hectare / second (24 m³ per gross hectare/day).
P	is the design population in thousands.

3.2.4 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.

3.2.5 Wastewater System Manholes

Refer to SECTION 2.5 for general manhole requirements.

Manholes shall be tested for leakage using the air vacuum method. Hydrostatic testing is not permitted. Where service connections are connected to the manhole, the service connections shall be pressure tested separately. Testing of manholes shall be done in accordance with the latest edition of the Standard Specification for Municipal Services as developed by the Nova Scotia Road Builders Association and the Nova Scotia Consulting Engineers Association Joint Committee on Contract Documents.

Wastewater system manholes shall be positioned so as to prevent the infiltration of surface water or ground water. In addition to O-ring gaskets, joints in precast sections below the concrete manhole cover shall be sealed with 25 mm butyl resin cord. The cord shall be placed on the upper inside ledge of the joint prior to placement of the subsequent section. The wastewater system manhole inclusive of the grade rings, shaft, precast sections and base shall be constructed with Blueskin waterproofing membrane. Manholes shall not be located in areas subject to flooding, such as, but not limited to the following locations:

- Drainage ditch or swale.
- Roadway gutters or low points.
- Future roadway gutters or low points.
- Overland flow routes.
- In areas subject to flooding.

Industrial, Commercial and Institutional (ICI) facilities shall be required to provide a Monitoring Access Point manhole into their service connection, located just behind the street line on private property, for inspection and sampling of the wastewater characteristics. The location should be such that the manhole is easily accessible. This location may be adjusted at the discretion of the Engineer.

Cast in place base for precast wastewater manhole: The bell end of the precast section shall be fully embedded in the partially set, cast in place base. Finish the interface with grout or concrete on the inside and outside of the manhole, sloping up at 1:1 to meet the precast section. For clarification, see detail for Cast-in-Place Base for precast manhole. Additionally, all lift holes for pre-cast manhole sections shall be grouted.

3.2.6 Hydrogen Sulphide

The wastewater system shall be designed to minimize hydrogen sulphide conditions. This shall include minimizing the use of drop manholes and precautions to reduce turbulence, and a reasonable retention time in pumping stations.

Where hydrogen sulphide conditions are unavoidably high the wastewater system including gravity and forcemain pipes, pumping station, etc. shall be constructed of corrosion resistant materials. Refer to Schedule “A” of MODY’s Schedule of Rates, Rules & Regulations for Water, Wastewater and Stormwater Services for limits for discharge to wastewater facilities.

Where min./max. wastewater velocities are present and systems with a large number of drop manholes are in place, the system, including gravity and forcemain pipes, pumping station, etc. shall be constructed of corrosion resistant materials.

3.2.7 Wastewater Service Connections

As noted in the National Plumbing Code of Canada (section 2.1.2.4 – Separate Services). Service connections connected to the public services shall be connected separately from piping of any other building, except that an ancillary building on the same property may be served by the same service.

Refer to SECTION 2.6 for wastewater service connections requirements

3.3 Pumped Systems (up to 30 l / s)

3.3.1 Design Requirements

Pumping stations and forcemains represent a long-term financial burden to MODY in terms of operating and maintenance costs and eventual replacement of system components. 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 system are shown to be greater than those of a pumping station.

These guidelines govern smaller or “submersible” type pumping stations with ultimate capacity of 30 l/s or smaller. 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.

Pumping stations and force mains shall be designed for the peak design flow from the tributary drainage area. Present and future conditions shall be considered.

The design shall ensure the safety of operations, in accordance with all applicable Municipal, Provincial and Federal regulations including the Occupational Health and Safety Act and applicable CSA specification.

Pumping stations shall function as an un-manned station.

Equipment that starts automatically shall be suitably signed to ensure that operators are aware of this condition. Lock-outs on all equipment shall be supplied to ensure that the equipment is completely out of service when maintenance or servicing is being carried out. All moving equipment shall be covered with suitable guards to prevent accidental contact.

Where auxiliary power supply buildings are provided, they shall include potable water, on demand supply hot water, toilet facilities, wash-up station facilities and an exterior water supply connection.

The exterior water supply connection shall consist of a 50 mm diameter supply line with a 38 mm water meter, a 38 mm Reduced Pressure Principle backflow prevention device and outfitted with a 38 mm wall hydrant with an internal shut off valve installed in a lockable enclosure suitable for exterior use. The wall hydrant thread shall meet the requirements as outlined in Section 1.0.

3.3.2 Submission Requirements

When submitting a proposed pump station design, the following items shall be included in the submission for review by MODY.

- Civil Drawings.
- Mechanical Drawings.
- Electrical Drawings.
- Pump Information.
- Design Report.
- Sewershed Boundary serviced by pump station.
- System Curves.
- Station Configuration.
- Program Ladder.

3.4 Pumping Stations

3.4.1 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.

3.4.2 Pump Types

Pumps for use in local wastewater pumping stations are approved as follows:

a. Submersible Pumps

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 MODY, only pumps from the following manufacturers are permitted:

- Flygt / Xylem.
- ABS.
- KSB.

b. Self-Priming Pumps

Horizontal type; casing and volute in contact with wastewater shall be cast iron class 30 or higher grade; two-vane, semi-open, ductile iron impeller with integral pump-out vanes on the back shroud, threaded onto the pump shaft and secured by lock screw; rotating assembly, including bearings, shaft mechanical seal and impeller shall be removable as a unit without removing pump volute or piping; mechanical seal shall have tungsten titanium carbide rotating and stationary faces lubricated by a separate oil-filled reservoir and be covered by at least a four year warranty; replaceable wear plate attached to a removable cover plate which in turn is to allow easy access for inspection. The reprime of a completely empty suction line to full pumping shall take a maximum of 5 minutes operating at the selected speed and impeller diameter with the reprime lift of the installation condition. The reprime lift shall be published data and is to be certified by the pump manufacturer upon request.

Pumps shall be specifically designed for pumping raw, unscreened, domestic wastewater (non-clog, solids handling type). Pumps shall be complete with premium efficiency electric motors, and if applicable be inverter duty and rated for use with variable frequency / speed drive (VFD/VSD) control systems. Pumps installed within the classified space of the wet well shall be CSA approved and manufacturer certified for Class 1, Div 1, Zone 1, Groups A, B, C or D hazardous locations.

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

3.4.3 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 designer 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.

3.4.4 Auxiliary Power Supply and Building

The auxiliary power supply system (loosely referred to here as “generator”) shall be designed with adequate capacity to operate the wastewater pump or pumps required to pump peak wastewater flows, control and monitoring systems, and heating and lighting systems within the pump house. The generator is to run automatically on a power outage and to stop when the power returns; the stopping and starting of the generator is to be activated in co-ordination with an automatic power transfer switch. The generator is to meet all applicable CSA, NEMA, NFPA and IEEE standards. The generator shall include at minimum a governor, battery operated starting system complete with battery charger, exciter, voltage regulator, control panel, generator temperature

and oil pressure gauges, alternator output circuit breaker and exhaust system. The generator and exhaust system shall be designed to minimize noise.

For pump stations where auxiliary power is not provided a quick connect feature for a portable generator consistent with existing MODY portable generator connections is required.

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 of the building.

A building shall be provided to house the auxiliary power supply unit, pumps, pump motors, heat and light, control panel, piping, valves, and any other required accessories. These items shall be located in the building in such a way as to provide safety for workers and convenient access for maintenance.

The fuel storage tank and installation is to be designed to meet the requirements of the National Fire Code of Canada, Section 4 and shall meet the requirements of the Contained Tank Assembly document ULC-S653 and must be either steel meeting CAN/ULC-S603 and S603.1 or FRP (Fiberglass Reinforced Plastic) meeting CAN/ULC-S615. Fuel storage tanks 1500 litres and less are to be installed inside the building and must have a concrete curb containment system sufficient to contain the entire volume of the tank complete with sensors in case of a leak or spill.

