2023

SANITARY INFRASTRUCTURE DESIGN STANDARD

S600

Barrie

Foreword

This document was prepared by AECOM Canada Ltd. in collaboration with the City of Barrie and under the direction of a Technical Review Committee assembled by the City of Barrie, consisting of the following members:

Mr. Mike Nugent, C.E.T. - Policy and Standards Supervisor, Chairperson (City of Barrie)
Mr. Derek Burke, C.E.T. - Project Technologist (City of Barrie)
Mr. Dave Caspick, C.E.T. - Manager of Development, Policy and Standards (City of Barrie)
Ms. Sherry Diemert, P. Eng. - Infrastructure Planning Engineer (City of Barrie)
Mr. Stew Patterson, P. Eng. - Manager of Infrastructure Planning (City of Barrie)
Mr. Wayne Bando, P. Eng. - Infrastructure Planning Engineer (City of Barrie)
Mr. Geoff Mitchinson - Technical Operations Supervisor (City of Barrie)
Mr. Craig Morton, C.E.T., PMP - Manager of Roads and Parks Operations (City of Barrie)
Mr. David Quenneville, - Manager of Wastewater Operations (City of Barrie)
Mr. Jeff Henry, C.E.T. - Senior Project Technologist (City of Barrie)
Ms. Tracy Gordon - Infrastructure Technologist (City of Barrie)
Mr. Craig Hebert, P. Eng. - AECOM Canada Ltd.
Mr. Jared Kelly, E.I.T. - AECOM Canada Ltd.
Mrs. Melanie Ego - AECOM Canada Ltd.
Mr. Rick Groves - AECOM Canada Ltd.

This updated manual replaces the City of Barrie's Sanitary Sewage Collection System Policies and Design Guidelines dated December, 1983. This updated manual was developed to better reflect current and emerging standards and technology, legislation, and best practices as they exist in 2011. It will be necessary to update the manual from time to time as regulations, design practices, and technologies continue to evolve. Current legislation shall be followed at all times.

Key revisions in this manual include, but are not limited to, the following:

- The method of determining design flows has been updated to more closely reflect current industry practice, particularly with regard to residential flows. Residential flows can be calculated on a Land Use or Zoning Designation Basis or by Development Details Basis rather than the 3-Level design flow system of the previous guidelines.
- Extraneous flows allowances will be calculated as a function of development area as opposed to a function of pipe length and diameter in the previous guidelines. This method more closely reflects current industry practice.
- Additional sections have been included to help illustrate the correlation these guidelines have with land use planning, infrastructure planning and legislation.
- General acceptance protocols have been included.
- Engineering submission reporting requirements have been included.
- Sanitary Sewer Design Sheets have been updated to reflect changes to design process.

DISCLAIMER

The City of Barrie has supplied this manual with the express understanding that it shall not be liable in any manner whatsoever to any person, corporation or organization for damages, injuries or costs resulting from the use of the information supplied.

The City of Barrie reserves the right to amend, alter or to accept revisions to this manual at any time without further notice.

Over time, it will be necessary to update this manual as the regulations, design practices and technologies continue to evolve and change. It is the user's responsibility to check the City of Barrie's website for the current revision of this manual. Manual holders should immediately discard superseded and cancelled standards.

Last Revision Date: April 2023

REVISION No.	DATE	COMMENT
1	March 1998	Addition of Design Sheets
2	September 2012	Major Guideline Update
3	October 2017	Guideline changes to Peak Flow, Minimum Pipe Diameter, Minimum and Maximum Velocities, Minimum Slopes, Pipe Capacity Formula and the requirement to use Self-Leveling Maintenance Hole Frame and Grate. Update to BSD-41.
4	April 2023	Added new document names and numbers throughout

TABLE OF CONTENTS

Foreword ii

1. Introduction 1

1.1. Purpose 1

1.2. Municipal Land Use and Infrastructure Planning 1

1.2.1. Official Plan 1

1.2.2. Official Plan Amendments 2

1.2.3. Secondary Plans 2

1.2.4. Sanitary Collection System Master Plans 2

1.2.5. Municipal Class Environmental Assessment 3

1.3. Format of Document 4

2. Legislation – Acts and Regulations 5

3. Sanitary Sewage Collection System Policies and Design Guidelines 6

3.1. Servicing Responsibilities 6

3.2. General Design Considerations 6

3.2.1. Design Period 6

3.2.2. Tributary Area 6

3.2.3. Combined Systems 6

3.2.4. Septic Systems 7

3.2.5. Standard Drawings 7

3.3. Design Flows 7

3.3.1. Residential Flows 7

3.3.1.1. Design Population *7*

3.3.1.2. Average Daily Flow *8*

3.3.1.3. Peak Flow *8*

3.3.2. Commercial and Institutional Flows 9

3.3.2.1. Average Daily Flow *9*

3.3.2.2. Peak Flow *9*

3.3.3. Industrial Flows 9

3.3.3.1. Average Daily Flow *9*

3.3.3.2. Peak Flow *9*

3.3.4. Extraneous Flows 10

3.4. Sanitary Sewer Design 10

3.4.1. Hydraulic Design Sheets 10

3.4.2. Minimum Pipe Diameter 10
3.4.3. Minimum and Maximum Velocities 10
3.4.4. Minimum Slopes 11
3.4.5. Pipe Capacity Formula 11
3.4.6. Changes in Pipe Size 11
3.4.7. Hydraulic Losses at Maintenance Holes, Junction Chambers 11
3.5. Sewer System Layout 12
3.5.1. Location in the Right-of-Way 12
3.5.2. Curved Sewers (Radius Pipe) 12
3.5.2.1. Tracer Wire 12
3.5.3. Pipe Crossing and Clearance 12
3.5.3.1. Separation between Sanitary Sewers and Watermain 12
3.5.3.2. Separation between Sanitary Sewers and Storm Sewers 13
3.5.4. Minimum Cover 13
3.6. Maintenance Holes 13
3.6.1. General Requirements 13
3.6.2. Maintenance Hole Location and Spacing 14
3.6.3. Drop Inlet Structures 14
3.7. Pipe Materials and Installation 14
3.7.1. Pipe Materials and Specifications 14
3.7.2. Minimum Bedding and Backfill Requirements 15
3.8. Sanitary Service Connections 15
3.8.1. Minimum Pipe Diameter, Grade & Depth of Cover 15
3.8.2. Pipe Materials for Service Connections 15
3.9. Inverted Siphons 16
3.10. Sewage Pumping Stations 16
3.10.1. Station Capacity 16
3.10.2. Site Considerations 16
3.10.3. Types of Pumping Station 16
3.10.3.1. Wet Well/Dry Well Pumping Station 17
3.10.3.2. Wet Well or Submersible Pumping Station 17
3.10.3.3. Suction Lift Pumping Station 17
3.10.3.4. Screw Pump Pumping Station 17
3.10.4. Pumps 17

3.10.5. Wet Wells 18
3.10.6. Dry Wells 20
3.10.7. Pump Suction Piping 20
3.10.8. Pump Discharge Piping 20
3.10.9. Standby Power 21
3.10.10. SCADA/Communications 21
3.10.11. Pumping Station Water and Facilities. 22
3.11. Forcemains 22
3.11.1. Minimum Diameter 22
3.11.2. Velocity and Transient Analysis 22
3.11.3. Materials 22
3.11.4. Emergency Valve Connections 23
3.11.5. Air Release Valves 23
3.11.6. Bedding and Installation 23
3.11.7. Tracer Wire 23
3.12. Emerging Technologies 23
4. Acceptance Protocol for Sanitary Sewers, and Service Connections 25
4.1. Performance Evaluation of Sanitary Sewers, Maintenance Holes and Services Prior To Acceptance 25
4.1.1. Visual Inspection 25
4.1.2. As-Constructed Survey, Drawings and Sanitary Sewer Design Sheets 25
4.1.3. CCTV Inspection and Flushing 25
4.1.4. Deflection Testing 25
4.1.5. Leakage Testing 25
4.1.5.1. Infiltration Testing 25
4.1.5.2. Exfiltration Testing with Water 26
4.1.5.3. Exfiltration Testing with Low Pressure Air 26
4.1.6. Visual Inspection 26
4.2. Performance Evaluation of Forcemains Prior to Acceptance 26
4.2.1. Visual Inspection 27
4.2.2. Hydrostatic Leak Test 27
5. Engineering Submission Reporting Requirements 28
5.1. Submissions to External Agencies 28
5.1.1. Ministry of Environment (MOE) District and Approval Offices 28