Exterior wall assembly of the building shall be 200 mm split-face concrete block with a minimum of R20 (RSI 3.5) insulation. The door shall be a heavy duty steel door with a minimum 750 mm width, and must be sized to accommodate the removal and maintenance of equipment and shall be insulated with a minimum of R6 (RSI 2.8) insulation. The building shall have a hip roof with a minimum slope of 2:1 (horizontal : vertical) and a minimum of R30 (RSI 5.3) insulation with asphalt shingles (25 year rated). There shall be no windows in any exterior wall. Adequate ventilation for all mechanical equipment shall be provided by vandal resistant, insulated, heavy duty type steel intake and exhaust louvers. Engine emissions shall be directed away from the building so as not to create a ventilation "short circuit". The louver system shall be designed to prevent a negative pressure situation within the building. Provision shall be made to support wall- mounted equipment inside the building. The building is to be designed “secure”.

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.

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

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

Doors shall swing outward to open and panic hardware should be installed for emergency exit. All hinge pins on doors shall 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 shall be keyed alike to MODY standard system.

The Engineer may approve an alternate architectural design to better blend in with surrounding Community.

3.4.5 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.

3.4.6 Benching and 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).

3.4.7 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.

3.4.8 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.

3.4.9 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 MODY for review and approval and to confirm the most effective and efficient pumping solution has been selected.

3.4.10 Flow Velocities

Suction and header piping shall be sized to carry the anticipated flows. Flow velocities shall be:

- Minimum cleansing velocity of 0.6 m/s.

- Maximum velocity of 2.4 m/s.
- Regardless of the above conditions, piping less than 100 mm in diameter is not acceptable.

3.4.11 Piping

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.

3.4.12 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 wetwell.

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.

3.4.13 Hydraulic Analysis

A hydraulic transient analysis shall be undertaken to ensure that transients (water hammer) resulting from pumps starting, stopping, full load rejection during power failure, etc. do not adversely affect the pipe or valves in the system. The results of the hydraulic analysis shall be provided by the designer in the form of a Design Brief to support the system design.

3.4.14 Valves

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 forcemain pipe arrangement. The drain shall be directed to the wet well and equipped with backflow protection.

3.4.15 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.

3.4.16 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 premixed 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 a waterproof membrane, Blueskin or approved alternate.

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

3.4.17 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 MODY 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 MODY’s standard system.

3.4.18 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:
    - o Red - Pump Running.
    - o Green - Pump in Standby Mode.
    - o 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 MODY.
- 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 MODY 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 MODY. All PLC and OIT programming complete with documentation must be provided to MODY 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 the MODY`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.

3.4.19 Level Controls

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.

3.4.20 Electrical

An Arc Flash Hazard Analysis study must be performed 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). Arc Flash Hazard warning labeling must be provided and shall include system voltage, flash protection boundary distance, hazard risk category, available fault current, incident energy at 460mm and study report issue date.

Electric motors less than 7.5 kW shall be 208 volt, 3 phase; electric motors 7.5 kW and larger shall be 600 volt, 3 phase. All electric motors shall be premium efficiency motors.

All electrical conduits shall be sized in accordance with the latest edition of the Canadian Electrical Code but being a minimum of 50 mm in diameter. Utility service to the control panel shall be through buried conduit and a spare service conduit shall be

provided. Electrical conduit between the control panel and any remote chambers shall be buried. Each pump cable shall be installed in a separate conduit.

There shall be no electrical junction boxes located below the maximum flood level of the pumping station. A NEMA4 corrosion resistant junction box with terminal strips and transit seals must be installed between the EYS seals and the wet well. No splices shall be permitted in power or control cables between the pump and the control panel.

3.4.21 Site Considerations

The pumping station, auxiliary power buildings and control panels shall be located off the street right-of-way. The property on which these facilities are located shall be sized to accommodate proper access, maintenance and all features associated with the station; the property shall regardless be a minimum of 150 m² and shall be deeded to MODY. The pumping station shall not be sited in a floodplain and the site shall be evaluated for groundwater conditions. As determined by the Engineer, the site shall be big enough to facilitate a re-build of the station while the current station is operational. MODY will compensate the developer for land exceeding the required 150 m2 at full market value.

The site grading and stabilization is to be in accordance with the overall subdivision grading plan for a new development. The elevation of the top of the wet well shall be no less than 100 mm and no more than 150 mm above the finished grade of the pumping station lot.

Non-hard surfaces are to be landscaped. Creative use of low maintenance shrubbery and foliage is to be used to screen the site. The station is to blend in with existing, surrounding and future development.

The driveway to the pumping station shall be designed for commercial level access, egress and turning movements, shall be asphalted and shall have access from the street. The driveway shall be constructed of surge material as required by the Design Engineer, 150 mm Type 2 gravel, 150 mm of Type 1 gravel and 75 mm of asphalt to a minimum width of 3.5 m, and a minimum length of 7.5 m.

Provision shall be made for the installation of a 2.44 m security fence for the property. MODY will evaluate the fencing requirements upon review of the proposed site.

3.4.22 Safety Precautions

The pumping station and appurtenances shall be designed in such a manner as to ensure the safety of operations, in accordance with all applicable Municipal, Provincial and Federal regulations including the Occupational Health and Safety Act. An adequate hazard assessment of the design should be conducted to ensure that all confined spaces are eliminated. All moving equipment shall be covered with suitable guards to prevent accidental contact.

Equipment that starts automatically shall be suitably designed to ensure that operators are aware of this condition. Lock-outs on all equipment shall be supplied to ensure that the equipment is completely out of service when maintenance or servicing is being carried out.

Diesel generator fuel supply lines shall be equipped with fusible link valves. Fuel lines between the generator and the fuel supply shall be located in appropriately sized sleeves cast into the station floor.

3.4.23 Testing

Wet Well

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 m² 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.

Station Piping

All station process piping (from the pumps to the forcemain connections) shall be hydrostatically tested. Piping must maintain a minimum pressure of 1035 kPa for two hours, as indicated in 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.

3.4.24 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 developer's professional engineer and MODY as necessary. The SCADA tag list is to be provided to MODY at least two weeks prior to facility start-up to allow MODY technical operations 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 startup 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
- Developer's Professional Engineer
- MODY Staff (as necessary)

3.4.25 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 developer's professional 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 developer's professional engineer and MODY that all equipment and systems function properly and in accordance with the project documents. The developer's professional 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 (ie. ventilation, pump lifts, heating, hatches and accessories, valving, etc.);
- Demonstrate removal and reinstallation of all removable/serviceable mechanical equipment (ie. screening baskets, pumps, etc.);
- If an auxiliary power supply system ("generator") is installed, confirm functionality by:
    - simulating a power interruption at full demand, ie. 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 developer's professional engineer and MODY facility operator will be present to witness facility commissioning and will liaise with, and call to the site, other MODY 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 (ie. MODY staff time and developer's professional 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 developer's professional 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:

- Developer's Professional Engineer (Commissioning officer as lead)
- Contractor
- Subcontractors
- Suppliers
- MODY Facility Operator
- Other Halifax Water Staff (as necessary)

3.4.26 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 MODY's HMI. Under direction from the MODY technical operations 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:

- MODY technical operations representative (Lead)
- Contractor
- Subcontractors (as necessary)
- Suppliers (as necessary)
- Developer's Professional Engineer

3.4.27 Facility Training

After successful commissioning, the contractor or the developer's professional engineer provides training for MODY Staff 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 setpoints 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 forcemains, 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 MODY.

The following personnel shall be present at facility training:

- Contractor (may act as lead)
- Developer's Professional Engineer (may act as lead)
- Subcontractors (as necessary)
- Suppliers (as necessary)
- MODY Facility Operator(s)

3.4.28 Facility Commissioning Report

Following successful completion of commissioning and training, the developer's professional 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 developer's professional engineer that the facility meet design intent, are operating within specified parameters and are ready for intended use;

3.4.29 Operations and Maintenance Manual

The developer's professional 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 facility operation and maintenance manual, in a form acceptable to the Engineer. The manual must contain the following items in same general order:

- Title Page including:
    - identification of document as an operations & maintenance manual;
    - facility name;
    - facility Contractor;
    - facility 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 facility:
    - 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;
- Facility design intent, parameters and limitations (ie. Design report);
- As constructed civil, mechanical and electrical drawings. This is to include forcemain drawings and details of transient devices on the forcemains;
- 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;
- Facility 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 facility 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 shall be taken at various angles showing the main features of the inside and outside of the facility. A plan index shall be provided showing location and angle of each photo in relation to the facility.