5.1.2. Ministry of Natural Resources (MNR) 28
5.1.3. Ministry of Transportation (MTO) 28
5.1.4. Nottawasaga Valley Conservation Authority (NVCA) 28
5.1.5. Lake Simcoe Region Conservation Authority (LSRCA) 28
5.1.6. Other Agencies 28
5.2. Reporting Requirements for Conceptual/Preliminary Design of Sanitary Sewage Collection Systems 29
5.2.1. Background Information 29
5.2.2. Sanitary Drainage Areas 29
5.2.3. Sanitary Sewage Collection System Design 29
5.2.4. Primary Figures and Drawings 29
5.2.5. Stand Alone Reports 29
5.3. Reporting Requirements for Detailed Design of Sanitary Sewage Collection Systems 29
5.3.1. Background Information 29
5.3.2. Sanitary Drainage Areas 30
5.3.3. Sanitary Sewage Collection System Design 30
5.3.4. Sewage Pumping Station Design 30
5.3.5. Primary Figures and Drawings 30
5.3.6. Supporting Calculations and Modeling Details and Output 30
5.3.7. Stand Alone Reports 31
6. References 32

Appendices

Appendix A –Summary of Approved City of Barrie Sanitary Master Plans and Infrastructure Map

Appendix B – Summary of Applicable Legislation, Acts and Regulations

Appendix C – Sanitary Sewer Design Sheets

1. Introduction

1.1. Purpose

These guidelines are intended to assist developers, consulting engineers, and other designers in designing sanitary sewage collection works that will meet the requirements of the City of Barrie by providing a basis for the design of sanitary sewage collection works, including minimum acceptable servicing levels.

The design of all communal sewage works within the City is subject to the approval of the City. The policies and guidelines within this document may be altered at any time at the sole discretion of the City, and it is the responsibility of the designer to obtain and make use of the latest version of this document and associated legislation at the time of engineering design.

These guidelines are meant to apply, where applicable, to all portions of the sanitary sewage collection system from the Water Pollution Control Plant up to the outside wall of the individual foundation walls of the structures which are serviced by the system, in order to ensure continuity and integrity in the system's design, construction and operation.

The development review process involves a number of review agencies, each of which has guidelines, policies, and criteria that should be followed when completing sanitary sewage collection system designs. In an effort to maintain some consistency and to streamline the development review process, a review of guidelines, policies, and criteria from various governing review agencies was completed while preparing the policies and guidelines included in this document. While best efforts were made to minimize discrepancies between the City's guidelines and those from various agencies, it was not possible to do so in all cases, while meeting the City's requirements. Where a discrepancy between the policies and guidelines presented in this document and other agency guidelines exists, the policies and guidelines in this document will govern in completing the City's review of development applications. Otherwise, the guidelines, policies and criteria of other review agencies such as the MOE, the LSRCA and the NVCA will govern.

It must be emphasized that these are, in fact, design guidelines only. It is not the intention of the City of Barrie to curtail innovation of designs. If it can be clearly demonstrated that alternative designs fulfill the requirements and concerns of the City, then they will be considered for approval.

1.2. Municipal Land Use and Infrastructure Planning

The Municipal Land Use and Infrastructure Planning processes have evolved over time to enable a streamlined review process and to ensure that qualified input and representation from the agencies, public, and consultants is provided at the appropriate time. The following sections describe the various Municipal Land Use and Infrastructure Plans that are undertaken at different stages of the overall planning process.

1.2.1. Official Plan

An Official Plan is a long range planning document that guides the use of land in the City as well as its future growth and development. It provides direction on how and where change and growth should take place, and identifies the services and facilities needed to support the development of healthy and complete communities while setting out measures to conserve our natural and cultural heritage.

On April 23, 2010, The Ministry of Municipal Affairs and Housing (MMAH) approved a new Official Plan for the City of Barrie. Portions of the Plan have been appealed to the Ontario Municipal Board and are not considered to be in effect at this time.

1.2.2. Official Plan Amendments

Amendments may be made to the Official Plan at any time in accordance with the Planning Act to revise it and/or incorporate new objectives, policies, and specific designations. At a minimum, the City must review and revise the Official Plan every five years as required to ensure that it conforms to provincial plans, has regard to matters of provincial interest, and is consistent with provincial policy statements. The current version of the City of Barrie Official Plan can be found on the City's website at www.barrie.ca.

1.2.3. Secondary Plans

On occasion, the City of Barrie requires the preparation of Secondary Plans or "district plans" to address the development or redevelopment of large areas of land or neighbourhoods. A Secondary Plan is typically adopted as an amendment to the City of Barrie Official Plan and outlines the goals, objectives and policies governing the development and redevelopment of land for the area which it applies.

Secondary Plans typically include policies related to community size and structure, housing, schools, parks, and commercial development. The text of a Secondary Plan is usually accompanied by schedules identifying proposed land uses, development constraints, and transportation schedules. The policies of the Secondary Plan are intended to complement the more general policies of the City's Official Plan, and are implemented through plans of subdivision and site planning.

There are 12 Secondary Planning Areas within the City which have, to a large extent, been developed in accordance with the approved Secondary Plans:

1. Ardagh Secondary Plan;
2. Bayshore Secondary Plan;
3. Cundles East Secondary Plan;
4. East Bayfield Secondary Plan;
5. Edgehill Drive Secondary Plan;
6. Georgian Drive Secondary Plan;
7. Holly Secondary Plan;
8. Innis-Shore Secondary Plan;
9. Little Lake Secondary Plan;
10. Northwest Secondary Plan;
11. Painswick South Secondary Plan; and
12. West Bayfield Secondary Plan.

New development proposed within these areas shall be in accordance with the Secondary Plan policies for the applicable Secondary Plan as amended from time to time, subject to the policies applying to intensification nodes and corridors. New Secondary Plans may be developed from time to time as required for the growth and development of the City. In the event of a conflict, the Provincial Policy Statement and the Growth Plan for the Greater Golden Horseshoe take precedence over the approved Official Plan and Secondary Plans.

1.2.4. Sanitary Collection System Master Plans

Master Plans are long range plans which integrate infrastructure requirements for existing and future land use with environmental assessment planning principles, and provide a framework for future works and developments. Long range infrastructure planning enables the proponent to comprehensively identify need and establish broader infrastructure options. The combined impact of alternatives is also better understood which may lead to other and better solutions. In addition, the opportunity to integrate with land use planning enables the proponent to look at the full impact of decisions from a variety of perspectives.

Like all Master Plans, Master Plans for sanitary sewage collection systems are typically undertaken for a logical planning unit, such as at the regional level, City-wide level, or individually for a specific sanitary drainage area or a group of sanitary drainage areas. Sanitary Collection System Master Plans provide the analysis required to identify sanitary servicing needs, including suggested improvements to existing infrastructure and proposed future infrastructure to accommodate future conditions and proposed development.

The City of Barrie's existing sanitary sewage collection system consists of three (3) sanitary drainage areas referred to as the North (includes the drainage areas historically known as North, Cundles and Lakeshore); the South (includes the drainage areas historically known as Painswick, Hewitts, Bayview and Paddison Farms drainage areas); and Industrial (includes the drainage areas historically known as Industrial and Essa). The City has modelled the sanitary sewer system and is continually updating and expanding the level of detail. The City has several approved Sanitary Master Plans for various areas of the city as shown on the Sanitary Infrastructure Map included in Appendix A. At the time of preparing this guideline, the Sanitary Master Plans were being updated for the entire City and scheduled for completion at the end of 2012. The newly annexed lands will be divided into two sanitary drainage areas referred to as Annexation East and Annexation West. It should be noted that Master Plans are subject to change, and it is the responsibility of the designer to ensure that the most current Master Plans are being used. A summary of the City's approved Sanitary Master Plans is included in Appendix A.