3.5 Forcemain Standards

3.5.1 Pipe (Forcemain)

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

- Ductile Iron pipe, AWWA C151 Special Class 52, cement mortar lined with polyethylene encasement. Anodes shall be installed on this pipe to provide cathodic protection. Anode Spacing requirements are every 30m.

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 forcemain is the Hazen-Williams Formula. Variations in the roughness coefficient (C) through the life of the pipe shall be taken into account.

The designer shall assess the forcemain for possible damage from sulfide generation. In sections of the forcemain 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 forcemain 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".

The minimum diameter of the forcemain shall be 100 mm.

3.5.2 Limiting Velocities

The forcemain shall be designed with a minimum cleansing velocity of 0.6 m/s.

The maximum velocity shall not exceed 2.4 m/s.

3.5.3 Minimum/ Maximum Depth

Forcemains shall have a minimum cover of 1.5 m and a maximum cover of 2.4 m, measured from the finished surface to the crown of the pipe.

3.5.4 Location

Forcemains 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.

Forcemains shall terminate in a well benched manhole such that the flow is directed down the barrel of the receiving gravity wastewater system pipe. The downstream pipe receiving flow from a forcemain must be of sufficient size and grade to prevent surcharging from the forcemain. The forcemain must be mechanically restrained to the manhole and where applicable mechanically restrained within the manhole to prevent movement

3.5.5 Valves

Automatic air relief and vacuum valves, suitable for wastewater applications, shall be located in a manhole at high points of the forcemain 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.

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 forcemain arrangements to operate independently.

Gate valves on a forcemain 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.

3.5.6 Change in Direction

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 Section 3.0 of this specification for details on thrust restraint requirements.

3.5.7 Hydrostatic and Leakage Testing

Testing shall not be carried out until the street base course (first lift of gravel) has been placed and compacted. Pipework located outside of the street right of way (R.O.W.) (i.e. easements) shall be at finished grade prior to testing.

4 STORMWATER SYSTEM

4.1 General

Storm drainage design and stormwater management are dynamic areas of engineering design. The purpose of this section is to provide minimum design standards to the designer. However, this guidance should not hinder the application of newer practices or carefully evaluated innovative approaches to stormwater management. Designers are encouraged to present their innovative ideas together with supporting documentation to MODY for consideration where the design will deviate from the typical specifications.

The design criteria contained in this section are included to illustrate the more common aspects encountered in the design of stormwater systems. Any stormwater system within the core boundary of MODY shall be designed to achieve the following objectives:

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

The design should also ensure that MODY personnel are not exposed to hazards when conducting operation and maintenance of the stormwater system.

Gravity stormwater systems (piped systems and ditch/open channel systems) are to be installed for all new development areas. This system is required to be installed at a depth to facilitate gravity flow for on street and off street connections where a full depth basement is installed. Where a gravity stormwater system is installed, all adjacent lots are required to connect to this system for provision of stormwater service.

The stormwater system may consist of a combination of the following components or features:

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 *)	MODY
Cross culverts (within core area *)	MODY
Driveway culverts – across municipal ditch (within core area)	MODY
Driveway culverts (outside municipal right of way)	Property Owner
Rear yard swales	Property Owner

Side yard swales located in an MODY easement (as part of overall municipal drainage system)	MODY / Property Owner
Subsurface interceptor drains (within the municipal right of way)	MODY
Subsurface interceptor drains (outside municipal right of way)	Property Owner
Roadways	MODY
Curb and gutter	MODY
Municipal catch basins, ditch inlets/outlets	MODY
Catch basins on private property (rear, side or front yard **)	MODY / Property Owner
Manholes (part of municipal system only)	MODY
Pipes (part of municipal system only)	MODY
Stormwater management facilities	MODY
Stormwater service connections (main to street line)	MODY
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

(** 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.

4.2 Design Approach

4.2.1 Minor Stormwater Drainage System

The minor stormwater drainage system shall be designed to convey the 1 in 5 year storm without surcharge. The minor system typically consists of lot grades, ditches, back yard/side yard swales, roof leaders, foundation drains, gutters, catch basins (and other inlet structures), manholes, stormwater systems and culverts. Typically, the minor systems are designed to reduce inconvenience to the public related to runoff events. The curb and gutter and cross culverts of the street system generally shall convey the 1 in 10 year storm event unless otherwise approved by MODY.

4.2.2 Major Stormwater Drainage System

The major stormwater drainage system (overland flow system) shall be designed to convey the 1 in 100 year storm. The major stormwater system consists of natural streams, valleys, swales, man-made channels, roadways, ponds, and watercourses. The major stormwater system conveys runoff from infrequent events that exceed the minor stormwater system and the street system capacity. Overland flow routes shall follow the natural topography. Realignment of the natural flow path shall be discouraged to avoid future drainage issues. Existing water and drainage courses shall be left in their natural state. Watercourse and wetland alterations are subject to review and approval of the NSE.

The stormwater management report will identify the minor and major flow routes. Notwithstanding the above shall be sized to convey the appropriate storm event.

The capacity of the overland flow routes shall be supported by calculations as part of the overall stormwater management report. When the overland flow is routed along roadways, the designer shall consult with MODY regarding criteria for maximum depth of flow and maximum flow velocity on the roadway.

The stormwater management and overall lot grading plans shall show all watercourses, wetlands, and any other areas subject to flooding under both pre- and post-development conditions.

4.2.3 Downstream Effects of Stormwater Control Facilities

The downstream stormwater system shall have the capacity to convey discharge from its fully developed watershed. Mitigative measures or upgrades may be required to the downstream stormwater system to reduce adverse impacts.

4.2.4 Design Parameters

Basis of Design

The stormwater system shall be designed for flows from all lands within the watershed in which the system is situated, and lands anticipated being tributary to the watershed, by future development.

Redirecting of stormwater to another watershed is not favoured, however, may be considered by the Engineer provided the appropriate downstream analysis has been completed and capacity exists.

Design Flow

The design is to be based on the larger of winter or annual flow. Submit calculations and size stormwater systems as follows:

- Ordinary residential, commercial, or industrial land uses: annual (year-round) rainfall data.
- Where the duration is greater than 6 hours: winter precipitation and ice/snow melt data.
- Where the design area includes a significant proportion of undeveloped land: annual and winter data.

Downstream Effects

The downstream stormwater system shall have the capacity to convey discharge from the fully developed watershed.

4.3 Meterological Data

Acceptable rainfall data for calculating runoff shall be taken from:

- Intensity – Duration – Frequency (IDF) Curves from Environment Canada's Meteorological Service of Canada using the reporting area closest to the subject development and the most current data.

$$I = a \times Tb$$

where:	I	Rainfall rate (mm/hour)
	a	coefficient (published - Environment Canada)
	T	duration/time of storm (hours)
	b	exponent (published - Environment Canada)

Synthetic design storms using hyetographs of the Chicago type distribution with r = 0.5 hour, 2 hour and 24 hour storm duration, discretization intervals of 5 minutes and 1 hour for the 2 hour and 24 hour storm durations, respectively.

Historical design storms using historical flood records or runoff simulations of historical storms. These are required to verify the performance of storage facilities and major structures.

4.4 Runoff Methodology

The professional engineer must determine the best runoff calculation method to be used and must also calibrate and verify for local conditions. The professional engineer shall provide for future reference the reason why a certain method is selected. The Engineer may request that a second method be used as verification or checking of the results.

4.5 Stormwater Management Plan

A stormwater management plan shall be prepared and included as part of the submission for any land development to deal with stormwater and drainage issues related to the development. At a minimum the stormwater management plan shall be prepared containing the design criteria for the 1 in 5, 1 in 10 and 1 in 100 year events. This design shall also address factors such as

watercourse protection, erosion and sediment control, impact on adjacent property, maintenance requirements, public safety, access, liability and nuisance. Storage facilities shall be planned and designed to encompass larger facilities rather than facilities serving individual properties.

Storage facilities shall be designed to control the peak runoff conditions for storm events with different return frequencies including the major storm.

The plan shall include site engineering analysis to a level consistent with the size of the development, its location within the drainage basin, and the sensitivity of the area's drainage system. The plan shall include details of the safety implications of the proposed system, and an examination of erosion should be assessed within the development and downstream receiving streams due to increased peak and total flows and flow velocities as a result of the development.