1.2.5. Municipal Class Environmental Assessment

The Municipal Class Environmental Assessment (EA) applies to municipal infrastructure projects such as roads, water, and wastewater projects, and has proven to be an effective way of complying with the Environmental Assessment Act in Ontario. Frequently occurring municipal infrastructure projects with common characteristics and predictable environmental effects fall under the Municipal Class EA approach. Such projects are classified in the Municipal Class EA (MEA, September 2007) in terms of Schedules according to their potential impact on the environment:

Schedule A — Generally includes normal or emergency operational and maintenance activities. The environmental effects of these activities are usually minimal and, therefore, these projects are pre-approved. Examples of Schedule A activities may include, but are not limited to, cleaning, repairing and renovating existing sanitary collection systems, treatment facilities, pumping plant equipment or outfalls; installation of new service connections and appurtenances from existing sewers; increasing pumping station capacity where new equipment is located within an existing structure and current rated capacity is not exceeded; and expanding sanitary collection systems and all necessary works to connect to an existing sanitary outlet where required as a condition of site approval.

Schedule A+ — These projects are pre-approved, however the public is to be advised prior to project implementation. The manner in which the public is advised is to be determined by the proponent. Examples of Schedule A+ activities may include, but are not limited to, expanding sanitary collection systems and all necessary works to connect to an existing sanitary outlet, provided all works are to be completed within an existing road allowance or utility corridor; and increasing pumping station capacity where new equipment is located within an existing structure and current rated capacity is exceeded.

Schedule B Generally includes improvements and minor expansions to existing facilities. There is the potential for some adverse environmental impacts and therefore the proponent is required to proceed through a screening process including consultation with those who may be affected. Examples of Schedule B activities may include, but are not limited to; expanding sanitary collection systems and all necessary works to connect to an existing sanitary outlet where works are to be completed outside of existing road allowances or utility corridors; and constructing new pumping stations or increasing pumping station capacity where new buildings or structures will be required.

Schedule C Generally includes the construction of new facilities and major expansions to existing facilities. These projects proceed through the environmental assessment planning process outlined in the Municipal Class EA document (MEA, September 2007). An example of a Schedule C activity may include, but is not limited to, constructing new sanitary systems, including outfall to constructed wetland or water body.

The activities listed above are a brief overview relating to the Municipal Class EA (MEA, September 2007) at the time these guidelines were created. It is the sole responsibility of the designer to refer to the most current version of the document to ensure all appropriate processes are followed and projects remain in compliance with the Environmental Assessment Act in Ontario.

1.3. Format of Document

This document is organized into six (6) sections intended to provide guidance to the reader regarding guidelines for the design and approval of sanitary sewage sewer collection systems within the City of Barrie. The sections of this document are summarized as follows:

Section 1 – Introduction: An introduction to the Barrie Sanitary Sewage Collection System Design Guidelines and municipal planning process.

Section 2 – Legislation – Acts and Regulations: A brief overview of applicable federal, provincial, and municipal legislation relevant to sanitary sewage collection system design.

Section 3 – Sanitary Sewage Collection System Policies and Design Guidelines: The City of Barrie's policies and guidelines related to sanitary sewage collection system design.

Section 4 – Acceptance Protocol for Sanitary Sewers and Service Connections: The protocol for performance review and requirements for acceptance of newly constructed sanitary sewers and service connections by the City.

Section 5 – Engineering Submission Reporting Requirements: Requirements for sanitary sewage collection system design details for inclusion in development submissions to the City.

Section 6 – References: A list of reference material cited in this document.

2. Legislation – Acts and Regulations

The sanitary sewage collection system policies and design guidelines provided in this document were developed based on applicable federal, provincial, and municipal legislation including:

- Ontario Water Resources Act (OWRA);
- Conservation Authorities Act;
- Environmental Assessment Act;
- Water Opportunities and Water Conservation Act;
- Ontario Environmental Protection Act;
- Lake Simcoe Protection Act;
- Lakes and Rivers Improvement Act;
- Clean Water Act, including Source Water Protection Plans;
- Sustainable Water and Sewage Systems Act;
- Drainage Act;
- The Planning Act;
- Public Lands Act;
- Places to Grow Act;
- Fisheries Act;
- Navigable Waters Protection Act;
- City of Barrie Sewer Use By-Law; and
- City of Barrie Design Standards.

A summary of the above legislation and policies and their relevance to sanitary sewage collection system design in the City of Barrie is included in Appendix B.

3. Sanitary Sewage Collection System Policies and Design Guidelines

This section outlines the City of Barrie's guidelines regarding sanitary sewage collection system design, including sanitary sewers, service connections, sewage pumping stations, and forcemains. When constructing on private property, construction materials and practices must be in accordance with the Ontario Building Code (OBC) and the City of Barrie Standards.

3.1. Servicing Responsibilities

Private developers developing within the City are required to:

a) Provide a sanitary collection system which will carry all sewage generated within, or being directed through, the site to a sufficient outlet as approved by the City;
b) Provide a sanitary collection system sufficient to accommodate all flows that are generated within the development plus all flows that can be expected to be generated externally to the development which may naturally be serviced through the development; and
c) Provide sufficient collection facilities that would allow for simple connection for future upstream external developments.

These requirements are all the responsibility of, and at the expense of the developer. The City may consider possible cost sharing arrangements with respect to the oversizing of the system, however, all cost sharing arrangements must be included in any site development agreement or subdivider's agreement as the case may be.

3.2. General Design Considerations

3.2.1. Design Period

All sanitary sewers shall be designed to accommodate sewage flows from the ultimate development expected in the tributary area. At the direction of the City, in the event that by designing trunk and interceptor sewers for the ultimate development the costs are prohibitive, then these sewers may be designed for at least a 20 year minimum design period with enlarging being undertaken at a later date in order to achieve the ultimate design capacity.

3.2.2. Tributary Area

The limit of the tributary area shall be determined by the natural topographical boundaries to the extent that a system could be simply designed by gravity flow to service the area. Political and/or ownership boundaries will not restrict the delineation of the tributary area limits. The area outside the tributary area adjacent to the tributary limit, which could conceivably be simply re-graded to flow to the area in question or that could simply be serviced by extending the gravity sewers beyond the tributary area limit, must be included when considering the hydraulic design and design flows. The final design must be based on the tributary area which meets the approval of the City. Sanitary drainage plans identifying the internal and external catchment areas will be required.

3.2.3. Combined Systems

Combined sewer systems will not be permitted as per the Barrie Sewer Use By-law. No stormwater from any source, including sump pumps, roof drains and foundation drains, shall be connected to the sanitary sewer. Every effort should be made to have such connections redirected to overland flow or the storm drainage system.

3.2.4. Septic Systems

Development of private sewage treatment systems is not permitted. The review and approval of new private sewage treatment systems may be considered by the City only in cases where replacement or upgrading of existing systems is warranted.

3.2.5. Standard Drawings

In addition to these written guidelines, reference should also be made to the City of Barrie's Infrastructure Standard Drawings.

3.3. Design Flows

The careful determination of design flows is a crucial step in the design of an appropriate sanitary sewage collection system. The design flows for sanitary sewer design must account for flows from all sources: residential connections, commercial and institutional connections, industrial connections and extraneous flows from groundwater infiltration and surface water inflow.

In lieu of precise information on development on the whole or any part of the sanitary sewer drainage area, reference will be made to the latest zoning plan issued by the Planning Services Department.

3.3.1. Residential Flows

3.3.1.1. Design Population

Land Use or Zoning Designation Basis

When the most detailed knowledge of the ultimate land use for the tributary area consists simply of its overall proposed land use and/or zoning as determined from such sources as the governing Official Plan, Secondary Plans or Zoning By-Law, the design population can be estimated on an area basis using the following minimum design population values. When the exact land use/zoning is not confidently known, then an assessment shall be made and more restrictive values must be used. The City may alter the values associated with any particular development as determined appropriate.

Low Density	single detached, duplexes or semi-detached dwellings	25 units/hectare @ 3.13 ppu

- Typical zoning designations for Low Density Development may include RH, R1, R2, R3, R4, RM1 and RM1-SS. It should be noted that zoning designations are subject to change, and it is the responsibility of the designer to ensure that the most current zoning by-laws and designations are being used.

Medium Density	triplexes and fourplexes	26 - 35 units/hectare @ 2.34 ppu
	cluster and/or block townhouses	40 units/hectare @ 2.34 ppu
	street townhouses	47 units/hectare @ 2.34 ppu
	'walk-up' apartments	26 - 53 units/hectare @ 2.34 ppu

- Typical zoning designations for Medium Density Development may include RM2 and RM2-TH. It should be noted that zoning designations are subject to change and it is the responsibility of the designer to ensure that the most current zoning by-laws and designations are being used.

High Density	Apartment dwellings	54 - 300 units/hectare @ 1.67ppu

- Typical zoning designations for High Density Development may include RA1 and RA2. It should be noted that zoning designations are subject to change, and it is the responsibility of the designer to ensure that the most current zoning by-laws and designations are being used.

The method of determining design population for residential flows will depend upon the particular stage that is being considered and the appropriate detail required for the desired level of design accuracy. Reference shall be made to current zoning policies.

Development Details Basis

When the details regarding the proposed uses on individual lots are known, or can be assumed with reasonable certainty, a more detailed approach to design population and associated design flow estimation is required. This approach involves the determination of individual design flows for the various areas in the tributary area which will contribute to an individual sewer reach. The actual number of units shall be used and the design population estimated using the following people per unit (ppu) values.

Low Density	3.13 ppu
Medium Density	2.34 ppu
High Density	1.67 ppu

3.3.1.2. Average Daily Flow

Average daily domestic flow = 225 L/day/person (excluding extraneous flows)

3.3.1.3. Peak Flow

Peak domestic flow is to be calculated using the following formula:

$$Qp = \frac{P \times q \times M}{86.4} + I \times A$$

Where Qp = Peak residential sanitary sewage flow, including peak extraneous flows (L/s)

P = Design population in thousands (see Section 3.3.1.1)

q = Average daily domestic flow per capita (L/day/person) (see Section 3.3.1.2)

M = Peaking factor (see Section 3.3.1.3)

I = Peak extraneous flow (L/s/ha) (see Section 3.3.4)

A = Tributary area (ha) (see Section 3.2.2)

As per the MOECC Design Guidelines for Sewage Works, 2008 (MOE Guidelines), the peaking factor, M, can be calculated using the Harmon Formula or Babbit Formula. The Babbit Formula gives peaking factors that are more representative of instantaneous peaks, and the Harmon Formula gives peaking factors that are more representative of peak hour. The Babbit Formula shall only be used to assess the upstream reaches of the sewer shed where depth of flow and minimum scour is a concern for partial flow conditions where depth of flow is less than 30% of the pipe diameter.

Harmon Formula

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

Babbit Formula

$$M = 5/P^{0.2}$$

Where P = Design population in thousands

The minimum permissible peaking factor M is 2.0 per the MOECC Guidelines.

3.3.2. Commercial and Institutional Flows

3.3.2.1. Average Daily Flow

Due to the high variability of sanitary flows between various commercial and institutional establishments, design flows for specific commercial and institutional uses are to be based on actual flow records for similar uses whenever possible. In the absence of historical data for estimation, the designer may refer the common commercial sewage flow rates recommended in the most current Ministry of the Environment Guidelines. For more general applications, where the specific use is not known, a minimum average design flow rate of 28 m^3/day/ha shall be used. This does not include an allowance for extraneous flows.

3.3.2.2. Peak Flow

Whenever possible, peaking factors should be based on an individual assessment of each type of use. Peak values and peak times vary greatly between various commercial and institutional establishments. so the designer must consider the intended use and design accordingly. Peak sewage flows will often correspond to water usage rates for most establishments. For more general applications, where specific information is not known, a factor of two (2) may be used.

3.3.3. Industrial Flows

3.3.3.1. Average Daily Flow

Sanitary sewage flows from industrial areas are industry/process specific and can vary greatly. Where possible, design flows should be based on an individual assessment of expected flow rates or actual flow records for each individual industrial use. In the absence of such information, the following average day design flows shall be used for industrial development:

General Industrial	= 35 m3/day/ha
Heavy or Special Industrial Use	= 55 m3/day/ha
Unknown Mix of General & Heavy	= 50 m3/day/ha

These rates do not include extraneous flows.

3.3.3.2. Peak Flow

Peak sewage flow rates vary greatly depending on the type of industry, production schedules and processes used. As such, peak sewage flow rates shall be based on an individual assessment of expected peak flow rates or actual flow records whenever possible. In the absence of such information, a peaking factor between two (2) and four (4) may be used based on the designer's best judgement. Industrial uses, which have the potential to produce higher than average sewage flow rates, may be required to provide flow monitoring devices and/or flow equalization with off-peak discharge facilities as determined by the City.

3.3.4. Extraneous Flows

When designing a sanitary sewer system, an allowance should be made for the infiltration of groundwater into the sewers and sanitary service connections (infiltration) and for other extraneous water entering the sewers from sources such as maintenance hole covers (inflow).

The amount of groundwater leakage into the sewer system will vary with the quality of construction, type of joints, ground conditions, and level of groundwater in relation to pipe. Although such infiltration can be reduced by proper design, construction, and maintenance, it cannot be completely eliminated and an allowance should be made in the design sewage flows to incorporate this flow component.

An extraneous flow rate of 0.1 L/s/ha shall be used for sanitary sewer design.

The above rate assumes strict adherence to construction standards in the installation of sanitary sewers and building connections, and does not account for any other extraneous flows such as foundation drain connections, excessive flooding through maintenance hole covers, significant groundwater problems, etc.

Where collection system infrastructure is being designed to convey flows from existing developed areas, the extraneous flow allowance used may be increased based on flow monitoring data and/or system modelling, as directed by the City of Barrie.

Where a sewer is located within the floodplain of a watercourse, maintenance hole covers are to be raised above the maximum flood elevations, or watertight maintenance hole covers with associated air vents may be required as directed by the City.

3.4. Sanitary Sewer Design

3.4.1. Hydraulic Design Sheets

The design of sanitary sewers shall be completed using the City of Barrie's Sanitary Sewer Design Sheets as provided in Appendix C, or a similar format as deemed appropriate by the City.

3.4.2. Minimum Pipe Diameter

The minimum diameter for sanitary sewers conveying raw sewage from residential areas with no potential for future intensification or sanitary sewer shall be no less than 200mm in diameter (NPS-8). Sanitary sewers located in Industrial, Commercial, Institutional, and mixed land use areas shall be no less than 250 mm in diameter (NPS-10). The downstream sanitary sewer diameter shall be no less than the upstream sanitary sewer diameter.

3.4.3. Minimum and Maximum Velocities

Sanitary sewers shall be designed such that a minimum sewage flow velocity of 0.60 m/s is achieved without including inflow and infiltration flows. The actual velocity at peak flow conditions should be calculated and slope increased to ensure adequate flushing velocities are maintained. A sample spreadsheet is available on City of Barrie website, and can be reviewed in Appendix C.

In order to reduce pipe scour, the maximum flow velocity shall be 3 m/s. Velocities in excess of 3 m/s may be permitted in special situations, provided that slope anchors are used to prevent pipe separation, and measures are taken to protect against scour. If velocities above 3 m/s are proposed, documentation must be submitted to the City for approval, indicating potential risks and mitigative measures required to ensure the long term integrity of the collection system. Minimum calculated velocities shall not exceed full flow velocities.

3.4.4. Minimum Slopes

Even where minimum velocities of 0.6 m/s are achieved, it is still generally desirable to use a minimum slope of 0.4% for sanitary sewers 200 mm to 375 mm in diameter, and a minimum slope of 0.3% for sanitary sewers larger than 375 mm in diameter. In certain circumstances, such as where increased slopes would be require deepening of extensive sections of the sewage collection system or the additional of a pump station, slopes shall not be less than those listed in Table 5.4 of the MOECC Guidelines, but these slopes may result increased maintenance costs for the City depending on the actual depth of flow.

For the most upstream section of sanitary sewer where there is no opportunity to extend the sanitary sewer in the future, the sanitary sewer slope need not exceed 2%, regardless of whether or not the minimum 0.6 m/s velocity cannot be achieved.

3.4.5. Pipe Capacity Formula

Pipe capacity is to be calculated using Chézy-Manning's formula:

$$Qfull = \frac{AxR^{\frac{2}{3}}xS^{\frac{1}{2}}}{n}$$

Where Qfull = Flow capacity of sewer (m3/s)

A = Cross sectional area of pipe (m2)

R = Hydraulic radius of pipe (m)

S = Sewer slope (m/m)

n = Manning's roughness coefficient (shall be a minimum value of 0.013)

Trunk sanitary sewers greater than 375 mm in diameter shall be upsized when flows exceed 85% of full flow under future peak flow conditions including Inflow and infiltration (± 0.7 depth of flow over diameter of pipe). For local sewers, 375 mm diameter or less, sanitary sewers shall be upsized if future peak flows including Inflow and infiltration exceed 50% of full flow under future peak flow conditions including inflow and infiltration (± 0.5 depth of flow over diameter of pipe). The reason for this is that I&I on a local basis may be much higher and to account for potential blockages in the sanitary sewers.