The stormwater management plan shall also include drainage plans and detailed runoff calculations. The calculations shall include input information showing sub-watersheds, rainfall abstraction, antecedent moisture conditions and schematization of the system for pre and post development and all stormwater management alternatives; and output information which shows the main step of the calculations and the peak discharge at key points in the system. At the points of discharge from the proposed development, the flow route to the major drainage path shall be indicated.

The management plans shall 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), 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 table and any other information required by the Engineer.

4.6 Piped Stormwater Systems

4.6.1 Hydraulic Design

Gravity flow in stormwater systems shall be calculated using the Manning's Formula or other approved method, with allowances made for energy losses at inlets, manholes, junctions, outlets, etc.

PIPE MATERIAL	MANNING ROUGHNESS
Concrete	0.013
PVC	0.010
Polypropylene	0.012
HDPE (at discretion of engineer)	0.012

The minimum peak design flow velocity under full development or any place of development shall be 0.75 m/s.

The maximum flow velocity, assuming the pipe to be flowing full, shall be 6.1 m/s. for pipes less than or equal to 750 mm in diameter. A higher flow velocity (up to 7.5 m/s) may be permitted for pipe sizes greater than 750 mm in diameter if adequate energy dissipation and ventilation is provided.

4.6.2 Stormwater System Pipe

The minimum stormwater system main diameter shall be 300 mm.

Approved stormwater system pipe materials shall be as follows:

- Reinforced concrete pipe meeting the requirements of the latest CAN/CSA Standard A257.2 and ASTM Standard C76.
- Polyvinyl Chloride (PVC) pipe and fittings meeting the requirements of the latest ASTM Standard D3034, DR35, and CAN /CSA Standard B182.2.
- Dual Wall Corrugated Profile PVC pipe and fittings meeting the requirements of the latest ASTM Standard F794-97 and CAN/CSA Standard B182.4.

- Profile High Density Polyethylene (HDPE) pipe and fittings (up to 900 mm) meeting the requirements of the latest CAN / CSA Standard B182.8, with a minimum pipe stiffness of 320Kpa and Type 1 (Water-tight) joints with integrated bells/welded joints.
- ADS SaniTite HP - 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 ASTM Standard F 2736-10, F 2764-10 and CSA Standard B182.13-11.
- Pipe size shall 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.
- Pipe gaskets are to be utilized for all stormwater system main installation.

4.6.3 Manholes

When providing in-line storage of stormwater flows as approved by the Engineer, baffles within the manhole base will not be permitted.

Refer to SECTION 2.0 – COMMON ELEMENTS

4.6.4 Catch Basins

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.

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.

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

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 m.

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.

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

The interception capacity of the catch basins shall be compatible with the capacity of the stormwater system. The stormwater management report shall illustrate the HGL produced during the minor and major storm events.

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”).

4.6.5 Catch Basin Leads

Catch basin leads shall meet the following criteria:

- Be 200 mm diameter or larger manufactured from concrete or PVC DR35.
- 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.).
- Have a minimum cover of 1.3 m at construction completion.
- Have a minimum slope of 1%.

- Be included in the CCTV report.
- Be connected to the manhole with an invert no higher than the obvert of the outgoing pipe or 1.0 m above the invert of the outgoing pipe whichever is higher.
- Shall protrude not more than 75 mm into the catch basin or manhole
- Incorporate a flexible joint within 450 mm of the O.D of the manhole.

4.6.6 Service Connections

Refer to SECTION 2.6 for stormwater service connection requirements

4.6.7 Inlets, Outfalls and Grates

Refer to SECTION 4.9 - CULVERTS

4.7 Streets

During minor storms, the depth of flow in gutters shall not exceed 50 mm. During major storms, the depth of flow shall not exceed 50 mm above the crown in areas with curb and gutter. In no circumstances shall the flow of stormwater overtop the curb, escape ditches or travel into driveways. The flow of water shall travel through the major overland flow route.

4.8 Ditches/Open Channels

The design shall include safety, nuisance and maintenance implications of ditches and open channels. Statements dealing with these factors shall be included in submitted documentation.

4.8.1 Design

Ditches and open channels (if approved) shall meet the following requirements:

- Have a minimum grade of 2.0%.
- Roadway ditches shall conform to the typical cross section as per MODY specifications.
- Hydraulic capacity is based on the minor storm, unless the ditch functions as the major overland flow route.
- Under maximum flow conditions not more than 90% of ditch capacity is utilized.
- The invert should be a minimum of 0.2 m below the extension of the subgrade line.
- Side slopes shall be no steeper than 2:1 (horizontal:vertical).
- Where a ditch or open channels grade exceeds 4%, the bottom of the ditch (wetted perimeter) shall be further stabilized to prevent erosion. Stabilization measures may include the placement of surge (Rip Rap) and or check dams.
- Where asphalt swales are placed on a roadway shoulder, appropriate erosion protection shall be installed on the downstream side, protecting the side of the ditch.
- Except at street intersections, cross culverts, ditches, overland flow routes and channels shall have a maximum deflection angle between 90° & 270°. Where a deflection of 90° or 270° is proposed the ditch shall be piped with the appropriately sized inlet / outlet structure and manhole. Deflections between 0° & 90° and 270° & 360° are not permitted.
- In areas where the natural grade does not allow a conventional ditch to be installed, engineered side slopes (back & front) to the ditch shall be provided.

4.8.2 Maximum Velocity

Channel velocities shall be minimized to prevent erosion. The maximum channel velocity in the major storm shall not exceed the following - unless the channel is lined, or acceptable energy dissipation measures are provided:

Channel Material	Mean Channel Velocity (m/s)
Fine Sand	0.46
Coarse Sand	0.76
Fine Gravel	1.83
Earth	
Sandy Silt	0.61
Silt Clay	1.07
Clay	1.22
Soft Sandstone	2.44
Soft Shale	1.07
Grass-lined earth	
Bermuda grass	
Sandy Silt	1.83
Silt Clay	2.44
Kentucky Blue Grass	
Sandy Silt	1.52
Silt Clay	2.13
Poor rock (usually sedimentary)	1.83
Good rock (igneous or hard metamorphic)	6.10

The above values assume a straight, uniform channel. More stringent velocity restrictions will be required for differing channel configurations

4.9 Culverts

4.9.1 Inlets and Outlets

The design shall address such factors as embankment stability, public safety, erosion, energy dissipation, head losses, appearance, or other items as specified by the Engineer.

All culverts shall have inlet / outlet precast concrete headwalls.

Inlet and outlet control methods shall be utilized in determining the hydraulic capacity of culverts in conjunction with the Manning's Formula.

Headwater Depth - 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.

Structures and Grates - Culverts and piped systems that are less than 30 m in length will not require grates.

Inlet and outlet pipes of culverts and piped systems that are longer than 30 m in length and are 450 mm in diameter or larger (or equivalent area or larger), shall be constructed with a pre-cast concrete headwall structure.

Inlet & Outlet Pipe, up to 1500 mm Diameter (or equivalent area).

Inlet & Outlet Pipe, >1500 mm Diameter (or equivalent area).

The handrail on the headwall shall be constructed in two separate, hinged sections.

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.

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.

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 inlet grate shall have a minimum area 6 times the inlet pipe area (this does not negate the designer's responsibility to investigate the possibility that a ratio higher than 6 may be required).

Location - 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 MODY.

4.9.2 Pipe Sizes

Driveway culverts shall not be smaller than 450 mm in diameter nor smaller than any upstream culvert and shall be installed with precast concrete headwalls.

Roadway culverts shall have a minimum diameter of 525 mm and a minimum cover of 500 mm.

The Stormwater Management Plan or Subdivision Grading Plan shall also show, in tabular form, the required driveway culvert pipe sizes for each lot in the development. The table shall show the required pipe size for all of the approved culvert pipe materials.

4.9.3 Pipe Materials

Approved culvert pipe materials shall be as follows:

- Reinforced concrete pipe meeting the requirements of the latest CAN/CSA Standard A257.2 and ASTM Standard C76.
- Profile High Density Polyethylene (HDPE) pipe meeting the requirements of the latest CAN / CSA Standard B182.8 and ASTM standard F-667, with a minimum pipe stiffness of 320Kpa.
- ADS SaniTite HP - Profile Polypropylene (PP) pipe, corrugated dualwall (300-750 mm) and corrugated triple wall (750–1500 mm) meeting the requirements of the latest ASTM Standard F 2736-10, F 2764-10 and CSA Standard B182.13-11.