3.4.6. Changes in Pipe Size

Where an increase in pipe size occurs at the downstream side of the maintenance hole, maintain obverts of incoming and outgoing pipes at the same elevation. This practice is effective in minimizing hydraulic losses across maintenance holes and reduces the probability of sanitary sewage backup in the collection system.

3.4.7. Hydraulic Losses at Maintenance Holes, Junction Chambers

The following minimum drop values shall be used to account for hydraulic losses incurred at sewer maintenance holes.

Table 1. Hydraulic Losses at Maintenance Holes, Junctions and Transitions

Maintenance Hole Type	Minimum Drop
Straight Run	Grade of Sewer
0-45^{o} turn	0.03 m
46-90^{o} turn	0.06 m
Junctions and Transitions	Physical Modeling recommended

3.5. Sewer System Layout

3.5.1. Location in the Right-of-Way

The sanitary sewer is to be located as per the City of Barrie Standard Drawings. Sanitary sewers are generally located on the centreline of the roadway, or under the crown of the travelled road in cases where the crown of the travelled road is not equal to the centreline of the roadway.

In cases where the above locations cannot be ensured, and the maintenance hole is subject to surface water flooding, then watertight maintenance hole grates with suitable air vents at spacing no less than every third maintenance hole must be used.

3.5.2. Curved Sewers (Radius Pipe)

Curved or deflected sewer lines are allowed for sanitary sewers greater than 600 mm in diameter with the approval of the City. The minimum radius of curved sewers shall be in accordance with the minimum radii table as provided by the manufacturer. Deflected sewers shall not exceed the maximum deflection specified by the pipe manufacturer.

3.5.2.1. Tracer Wire

Tracer wire shall be installed on all curved sewers. Tracer wire shall be brought to the surface using 50 mm diameter valve boxes spaced at 300 m intervals along the curved sewer for locating purposes.

Tracer wire shall be #12 AWG (0.0808” diameter) high strength copper clad steel conductor (HS-CCS), insulated with a 30 mm, high density polyethylene (HDPE) insulation, rated for direct burial use at 30 volts. Tracer wire is to be placed six (6) inches above the pipe (where practical), and installed in such a manner that allows, from proper access, for connecting of line tracing equipment, proper locating of wire without loss or deterioration of low frequency signal, and without distortion of signal caused by multiple wires being installed in close proximity. Tracer wire shall be brought to the surface using 50 mm diameter valve boxes spaced at (no greater than) 300 m intervals along the curved sewer for locating purposes. In all non-standard locations, such as easements, parks, townhouse/condominium developments and reconstruction projects, metallic warning tape shall also be used over all watermains. The metallic warning tape shall be laid in the trench, 0.3 m (12”) to 0.5 m (19”) directly above the sanitary main.

A continuous length of wire must be used. If the wire must be joined, only the approved connectors shall be used and installed per manufacturer’s instructions.

To ensure there is no damage to the tracer wire during or after construction, the City’s Representative shall perform a continuity test on the wire. Should the City’s Representative find a problem with continuity or installation of the tracer wire, the Contractor/Developer shall be responsible for the repair, at no cost to the City.

3.5.3. Pipe Crossing and Clearance

3.5.3.1. Separation between Sanitary Sewers and Watermain

Sanitary sewers and watermains located parallel to each other shall be constructed in separate trenches, maintaining a minimum clear horizontal separation distance of 2.5 m from outside edge to outside edge of the pipe. When it is not possible to maintain a separate trench and the minimum horizontal separation distance, the crown of the sewer should be at least 0.5 m below the invert of the watermain and separated by in situ material or compacted backfill. Joints should be offset as much as possible between sewers and watermains.

Where a crossing of a sanitary sewer and watermain is required, the watermain should cross above the sewer wherever possible. Whether the watermain crosses above or below the sewer, a minimum vertical distance of 0.5 m between the outside edge of the watermain and the outside edge of the sewer should be provided to allow for proper bedding and structural support of the watermain and sewer pipes. Sufficient structural support for the sewer pipes should be provided to prevent excessive deflection of the joints and settling. The length of water pipe should be centered at the point of crossing so that joints in the watermain will be equidistant, and as far as possible from the sewer. The crossing should be perpendicular if possible. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, one of the following methods should be specified:

- The sewer should be designed and constructed equal to the water pipe and should be pressure tested at 350 kPa (50 psi) to assure watertightness; and/or
- Either the watermain or the sewer line should be encased in a watertight carrier pipe which extends 3 m (10 feett) on both sides of the crossing, measured perpendicular to the watermain.

3.5.3.2. Separation between Sanitary Sewers and Storm Sewers

A minimum clearance of 0.5 m between the obvert of the sanitary sewer and the invert of the storm sewer shall be provided if the sanitary sewer connections are required to go under the storm sewer. The minimum horizontal clearance between the outside walls of the adjacent sewer pipes shall be 0.8 m.

3.5.4. Minimum Cover

The minimum depth of cover over sewers shall be 2.5 m, measured from the sewer obvert to the finished road or ground surface elevation. The sanitary sewer main should be installed at a depth to prevent frost damage and also allow for gravity drainage of at least 2% from basements. Generally, sewers placed between 0.9 to 1.5 m below basement floor elevation will allow for sufficient drainage and cover; however it is the responsibility of the designer to determine the nature of each development to ensure depths are sufficient for servicing. In special cases where the minimum cover is not feasible, approval may be given for a lesser depth of cover subject to the provision of frost protection, if deemed necessary by the City.

3.6. Maintenance Holes

3.6.1. General Requirements

Maintenance holes shall be a minimum diameter of 1200 mm.

Full height benching is required in maintenance holes for pipes 300 mm or less in diameter. Three-quarter height benching can be used for pipes greater than 300 mm.

Channels shall have a steel trowel finish while benching should have a wooden float finish. Benching shall be at a slope of 8:1 towards the channel.

The maximum change in the direction of flow in any sanitary sewer manhole shall be 90 degrees. A change of flow direction at acute interior angles shall not be permitted.

Flexible joints shall be used at 0.3 m from the outside edge of maintenance holes.

For service connections to existing trunk or interceptor sewers, the invert of the service connection inspection chamber shall be a minimum of 1 m above the crown of the trunk or interceptor sewer. If the hydraulic elevation of any potential surcharge in the trunk or interceptor sewer is known, the invert of the inspection chamber on the service connection must be above the surcharge elevation.

A self-levelling frame and cover shall be used for all new maintenance holes that are within an asphalt roadway.

Watertight maintenance holes and sealed maintenance hole lids are required where structures are below the expected groundwater table, and in areas prone to ponding and/or flooding.

Lockable maintenance holes shall be considered in areas where public access is a concern, such as park blocks, open spaces, pumping stations, and water pollution control plants.

3.6.2. Maintenance Hole Location and Spacing

Maintenance holes shall be provided at the beginning of each sewer line, change in alignment, grade, material and at all junctions (except in curvilinear installations).

Maintenance holes shall generally be located at the road centreline as per City Standards. To avoid undue impact loads, wherever possible, maintenance holes shall be located away from the normal wheel track.

Maintenance holes shall be located, whenever possible, with a minimum of 1.5 m clearance away from any other service.

The maximum distance between maintenance holes shall be as follows:

Table 2. Maximum Maintenance Hole Spacing

Sewer Size	Maximum Spacing
250 mm	110 m
300 – 900 mm	120 m
≥ 975 mm	150 m

3.6.3. Drop Inlet Structures

Drop maintenance holes are to be used where the invert levels of the inlet and outlet sewers differ by greater than 610 mm. Drop structures should be external unless the maintenance hole is of a large size (i.e. 1500 mm or larger in diameter). Drop maintenance holes shall be in accordance with Ontario Provincial Standard Drawings or City of Barrie Standard Drawings. Drop structure connections must not interfere with access, ladders or safety grates in any way.

3.7. Pipe Materials and Installation

3.7.1. Pipe Materials and Specifications

The following pipe materials are permitted to be used for sanitary sewers:

- Concrete;
- Polyvinylchloride; and
- Polyethylene.

Pipe specifications shall conform to current OPSS.

The designer shall ensure that appropriate pipe material is used for industrial sewers where maximum resistance to corrosion is desirable.

3.7.2. Minimum Bedding and Backfill Requirements

Bedding materials and installation details shall conform to current Ontario Provincial Standards and City of Barrie Construction Specifications.

3.8. Sanitary Service Connections

One sanitary service connection must be provided per development lot.

Sanitary lateral connections for pre-serviced lots are to be located at the centreline of the lot, temporarily capped and marked with a 2" x 4" extending to the pipe, and painted green. Also, a detailed sanitary service connection as-built record, to the satisfaction of the City, shall be submitted to the Mapping and Records Coordinator.

All connections to new sanitary mains shall be approved factory made tees. Connections to existing sanitary sewer shall be made with approved factory made tees or saddles in strict accordance to manufactures guidelines and the City's approved product list.

A sanitary inspection maintenance hole as per Ontario Provincial Standards is to be provided for all commercial, institutional and industrial developments. These maintenance holes are to be located in an accessible location within the project's property boundaries.

All sanitary services shall be installed with traceable appurtenances to the satisfaction of the City.

3.8.1. Minimum Pipe Diameter, Grade & Depth of Cover

The minimum diameter of service connection shall be as follows:

Single service 100 mm – residential unit

150 mm – commercial/institutional

150 mm – industrial

All service connections shall be constructed at a preferred minimum grade of 2% and a maximum grade of 8%. If grades less than 2% are proposed, approval from the City is required. Risers shall be utilized when the invert depth of the sewer main exceeds 4.25 m deep, and will not exceed 3 m in height. Risers shall be installed at the time of construction of the sewer mains and in accordance with the standard drawings. Risers shall be firmly supported and anchored to the trench wall in a manner that will minimize the possibility of damage to the riser by the backfilling operations or by settlement. Supports and anchors are to be to the satisfaction of the City. Sweep bends shall be used in lieu of 45^{o} or 90^{o} bends.

The minimum depth of cover at the property line measured from proposed final grade shall be 2.4 m, measured from the sewer obvert to finished ground surface elevation unless permission for a shallower service is given by the City. Those portions of a service connection with less than 1.6 m of cover from finished grade are to be provided with thermal protection from frost.

3.8.2. Pipe Materials for Service Connections

The following pipe materials are permitted to be used for service connections:

- Polyvinylchloride

Pipe specifications shall conform to current OPSS and City of Barrie Approved Product List.

Service connections shall be green in colour.

3.9. Inverted Siphons

Design of inverted siphons requires site specific approval of the City.

3.10. Sewage Pumping Stations

The following sections discuss the design of sewage pumping stations. In addition to the guidelines and standards included here, all sewage pumping stations must be designed in accordance with current MOE guidelines.

3.10.1. Station Capacity

Sewage pumping stations shall be designed with sufficient capacity to accommodate the maximum design peak instantaneous flow from the ultimate tributary area. Allowances shall be made in the design such that with minor modifications, the pumping station capacity may be upgraded (e.g. upgrade or addition of pumps, motors, forcemains, etc.) to handle future peak flows from the ultimate tributary area. In certain instances, it may be more economical to initially over-design the pumping station for future flows rather than upgrading at a later date. In these instances, pumping station operations should be evaluated at various flow rates anticipated during the design life.

3.10.2. Site Considerations

The site for a sewage pumping station shall be selected after making detailed investigations as to the present and future needs of the developing area. The station shall be located to ensure that its tributary area is serviced with the minimum amount of cost.

The following shall also be reviewed when considering the site location of a sewage pumping station:

- Type of station, the capacity, and the type and number of pumps to be used;
- Soil investigations (i.e. rock or high water table resulting in increased construction cost);
- Flood protection shall be considered when designing sewage pumping stations. Sewage pumping stations shall be designed to be protected from damage during the 1:100 year storm and shall remain fully operational and accessible during the 1:100 year storm event. Regulations/requirements of municipalities, provincial and federal agencies regarding flood plain obstructions must be considered;
- Vehicle access and parking must be provided for inspection and maintenance of the station. The pumping station shall be readily accessible by maintenance vehicles during all weather conditions;
- Structural, architectural and/or landscaping design of the station to ensure that it does not detract from the surrounding area;
- Availability of utilities such as electric power (i.e. voltage to operate electric motors), gas power, potable water, fire protection and telephone service;
- A junction maintenance hole will be required to allow for one inlet into the well;
- Odour control and the location of sensitive receptors; and
- Noise control and backup power considerations and the location of sensitive receptors.

3.10.3. Types of Pumping Station

There are four major types of sewage pumping stations that the designer may consider for site specific conditions: wet well/dry well, wet well/submersible, suction lift and screw pump. Pumping station type selection must be approved by the City. It should be noted that preference will be given to the wet well/submersible type pumping station.

3.10.3.1. Wet Well/Dry Well Pumping Station

In a wet well/dry well pumping station, the pumps, motors and controls are located below grade in a dry well, located immediately adjacent to the wet well. The wet well is used to collect and temporarily store wastewater.

3.10.3.2. Wet Well or Submersible Pumping Station

The wet well or submersible pumping station has submersible pumps located in the same below grade chamber into which the wastewater flows. The pumps are located within the wet well and the motor and controls are typically mounted above grade.

3.10.3.3. Suction Lift Pumping Station

Suction lift pumping stations incorporate self-priming pumps in order to locate the pumps above the water level, and either eliminate or decrease the depth of the dry well.

3.10.3.4. Screw Pump Pumping Station

Screw lift pumping stations use an Archimedean screw with the motor mounted above grade.

3.10.4. Pumps

To determine the appropriate pumps for installation in the sewage pumping station, the following data must be included with the design submission. Final equipment selection must meet the approval of the City. The preferred pump supplier is ITT Flygt. Consideration may be given to similar and compatible equipment.

Multiple pumps shall be provided. Where only two units are provided, they shall be of the same size, to provide a firm capacity with one unit out of service and at least capable of handling the 10 year design peak hourly flow. The designer should ensure that all pumps will be subjected to hydrostatic and operating tests performed by the manufacturer.

Where a bar rack is required, preceding the pump, a mechanical hoist is needed. Where the size of the installation warrants, mechanically cleaned and/or duplicate bar racks shall be provided.

Pumps handling sanitary sewage from 750 mm or larger diameter sewers shall also be protected by bar racks. Appropriate protection from clogging shall also be considered for small pumping stations served by smaller sanitary sewers.

Except where grinder pumps are used, pumps handling raw sewage should be capable of passing spheres of at least 75 mm in diameter. Pump suction and discharge openings shall be at least 100 mm in diameter.

The pump shall be so placed that, under normal operating conditions, it will operate under a positive suction head, except where suction-lift pumps are used.

Each pump shall be equipped with a time totalizer and provision for automatic or manual alteration of the lead pump.

Each pump shall have an individual intake. Wet well and intake design shall be such as to avoid turbulence near the intake and to prevent vortex formation.

A sump pump equipped with dual check valves shall be provided in the dry well to remove leakage or drainage with discharge above the maximum high water level of the wet well. All floor and walkway surfaces shall have an adequate slope to a point of drainage. Pump seal leakage shall be piped or

channeled directly to the sump. The sump pump shall be sized to remove the maximum pump seal water discharge that would occur in the event of a pump seal failure.

Pumping station designs shall be based on system-head calculations and curves for three conditions using appropriate Hazen-Williams factor “C“ as follows:

a) Low sewage level in the wet well, C = 120;
b) Median sewage level over the normal operating range in the wet well, C = 130; and
c) Overflow sewage level in the wet well, C = 140.

System-head curve (b) should be used to select the pump and motor since this will reflect the normal operating condition. The extreme operating ranges will be given by the intersections of curves (a) and (c) with the selected pump curve. The pump motor shall be able to operate satisfactorily over this full range (i.e., between conditions (a) and (c)).

Although it is normal to size pumps and motors for design peak instantaneous flows, consideration shall be given to how the future and ultimate sewage flow requirements can be handled. Ultimate sewage flows would account for the build-out of the catchments area. These operating points shall also be shown on the system-head curves.