4.9.4 Enclosures of Watercourses, Ditches and Channels

The number of enclosures of an open channel created by roadways or other traffic crossings shall be minimized. For example if a watercourse crosses the road system in two locations in relatively close proximity, the design shall re-align the road system so that the number of crossings is eliminated or limited to one.

4.9.5 Ownership of System

Storm drainage from the public system shall not be carried on, through or over private property other than by natural watercourse or a system controlled by MODY or NSTIR. Easements will be required to provide for drainage from existing or future upstream development. Watercourses shall be utilized as stormwater conveyances consistent with overall watercourse objectives and subject to provincial approval. (Refer to Section 6.1).

Watercourses and natural drainage routes shall be maintained as open channels unless designated otherwise by a Stormwater Management Plan as approved or required by the Engineer. Watercourses shall not normally be permitted to drain to roadside ditches or piped stormwater systems.

4.10 Minor Stormwater Drainage System Connections

4.10.1 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 MODY 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 MODY ditch system and must be terminated at the property line. Discharge to the ditch system shall be achieved using clear stone or rock drain.

4.10.2 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 MODY requirements.

4.10.3 Roof Drains - Institutional, Commercial and Industrial (ICI)

ICI developments shall manage stormwater on site in order to ensure that the pre and post development flows are balanced. Roof drains may be connected to the internal private stormwater system, provided that the rainwater flows are incorporated into the pre and post development flows for this site.

4.11 Discharge to Adjacent Properties

Stormwater shall be self-contained within the development limits except for natural runoff from undeveloped areas and where it is intercepted and directed to a natural stream, water course or stormwater system owned by NSTIR, or MODY.

Stormwater shall not be directed to adjacent private properties unless private easements are provided.

If necessary, the Engineer may require zero increase in the peak rate of runoff from storms of a specified frequency.

4.12 Erosion and Sedimentation Control

Stormwater management systems shall be an integral part of overall site design and development. The professional engineer shall 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 Erosion and Sediment Control Manual and Guidelines for Use on Construction Sites"

4.13 Stormwater Management Facilities

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 MODY as part of the subdivision acceptance process. MODY may consider easements under special circumstances, at the discretion of the Engineer.

Where stormwater outfalls onto adjacent lands, the professional engineer shall ensure that the discharge volume and velocity will not impact the receiving area and the developer shall obtain written permission from the owner of the adjacent lands to allow for the stormwater to discharge at this location. Where this stormwater forms part of the major overland flow path, the developer shall secure easements to ensure the continued use of the drainage course except where the drainage course is a designated watercourse as per NSE regulations. In the case of a watercourse, the developer shall obtain all necessary permits prior to construction of the stormwater system.

The required storage volume for stormwater quality control shall be based on the 24 hour extended detention of the runoff generated by a short duration (4 hour), 25 mm storm event. The storage volume required for stormwater quality control shall be determined to meet the MODY's Rules and Regulations, specifically, the discharge shall not exceed the required concentration of parts per million (ppm) suspended solids per MODY requirements. These same extended detention criteria shall be used for provision of stream bank erosion protection unless otherwise specified by the Engineer or NSE.

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 in 2, 1 in 5, 1 in 10 and 1 in 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.

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

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

In lieu of constructing stormwater management ponds, MODY may consider the use of alternate measures to deal with stormwater management as outlined in this section. The professional 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.

MODY may consider the use of oversized in-line pipe storage in lieu of constructing stormwater management ponds. 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 handled by the oversized stormwater system installed for pipe storage. All requirements as outlined in this section are to be followed for design of this system.

4.14 Stormwater Management Pond Requirements

Stormwater management ponds shall include the following minimum design requirements:

4.14.1 Siting

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.

4.14.2 Access

Maintenance access roads shall be provided to access the pond inlet and outlet structures, by-pass manholes, outfall and overflow locations, and the bottom of the forebay and main cell for maintenance and cleaning. The access roads shall have the following features:

- Minimum 4.0 m in width.
- Maximum longitudinal grade of 8%.
- Maximum crossfall of 2%.
- Minimum offset from edge of access road to embankment of 1.0 m.
- Sufficient to carry heavy equipment for the purpose of removing sediment
- Gravel surface using Type 1 gravel (no crusher dust permitted) – where MODY has permitted grades between 6% & 8%, the surface shall be paved with asphalt.
- Fencing around entire pond and access route with access gates for authorized personnel as approved by MODY.
- Positive drainage shall be provided along the edge of the access road with an appropriate outlet (cut ditches may be required to ensure water is conveyed to an appropriate outlet and to avoid access road washouts).
- Turnaround areas shall be provided as needed with minimum 12.0 m turning radius.

4.14.3 Forebay

Forebay shall be provided to facilitate maintenance by concentrating sedimentation at the inlet area of the pond. The forebay shall be designed as follows:

- Length to width ratio shall be greater than 2.
- Depth shall be minimum 1.0 m to minimize bottom scouring activity.
- Area shall be less than one-third (1/3) the total pond area.

- Volume shall be less than 20% of the total permanent pool volume required for the facility.
- Volume shall be sufficient to accommodate 10 years of sediment accumulation.
- Forebay berm elevation shall be set at the normal water level (permanent pool elevation) of the pond.
- Forebay berm shall be minimum 2.0 m wide.
- Flow through culverts shall be situated within the forebay berm with inverts set at the predicted 10 year sediment level or 0.6 m from the initial design invert of the forebay (whichever is greater).
- Forebay berm flow through culverts shall have minimum 300 mm of cover to the top of the forebay berm elevation.

4.14.4 Height and Volume

Ponds shall be designed to limit their height and / or volume so that they do not meet the definition of a dam as defined by the Canadian Dam Association. (The definition of a dam is 2.5 m high with 30,000 m3 of volume).

4.14.5 Inlet Structure

Stormwater system inlets into the pond shall be designed with the following requirements:

- Invert shall be at or above the normal water level (permanent pool elevation). Submerged inlets will not be permitted.
- Inlet pipes shall be minimum 450 mm in diameter and with slopes less than 1%.
- Pre-cast concrete headwalls shall be constructed for the inlet pipe where it discharges into the pond.
- Erosion protection shall be provided where the inlet pipe discharges into the pond, shall extend a minimum 1.5 m beyond the discharge point and headwall, and shall consist of rip rap or river stone underlain with geotextile material.

4.14.6 Outlet Structure

The outlet structure shall be designed as bottom draw outlet structures with the following requirements:

- A reverse sloped pipe that will allow for extended detention is used to drain to an outlet chamber located in the pond embankment.
- The invert of the reverse sloped pipe shall be minimum 1.0 m above the bottom of pond elevation.
- A gate valve shall be installed at the downstream end of the reverse sloped outlet pipe at the outlet chamber.
- Outlet pipes shall be minimum 450 mm in diameter with slopes less than 1%.
- The outlet chamber shall be a concrete outlet structure with a ditch inlet frame and grate to allow for overflow protection.
- A low flow maintenance (or draw down) pipe shall be provided to allow for gravity draining of the pond to 0.5 m above the bottom pond elevation for routine maintenance and sediment removal purposes.
- The maintenance pipe shall drain to the outlet chamber.
- A gate valve shall be installed at the downstream end of the maintenance pipe at the outlet chamber.
- The maintenance pipe shall be designed to release the pond volume over 6 hours to ensure no downstream impacts on the receiving water.
- Outlet Structures shall be designed to allow for a gravity flow.

4.14.7 Shut Off Valve

The shut off valve shall be provided in the outlet structure to contain the extended detention storage component in the event of a spill within the drainage area.

4.14.8 Maintenance By-Pass

Details shall be provided in the design report and drawings that outline the method of by-passing flows during maintenance activities.

4.14.9 Forebay and Main Cell Pond

The bottom shall be lined with 300 mm of 50 mm clear stone (for stability of equipment during future sediment removal) where the native soils are not capable of supporting the required sediment removal equipment. This component shall be verified by the developer's geotechnical consultant.

4.14.10 Pond Liner

A geotechnical investigation shall be completed that details the need for liners or other construction related methods resulting from groundwater impacts.

4.14.11 Safety Platform

A 2.0 m wide safety platform with a maximum 5% crossfall into the pond shall be provided above the normal water level (permanent pool elevation).

4.14.12 Slopes

Above the safety platform shall be at 4:1 maximum and below the safety platform shall be 3:1 maximum.

4.14.13 Top of Pond Berm

The top shall be minimum 3.0 m wide where no maintenance access route is proposed.

4.14.14 Overflow Spillway

The overflow spillway shall be incorporated (typically along the pond embankment near the outlet area) to provide relief to the system in the event of a severe storm, a blockage of the system, or failure of the outlet structure. The 100 year storm shall be used in the overflow design assuming the pond is full and all outlets are blocked. The spillway shall be designed to convey the 100 year storm while maintaining a 0.15 m freeboard to the top of the slope around the perimeter of the pond. The spillway invert shall be at or above the 100 year water level. Erosion protection of the spillway shall be provided along the entire length of the spillway (i.e. top of berm, down the pond side slopes on the outside of the berm, and into the outfall channel or to the extent required based on the existing site conditions).

4.14.15 Warning Signage

Shall be installed near pedestrian routes or walkways that are adjacent to the stormwater management pond.

4.14.16 Retaining Walls

Retaining walls within the stormwater management pond property limits are not permitted.

4.14.17 As-Constructed Certification

Prior to acceptance of the subdivision and any associated stormwater infrastructure, the stormwater management pond shall be certified by the 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 DRAWING STANDARDS

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

5.1 Design Drawings

The engineering design drawing shall include:

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

5.1.1 Presentation

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

Units

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

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. MODY 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.

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.

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.

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.

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.

5.1.2 Detail Requirements

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

5.1.3 Plan

The plan of the engineering design drawing shall include:

- 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 and large diameter water service pipes (>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.
- All topographic features.
- The street and its dimensions and name and also intersecting street names.
- Curbs and gutters, sidewalks, and driveways.
- The boundary lines of each lot, lot number, and property identification (PID) numbers and civic numbers if available.
- The chainage at 10 m intervals with labels every 50 m along the centerline of the street, and the chainage of all intersecting street center lines.
- Any control monuments and bench marks that are within the area of the plan.
- Limits of the construction.
- At least two points of known chainage on the centerline of the street, to be related to the Nova Scotia Coordinate Survey System (ATS77) (SECTION 7.4.2 Electronic Submission – Geo-referencing).
- 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.
- Hydrologic features: watercourses, ditches, swales, oceans, lakes, rivers, wetlands, direction of flow.
- . Contours.

5.1.4 Profile

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

- 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 twodimensional figure indicating pipe invert and obvert.
- 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.
- The finished grade above the water, wastewater and / or stormwater main where the pipe(s) are not under a street.
- 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.

- Any other underground services and appurtenances.

5.1.5 Professional Engineer's Stamp

The engineering design drawing shall be stamped and signed by a professional engineer.

5.1.6 Format

The format of design drawing submission shall be:

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

5.2 Record Drawings

The record drawing shall include all information on the "Design Drawing" as per subsection 7.2, revised to reflect the "as recorded" information. As a minimum the field coordinates of the following shall be obtained for the purpose of producing record drawings:

- Valves.
- Hydrants.
- Fittings.
- Finish Grade.
- Pipe Bells.
- Pipe Elevation (water system).
- Corporation Stops.
- ARV Drain Pipes.
- Curb Stops.
- ARV Vent Pipe.
  Manholes (tops).
- Catch Basins.
- Manholes (inlet / outlet inverts).
- Pipe Elevation (wastewater & stormwater systems).
- Stormwater System Inlet / Outlet Elevations.
- Stormwater System Roadside Ditch Profile Elevations

5.2.1 Additional Information

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

- 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.
- The location of all service connections from main to property boundary.
- Dimensions to locate tees, bends, and other below ground fixtures.
- Hydrant leads to include measurement from:
    - Centre of hydrant valve to center of hydrant

- Centre of hydrant valve to main.
- Start and end of rock profile
- Start and end of insulation
- Start and end of water, wastewater and stormwater system encasement pipes.
- The location of restrained joints / pipe.

5.2.2 Format

The format of the record information submission shall be both:

- Hard copy record drawing on reproducible .075 mm (3 Mil) matte polyester film.
- Electronic format as per Section 5.3.

5.2.3 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.

5.3 Electronic Submission

5.3.1 General

The purpose of this section is to identify the technical requirements for electronic information supplied to the MODY.

5.3.2 Geo-Referencing

All work shall be referenced using the Nova Scotia Coordinate Survey System (ATS77).

Map projection: the Nova Scotia Modified Transverse Mercator projection and grid system (MTM Zone 4 and Zone 5) shall be used for referencing data.

Datum: the horizontal datum for all coordinates shall be ATS77 adjustment.

Units: all coordinates and dimensions shall be supplied in metric units.

5.3.3 Coordinate Accuracy

Measurements and distances shall be collected to an accuracy of ± 50 mm.

Real world coordinates shall be shown correctly with no front end truncation of the coordinate values.

5.3.4 Delivery Format

Data and text files shall be delivered in ASCII PNEZDID2 format (comma delimited).

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 Halifax Water designated feature codes – available online through the MODY 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,
172, 4940715.44588, 5569268.66440, 94.64779, WCVLGA, 200mm-closed
173, 4940716.79618, 5569269.21558, 93.87974, WCHA, zinc
174, 4940713.66591, 5569264.33459, 94.54840, WCWM400, abandoned
175, 4940709.31549, 5569261.09200, 94.73379, WCWM400,
176, 4940705.20019, 5569257.55010, 95.23455, WCWM400,
177, 4940709.31549, 5569265.53783, 94.73379, SWPIST, private-abandoned
178, 4940711.25680, 5569262.45345, 94.73379, SWMHSA, full of rock
179, 4940715.68974, 5569225.45388, 95.23455, SWPISA, insulated

Quotation marks shall not be used in the data file.

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.

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.

5.3.5 Delivery Media

CD, DVD or USB flash drive media, clearly labeled with the project name, project phase, date, and consultant's name.

5.3.6 Computer Aided Drafting (CAD) Standards

External parties preparing engineering drawings for the MODY may obtain essential symbology (AutoCAD blocks) from the MODY. These blocks include MODY 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 CAD drawings, Refer to MODY website (www.halifaxwater.ca).

6 APPROVAL AND ACCEPTANCE SUBMISSION REQUIREMENTS

6.1 Approval Submission Requirements

6.1.1 New Development Projects

Procedure

Design water, wastewater and stormwater systems to this specification, the standard specification, and in accordance with the MODY By-laws, ordinances, procedures and specifications where they apply.

Information provided by MODY (Record Drawings, GIS printouts, Service Connection Cards, etc.) are for information purposes only. The professional engineer shall field check all provided information to ensure its accuracy prior to submission of new water, wastewater and stormwater projects.

Information

The following information shall be provided on all review submissions involving an extension to the water, wastewater and stormwater systems, or work impacting existing plant:

- An overall plan indicating the existing and proposed water, wastewater and stormwater systems, including but not limited to the location of valves, fire hydrants, manholes and catch basins and the size of pipes. The plan shall clearly indicate the specifications edition (year) to which the project is designed to.
- Technical Specifications.
- Plan and profile drawings.
- Cross-section and detail drawings.
- Design calculations including a tabulation of population density, domestic demand, fire flow rate requirements, maximum static pressure and minimum static pressure under normal operating conditions, residual pressure under fire flow conditions, and flow velocity in the water system at each fire hydrant in the proposed system extension.
- Design calculations for the wastewater system.
- Design calculations for the stormwater system.
- For subdivision work, an estimate of the cost of the proposed water, wastewater and stormwater systems extension.

Water Pumped Systems

The following information shall be provided on all review submissions involving water booster pumping stations:

- Minimum, average, and peak flow rates.
- Curves for selected pumps including curves for head, BHP and NPSH.
- Motor horsepower and combined electrical/mechanical efficiency.
- Electrical motor power factor.
- Details of auxiliary power supply unit and pump house building.
- 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.