Where pumping stations are discharging directly to a sewage treatment plant or into a pumping station (i.e., forcemain directly into wet well of a downstream pumping station), some means of flow pacing is needed. This is provided most commonly by variable speed drives, depending upon the degree of flow pacing necessary. If even minor pump surges will have serious effects, variable speed pumps shall be used. If small surges can be tolerated, two speed or multiple speed pumps may be used.

The pumps and controls of main pumping stations, and especially pumping stations discharging to or operated as part of a sewage treatment plant, shall be selected to operate at varying delivery rates. In addition, where practical, such stations shall be designed to deliver as uniform a flow as feasible in order to minimize hydraulic surges. The firm design capacity (with the largest unit out of service) of the pumping station serving sanitary sewers shall be based on design peak instantaneous flow and shall be adequate to maintain a minimum velocity of 0.6 m/s in the forcemain.

3.10.5. Wet Wells

Where continuity of pumping station operation is critical, consideration shall be given to dividing the wet well into two sections, properly interconnected, to facilitate repairs and cleaning (including automatic cleaning devices). Divided wet wells shall be considered for all pumping stations with firm capacities in excess of 100 L/s (1600 USgpm).

The design fill time and minimum pump-cycle time shall be considered in sizing the wet well. The effective volume of the wet well shall be based on design average daily flow, and a filling time not to exceed 30 minutes, unless the facility is designed to provide flow equalization. Other factors that shall be considered include volumes required for pump-cycling, dimensional requirements to avoid turbulence problems, vertical separation between pump and control points, sewer inlet elevation(s), capacity required between alarm levels and basement flooding and/or overflow elevations, and number of and horizontal spacing between pumps.

The minimum surface plan area of a wet well shall be 4.9 m^2 (53 ft^2) [i.e. 2.5 m (8.2 ft) diameter or 2.25 m (7 ft) square]. Wet wells shall not provide excessive retention times, due to potential odour problems. The designer shall ensure that easy and efficient removal of pumps, motors, and other mechanical and

electrical equipment is provided. A suitable and safe means of access for persons wearing self-contained breathing apparatus needs be provided to wet and dry wells and valve chambers. Equipment such as access hatches, ladders, service platforms, guards, grates, and handrails, shall be constructed of a suitable material when exposed to wet and/or corrosive conditions.

For pumping stations equipped with 50 kW (67 hp) or smaller pumps, the wet well shall be of sufficient size to allow for a minimum cycle time of 10 minutes for each pump.

To achieve this minimum detention time in a two-pump station using constant speed pumps, the volume in cubic metres (m^3), between pump start and pump stop shall be 0.15 times the pumping rate of one pump, expressed in L/s. For two-speed or variable speed pumps, pumps over 50 kW (67 hp), or for other numbers of pumps, the required volume depends on the operating mode of the pumping units. The pump manufacturer's duty cycle recommendations shall be utilized in selecting the minimum cycle time. When the anticipated initial flow tributary to the pumping station is less than the design average daily flow, provisions shall be made so that the fill time indicated is not exceeded for initial flows. When the wet well is designed for flow equalization, as part of a sewage treatment plant, provisions shall be made to prevent septicity.

The wet well floor shall have a minimum slope of 1 to 1 to the hopper bottom. The horizontal area of the hopper bottom shall be no greater than necessary for proper installation and function of the inlet. The cross-sectional area of the wet well above the benching shall be constant for the full depth of the wet well.

Access to the wet well shall always be from the outside. An access ladder shall be provided from the top of the slab to the service platform, and a separated ladder from the platform to the bottom of the well.

The opening to the wet well shall be no smaller than 750 by 900 mm, or 900 mm in diameter. The cover shall be equipped with a lock and pry lip, and include a safety rail around the access. The opening edge shall be flush with the vertical wall of the wet well. The opening to the wet well shall be on the wall giving access to float controls, bubbler lines and similar equipment, without the necessity of entering the wet well.

The need for and type of screening facilities required for pumping stations varies with the characteristics of the sewage. For submersible pumping stations, screening may not be required, but for wet well/dry well stations, it is generally accepted practice to provide screening in the form of a basket screen or a removable bar screen. Although some basket screens may be cumbersome to remove and empty, their installation provides the advantage of not requiring entry of operating staff into the wet well for cleaning operations. With basket screens, guide rails shall be tubular and similar to submersible pump rails. Manually cleaned bar screens shall be sloped at 60º and have 38 mm clear openings. The vertical sides shall be solid. The minimum width shall be 600 mm. A drain platform shall be provided for screenings.

All wet wells need to be provided with ventilation. Natural ventilation will usually suffice for small pumping stations where access is limited. This can be achieved through two (2) 100 mm diameter vent pipes. Vents shall be equipped with a gooseneck at the top, extending 900 mm above the top of the slab of the wet well. The vents shall be equipped with an insect screen. One vent pipe shall extend within 300 mm of the crown of the inlet sewer and the other shall terminate on the underside of the roof slab. Natural ventilation can be supplemented with portable ventilation units. Adequate provisions for fresh air entry of all wet wells shall be followed. In some cases, mechanical ventilation may be preferred. In locations adjacent to sensitive receptors, such as schools or recreation sites, the need for supplemental odour control shall be evaluated and, if required, suitable equipment installed.

In wet well/ dry well installations, the air bubbler line (if used) and sump pump discharge shall be raised above the overflow elevation and shall cross between the wells below the frost line.

A service platform is normally required to allow for servicing of equipment and bar screen cleaning (if used).

3.10.6. Dry Wells

Guidelines for dry well design are listed as follows:

- The floor of the dry well shall be sloped towards a sump, equipped with sump pump. The discharge piping from the sump pump shall enter the wet well at an elevation above the maximum overflow level. Check valves will be installed to prevent any chance of back flooding from the wet well;
- A flood alarm shall be installed in the dry well;
- No water service shall be provided in the dry well without suitable backflow preventer as flooding may be possible. The water service capacity must not exceed the sump pump capacity;
- Mechanical ventilation of the dry well must be provided and all Ministry of Labour requirements met;
- The humidity level will be controlled to reduce damage to the electrical equipment piping and paint;
- Maintenance requirements will be designed into the dry well (i.e. openings to enable the removal of motors/pumps from the station). Lift beam with trolley or simple lift hook shall be provided at a maximum height of 1.2 m above the motors to permit removal;
- Instrumentation and controlling systems must be designed to the satisfaction of the City;
- Ventilation, heating, and dehumidification equipment shall be provided to protect electrical control equipment from excess moisture; and
- A lifting beam complete with a permanently attached trolley or hook shall be provided directly above the pump/motor assembly at a minimum height of 1.2 m above the motors to facilitate removal of the pump motors.

3.10.7. Pump Suction Piping

Pump suction lines shall be designed with the following features:

- Inlets consisting of 90^{o} short radius down turned flared elbows;
- Suction velocities for 20-year or greater pumping requirements, preferably in low end of 0.8 m/s to 2 m/s range;
- Flanged wall pipe with water stop collar;
- Gate valve (flanged);
- Flanged eccentric reducer; and
- Minimum pipe size of 100 mm.

3.10.8. Pump Discharge Piping

Pump discharge piping shall be designed with the following features:

- Velocities for the 20-year or greater sewage flow pumping needs, preferably in the low end of 0.8 to 4 m/s range;
- Flanged, concentric increaser;
- Spacer 150 to 300 mm long with one flanged end and one grooved end for Victaulic coupling;
- Elbows (as necessary);
- Check valve (flanged), preferably horizontally placed;
- Gate valve (flanged);

- Riser pipe; and
- Magnetic or other type of suitable flow meter and recorder (or pump timers for small, constant speed stations where accuracy of flow measurement is not critical – three (3) timers minimum, one (1) for each pump and one (1) for pumps operating in parallel).

3.10.9. Standby Power

The objective of standby power at a sewage pumping station is to allow for emergency operation of the pumping station in order to prevent the discharge of raw or partially treated sewage into any waters, and to protect public health by preventing back-up of sewage and potential discharge into basements, or onto streets and other public and private property.

All sewage pumping stations must provide an automatic generator for standby power in case of power failure. For small pumping stations, a quick connection for a portable generator may be considered by the City.

Standby generators shall be sized to provide adequate power to start and continuously operate all connected loads including pumps, lighting, ventilation and other auxiliary equipment necessary for the safe and proper operation of the sewage pumping station. The generating equipment shall be capable of operating all pumps necessary for adequate pumping station operation during emergency situations. The operation of only one pump during auxiliary power supply shall be evaluated and justified on the basis of design peak hourly flows relative to single-pump capacity, anticipated length of power outage, and storage capacity.