Wastewater Pump Stations

The following information shall be provided on all review submissions involving wastewater pumping stations:

- Minimum, average, and peak flow rates.
- Curves for selected pumps including curves for head, BHP and NPSH.
- Motor horsepower and combined electrical/mechanical efficiency.
- Electrical motor power factor.
- Details of auxiliary power supply unit and pump house building.
- 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.

6.1.2 Building Permit Applications

(Multi-Unit Residential, Industrial, Commercial, and Institutional (ICI))

Procedure

Design and construct the water, wastewater and stormwater service connections (public and private) to MODY's Design and Construction Specifications, the Standard Specification for Municipal Services, and in accordance with MODY Bylaws, ordinances, procedures and specifications where they apply.

Information provided by MODY (Record drawings, GIS printouts, service connection cards, etc.) are for information purposes only and the professional engineer shall field check all provided information to ensure its accuracy prior to submission of projects.

Information

The following information shall be provided on all review submissions involving building permit applications for ICI projects:

- Two (2) sets of site location drawings conforming to MODY's Design and Construction Specifications indicating the details of the proposed water, wastewater and stormwater service connections to be installed. All existing municipal systems (water, wastewater and stormwater systems) are to be indicated as well as all additional utilities (natural gas, power and communications), electrical conduits, transformers, fuel tanks, structures, etc. that are located within 3.0 m of the proposed service connections as indicated on the submitted drawings.
- Plan and profile drawings will be required for the wastewater and stormwater service connections and where the domestic water service connection is greater than 50 mm, or if requested by MODY due to site conditions and services layout. The requirements for sizes and content (as detailed in SECTION 7.2) are as follows:
    - Minimum – 580 mm wide x 840 mm long.
    - Maximum – 610 mm wide x 915 mm long.
- Completed Backflow Prevention applications (available at www.halifaxwater.ca) for both the domestic and sprinkler water service connections, complete with a drawing showing the orientation and location of the proposed backflow prevention device. The drawing shall also indicate the size of pipe and devices (PRV, BFP, Meter, etc.) The Backflow Prevention applications must be completed by either a licensed plumber or a professional engineer.
- Completed pollution prevention program abbreviated discharger information report (Form 1, available on www.halifaxwater.ca)
- Design calculations including peak domestic demand and fire flow rate requirements.
- Design calculations for the sizing of wastewater service connections.
- Design calculations for the sizing of stormwater service connections.
- Calculations confirming that the pre and post stormwater flows for the proposed development are balanced.
- The applicant shall provide the proposed sewage generation numbers for the proposed development. The required sewage generation numbers must be provided and certified by a professional engineer. Based on the submission of the sewage generation numbers, a downstream combined/wastewater system analysis may be required in order to confirm that capacity exists in the local combined/wastewater system. This capacity analysis must be performed and certified by a professional engineer. If it is determined that capacity does not exist in the local combined/wastewater system, it is the responsibility of the developer to complete the required upgrades to ensure capacity exists in the system.
- The plan shall indicate all surface classifications (undisturbed natural areas, building foot print, landscaped, graveled, concrete paved and asphalt paved areas) measured areas (m2) that are applicable to the proposed project. This information shall be provided for in tabular form and indicated on the plan.
- The plan shall indicate the square footage of the proposed building to be constructed for ICI uses. For multi-unit residential buildings the total unit count shall be provided on the plan.

6.2 Construction / Inspection Requirements

6.2.1 MODY Capital Projects

Contractor to provide MODY's representative with access to the work, and to locations where products to be incorporated into the work are being prepared.

Contractor to co-operate with and assist the MODY's representative in conducting tests.

Contractor to provide assistance, labour, and materials, as are normally required for examining, testing, and measuring the quality, weight, or quantity of any material used and supply samples of material requested before incorporation into the work.

Contractor to include costs for providing assistance and samples for testing and for arranging tests in Contract Price.

The MODY's representative will visit the site at intervals appropriate to the progress of construction to become familiar with the progress and quality of the work and to record the data necessary to evaluate the pay quantities under the Schedule of Quantities and Unit Prices.

The MODY's representative has authority to reject work which, in his opinion, does not conform to the requirements of the contract documents. Whenever it is considered necessary or advisable, the MODY representative has authority to require special inspection or testing of work whether or not such work be then fabricated, installed or completed. However, neither the MODY's representative authority to act nor any decision made by MODY either to exercise or not to exercise such authority, shall give rise to any duty or responsibility of MODY to the contractor, subcontractors, or their agents, employees or other persons performing any of the work.

6.2.2 New Development Projects

Prior to construction and not before MODY approval of the final detailed design, a pre-construction meeting is to be arranged by the developer with representatives of MODY, the developer, the developer's consultant and contractor. Provide MODY with 48 hour's notice of pre-construction meetings.

Prior to construction, the developer shall provide MODY with 3 hard copy sets and a digital file (PDF) of the "Issued For Construction" drawings.

Developer to provide MODY's representative with access to the work, and to locations where products to be incorporated into the work are being prepared.

Developer to provide assistance to the MODY's if required when they are collecting relevant information as part of their inspection.

Developer 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 established by a licensed surveyor. Control is to be established prior to commencement of excavation for pipe installation.

Developer is to notify MODY at least twenty-four (24) hours in advance of requirements for tests and inspections. All tests are to be conducted by the developer's professional engineer or their representative, and are to be witnessed by the MODY representative.

The MODY's representative will visit the site at intervals appropriate to the progress of construction to become familiar with the progress and quality of the work. The developer shall provide full-time inspection, by a professional engineer or their representative, for all aspects of the construction of the water, wastewater and stormwater systems, including all pipe bedding, pipe laying and backfilling of trenches.

The developer's professional engineer or their representative shall be 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 developer's professional engineer for record drawings is not permitted.

6.2.3 Building Permit Applications (ICI)

Prior to construction of water, wastewater and stormwater service connections all permit approvals must be in place.

Developer/contractor/consultant to provide MODY's representative with access to the work, and to locations where products to be incorporated into the work are being prepared.

Developer/contractor/consultant is to notify MODY operations department at least twenty-four (24) hours in advance of requirements for tests and inspections. All tests are to be conducted by the developer's professional engineer or their representative, and are to be witnessed by the MODY operations department representative.

The MODY's representative will visit the site at intervals appropriate to the progress of construction to become familiar with the progress and quality of the work. The developer shall provide full-time inspection, by a professional engineer or their representative, 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.

The developer's professional engineer or their representative shall be 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 developer's professional engineer for record drawings is not permitted.

The developer's professional engineer shall 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.

6.3 Acceptance Submission Requirements

6.3.1 New Development Projects

General Requirements

Following completion of the construction of any water, wastewater and stormwater systems and prior to acceptance of ownership of any of those systems by the MODY the following information and/or documentation shall be provided:

- Record Drawings – In reproducible and electronic format, certified by a Professional Engineer and in accordance with Section 5 of this specification.
    - Record drawings shall be provided for all new water, wastewater and stormwater systems including, but not limited to, all underground chambers (PRV's, lift stations, etc.), water booster and wastewater pump stations, and all associated appurtenances for any new system extensions.
- Service connection card complete for each lot as per the form provided at www.halifaxwater.ca.
- Professional engineer's certificate of compliance stating that the municipal water, wastewater and stormwater systems have been installed in accordance with the approved drawings and specifications.
- Nova scotia land surveyor certification stating that all services have been installed within the boundaries of the right-of-way, easements in favour of MODY or a parcel owned by MODY; and that the as-constructed centre line of the public street coincides with the final legal subdivision plans of the public street.
- Detailed records of all actual construction costs and quantities breakdown for the installed water, wastewater and stormwater systems.
- Copy of the certificate to construct from NSE.
- Warranty deeds including property descriptions and plans for property which is to be transferred to the MODY.
- Grants of easement including property description and plan for all water, wastewater and stormwater systems installed outside the public right-of-way.
- 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 included within the maintenance bond provided to MODY, in which case a copy shall be provided to MODY.
- Where applicable, payment of a capital cost contribution, in the amount calculated by MODY and subject to the terms of an MODY Services Agreement.

Water System Requirements

Records of water system hydrostatic tests and certification of compliance.

Acceptable bacteriological examination results.

Water Systems installation costs. The actual cost of the installed water system on each individual street or easement. Itemized as follows:

- Water pipe (including fittings); sizes and lengths.
- Hydrants (including leads, valves and anodes); quantity.
- Valves; sizes, anodes and quantity.
- Water services; sizes, number of fittings, anodes and length of services.
- All other system components.

Complete valve and hydrant records for each valve and hydrant on the forms found at the end of this section.

Operation and maintenance manual for water booster stations as outlined in Section 3.2.8.17.

Special tools and standard spare parts for water booster station equipment.

Note: Service connections will not be inspected, nor will water meters be issued until MODY have accepted the water, wastewater and stormwater systems and has been advised by MODY that all primary services have been accepted.

Wastewater System Requirements

Closed Circuit Television (CCTV) inspection and report (also required four weeks prior to end of warranty security period.) Refer to Section 8.3.2 for CCTV requirements.

Pipe test report including service connections to the property lines.

Manholes test and inspection report.

Operation and maintenance manual for pumping stations as outlined in Section 5.3.2.29.

Special tools and standard spare parts for pumping station equipment.

Completed wastewater pumping station inventory sheet.

Stormwater System Requirements

Closed Circuit Television (CCTV) inspection and report (also required four weeks prior to end of warranty period). Refer to Section 8.3.2 for CCTV requirements.

Pipe test report including service connections to the property lines.

Manholes test and inspection report.

Driveway culvert sizing tables.

Requirements as per Section 6.11.17

Closed Circuit Television (CCTV) Inspection Requirements for New Development

CCTV inspection procedures shall meet the requirements of the National Association of Sewer Service Companies (NASSCO).

Deflection testing for plastic pipe shall be in accordance with the requirements as set out in Section 33 31 00, Section 33 40 00 and Section 39 00 00 of the Standard Specifications for Municipal Services. The CCTV inspection and report must indicate the size of the deflection gauge (mandrel) being used when performing the pipe test.

The CCTV inspection and report shall be performed by a certified third party service provider who has been accredited through NASSCO's Pipeline Assessment & Certification Program (PACP).

A professional engineer's certificate stating that they have viewed the CCTV inspection and report and can certify that no deficiencies have been found. If deficiencies are found, the designer's engineer shall prepare a report outlining measures for repair to MODY for consideration.

The Engineer reserves the right to reject any CCTV inspection and report that does not meet the NASSCO.

(CCTV) Inspection Procedure – General

- Inspect the systems interior using a color, CCTV camera and document the inspection on a digital recorder.
- Code all defects using NASSCO certification programs:
    - System mains - follow PACP
- Use a video overlay system to clearly display the inspection header information for five (5) seconds at the start of each inspection.
- At the start of each inspection, record the mandatory information outlined in the NASSCO method (PACP) and the following additional information – all inspections:
    - Time and weather conditions o Location details o Pipe type (wastewater or stormwater) o Inspection number
- Record all defects and code using the NASSCO methods including but not limited to the following:
    - Any system pipe joint that displays a gap or spread, offset, gasket, or signs of infiltration.
    - Any service connection that displays water infiltrating around service connection, or any service connection exhibiting pronounced protrusion into the system line.
    - Any section of the system that is crushed, broken or displays longitudinal or circumferential cracks (other than hairline cracking) and that displays a gap / spread, offset, or signs of infiltration.
    - Any variance in grade, alignment, or diameter of system line section.
    - Any gravel, roots, or foreign material that may impede flow.
    - Any deformation in pipe shape.
    - Any section of system piping displaying standing water.
    - Any material change or spot repair.
    - Any evidence of clear water flows together with the location.
    - Any other evidence of water infiltration (staining, wetted perimeter of joint, high water marks, dripping).
    - Any other information that may be pertinent to the work.
    - Display pipe and manhole IDs on-screen at all times during the inspection for quick reference.
    - Display the exact location of the camera in metres on-screen.
    - Include on-screen text for every observation recorded during the inspection and in the database.
    - Convert the defect codes to condition ratings for the pipe segments using the PACP.
    - Maintain inspection notes during inspection for use in generating the final inspection report.
    - Ensure all equipment used to carry out the inspection, analysis, and reporting services is in a state of good repair and is safe for its intended use.
    - Ensure all video and still picture images are clear and sharp.

- Ensure recorded image from the CCTV camera is free of fog or haze in the pipe.
- Remove camera from sewer line if the camera lens becomes obscured with condensation, grease, scum, or debris and clean.

(CCTV) Inspection Procedure – System Mains

Provide references for the video that clearly display 'From' and 'To' manhole IDs and travel distance in metres on the periphery of the screen and arrange the information to minimize interference with the inspection image (defect code and description should appear on the screen while 'coding' for at least five (5) seconds).

Provide accuracy for distance measurement in the system to within 0.5% of the above ground measurement.

Perform pipe inspection one (1) system line section at a time from manhole to manhole by moving the camera through the system preferably in direction of flow along the axis of the pipe and record general construction, structural condition, and evidence of inflow, infiltration or surcharging together with the location of the defect.

Inspect continuous defects using the pan and tilt feature at intervals that will provide a representation of and fully display and identify that defect.

Operate camera at steady speeds capable of inspecting each pipe joint, tee connection, structural deterioration, infiltration and inflow source, and material deposits at a maximum speed of 9 m/min.

Record features and defects and stop and pan camera to record specific features including manholes, joints, service connections, and defects. Service connections are to be viewed and recorded at a camera angle of 90 deg. to provide a true depiction of the connections.

Record location of defects and service connections with maximum one (1) m tolerance measured from centerline of reference manhole.

Illuminate approximately two (2) m ahead of the camera to minimize reflective glare.

Adjust lighting as needed according to the size of the pipe to provide a clear picture of the entire periphery of the pipe for all conditions encountered.

Distribute lighting evenly around the perimeter of the pipe to prevent loss of contrast.

At the start of each inspection, record the mandatory information outlined in the NASSCO method (PACP) and the following additional information – pipe inspections:

- Pipe ID (From Manhole ID, To Manhole ID, Direction of travel (upstream, downstream))
- Pipe Segment Reference
- Lining Method
- Length Surveyed
- Purpose of Survey
- Weather

Closed Circuit Television (CCTV) Report

Provide a report that includes the location of each fault, defect, and service connection with distance measured from the centerline of reference manhole and clock position referenced to the axis of pipe, and report shall include pictures of significant defects (severely deteriorated pipe, severely protruding service connections, locations of severe inflow and infiltration flows, or any other relevant information), and technical recommendations based on the inspection observations.

Provide an inspection report and video for each system line section inspected.

For each inspected main line system reach (referenced manhole to manhole) provide: o .MPEG file. o Digital photographs in.JPG or .JPEG files.

- Inspection reports in searchable PDF files.
- o Any handwritten inspection logs or field maps prepared during inspection.
- Associated certification program inspection information (PACP) in a.MDB file format.
- Name files according to the file naming convention of:
    - "Street_PipeID_YYYY_MM_DD_Incremental Number (1, 2, 3, etc…)" with the corresponding file extension (.MPEG, .JPG/.JPEG, .PDF, .MDB, .SHP).

6.3.2 Building Permit Applications (ICI)

Following completion of the construction of ICI building projects the following information and/or documentation shall be provided prior to the issuance of a water meter:

- Record Drawings – In reproducible and electronic format, certified by a Professional Engineer and in accordance with Section 5 of this specification. This shall include all water, wastewater and stormwater service connections installed for the project.
- Records of water system hydrostatic tests and certification of compliance. (For water services 100mm and larger or as directed by MODY.)
- Acceptable bacteriological examination results. (For water services 100mm and larger or as directed by MODY.)
- Inspection of the backflow prevention device(s) by MODY.
- Final Inspection of the water, wastewater and stormwater service connections by MODY.
- Submission of the engineer's certificate of compliance for building services (refer to SECTION 8.4)
- Submission of the (CCTV) inspection and report of the wastewater and stormwater service connections (refer to Section 8.3.2).
- For (CCTV) inspections of wastewater and stormwater service connections that are less than 200mm in diameter, a lateral camera is to be utilized.
- Deflection gauge testing is not required to be performed on the wastewater service connection if the diameter is less than 200mm.
- Submission of a wastewater manhole and service connection test and inspection report (refer to Section 4.6.5).