Unless the generating equipment has capacity to start all pumps simultaneously with auxiliary equipment operating, special sequencing controls shall be provided to start pump motors.

Where permanent standby generating equipment is provided, the standby generating equipment shall include automatic (i.e. automatic transfer switch (ATS)) and manual start-up and load transfer. Where a connection for portable generating equipment or manual transfer is provided, sufficient storage capacity with alarm system needs to be provided to allow time (minimum two (2) hours) for detection of the pumping station failure and time to transfer, set up, and connect portable equipment.

3.10.10. SCADA/Communications

Supervisory Control and Data Acquisition (SCADA) shall consist of an integrated hardware and software system to provide full control and monitoring of the pumping station. The pumping station must be designed for operation in a manual configuration, and then automated with SCADA. The programmable logic controller (PLC) is to be an Allen Bradley Logix PLC or its successor model. Level control will be a combination of floats and Siemens Milltronics Level Sensor (ultrasonic level sensor). Flow monitoring and data logging shall be accomplished with a magnetic flow meter.

The selection of all hardware for SCADA and Communications shall be approved by the City of Barrie and will be communicated at the pre-design phase.

Alarm systems with a backup power source are required for all pumping stations. At a minimum, the following alarms are required:

- Power failure;
- High water level;
- Pump failure;
- Unauthorized entry; and

- Any other case of pump station malfunction.

Pumping station alarms shall include identification of the alarm condition and shall be transmitted to the Barrie Water Pollution Control Centre.

3.10.11. Pumping Station Water and Facilities.

Pumping stations, where possible, shall be serviced and equipped with a minimum 37 mm diameter potable water service equipped with a reduced pressure back flow preventer, so as to provide suitable wash down capabilities. Consideration shall be given to providing a washroom and storage facilities on larger pumping stations.

3.11. Forcemains

3.11.1. Minimum Diameter

The minimum diameter of forcemain shall not be less than 75 mm in diameter unless otherwise approved by the City. The forcemain is to be designed in conjunction with the long range capacity of the pumping station. All future forcemains shall be twinned from pump to outlet. Twinned forcemain installation provides redundancy and the ability to meet minimum flow velocities.

3.11.2. Velocity and Transient Analysis

Forcemain velocities shall range from 0.8 m/s to 2.5 m/s. These velocities are sufficient to re-suspend the solids in the forcemains which have settled out when the pumps are not operating. Forcemains shall be designed to the design pressure and must withstand sudden surges in pressure. A transient analysis for all forcemains over 150 mm diameter will be required and must be attached to the design brief.

The use of surge tanks and valves with adjustable rate of closure or other suitable means shall be evaluated.

3.11.3. Materials

The following pipe materials are permitted to be used for forcemains:

- Polyvinylchloride;
- High Density Polyethylene;
- Ductile Iron;
- Steel; and
- Concrete.

The pipe material selection is to take into account the design and transient pressures, soil conditions and constructability. Air and vacuum valves to maintain the required flow characteristics and to provide material protection and the need to install in appropriate chambers are to be evaluated. Pipe specifications shall conform to current City of Barrie Approved Product List.

In environmentally sensitive locations, preference for a fused pipe material shall be considered. All forcemain integrity is to be evaluated and confirmed with both a pressure and leakage test; flexible pipe material may also be tested with a deflection ball. Isolation valves shall be installed on long forcemains and be placed in conjunction with air or vacuum valves in the same chamber. Consideration of pipe swabbing facilities with mandrel launchers and catchers may be required in special instances.

It is also very important that forcemains constructed of a similar pipe material to other municipal services be clearly marked and identified in the buried location, this can accomplished with marker tape or other approved means.

3.11.4. Emergency Valve Connections

An emergency valve connection shall be installed on all forcemains downstream of the sewage pumping station to allow for the connection of discharge pipes from portable pumps to the forcemain, by-passing the sewage pumping station for either maintenance or emergency purposes.

If the sanitary pumping station is shut down for any reason, there needs to be the ability to allow for connection to emergency pumping. The standard method of emergency connection to a sucker truck shall include the required isolation valves and quick connection point at or near the pumping station wet well.

3.11.5. Air Release Valves

Low pressure double acting air release valves, or approved equal, shall be installed at high points in the forcemain to prevent air locking. Vacuum relief valves may be necessary to relieve negative pressures on forcemains. The designer shall evaluate the forcemain configuration and head conditions to determine areas where negative pressures will be anticipated, and design for pressure relief.

3.11.6. Bedding and Installation

Bedding materials and installation details for forcemains shall conform to current City of Barrie Approved Product List.

3.11.7. Tracer Wire

Tracer wire shall be installed on all forcemains for “locate” purposes. Tracer wire shall be brought to the surface using 50 mm diameter valve boxes spaced at 300 m intervals along the forcemain for locating purposes. Forcemains installed by trenchless technology in difficult soil condition shall use heaver gage tracer wire or install inside a fused HDPE sleeve.

Tracer wire shall be #12 AWG (0.0808” diameter) high strength copper clad steel conductor (HS-CCS), insulated with a 30 mm high density polyethylene (HDPE) insulation, rated for direct burial use at 30 volts. Tracer wire is to be placed six (6) inches above the pipe (where practical), and installed in such a manner that allows for proper access for connecting of line tracing equipment, proper locating of wire without loss or deterioration of low frequency signal, and without distortion of signal caused by multiple wires being installed in close proximity. Tracer wire shall be brought to the surface using 50 mm diameter valve boxes spaced at (no greater than) 300 m intervals along the curved sewer for locating purposes. In all non-standard locations, such as easements, parks, townhouse/condominium developments, and reconstruction projects, metallic warning tape shall also be used over all watermains. The metallic warning tape shall be laid in the trench 0.3 m (12”) to 0.5 m (19”) directly above the sanitary main.

A continuous length of wire must be used. If the wire must be joined, only the approved connectors shall be used and installed per manufacturer’s instructions.

To ensure there is no damage to the tracer wire during or after construction, the City’s Representative shall perform a continuity test on the wire. Should the City’s Representative find a problem with continuity or installation of the tracer wire, the Contractor/Developer shall be responsible for the repair, at no cost to the City.

3.12. Emerging Technologies

The use of emerging technologies in sanitary sewage collection system design may be considered by the City of Barrie on a case by case basis. Some existing emerging technologies that may be considered include the following:

- Water reuse systems;
- New pipe materials;
- New/emerging construction methods; and
- Hydraulic modeling software.

Due to the nature of emerging technologies, there is typically a lack of available monitoring data or design guidelines. As such, it is incumbent upon the proponent or Consulting Engineer to provide complete supporting calculations when submitting sanitary system designs utilizing emerging technologies. A pre-consultation meeting with the City to discuss the use of emerging technologies is recommended to review the proposed design, and to establish any specific requirements. All submissions employing sanitary collection system design with emerging technologies will be reviewed by the City and other review agencies on a site-by-site basis.

4. Acceptance Protocol for Sanitary Sewers, and Service Connections

4.1. Performance Evaluation of Sanitary Sewers, Maintenance Holes and Services Prior To Acceptance

Prior to acceptance of the sanitary sewer by the City, the following protocol shall be followed to ensure that the sanitary sewer system is operating per the design. All inspections shall be conducted in compliance with Ontario Provincial Standards and the Occupational Health and Safety Act (OHSA) (e.g. confined space entry protocol).

4.1.1. Visual Inspection

All pipelines, maintenance holes, and service lines shall be inspected during all phases of construction. The level of inspection is at the discretion of the Engineer of Record, and will be based partly on the Contractor's ability, experience, and past performance. Prior to final acceptance, all maintenance holes shall be visually inspected for defects, debris, and infiltration. The inspection shall be conducted in conjunction with a City of Barrie representative.

4.1.2. As-Constructed Survey, Drawings and Sanitary Sewer Design Sheets

A survey shall be completed for the sanitary sewer and services including maintenance holes, and as-constructed drawings shall be prepared. Sanitary service connection records shall be completed for each service to the satisfaction of the City. The sanitary sewer design sheets shall be revised as required to verify adequate design capacity and flushing velocities.

4.1.3. CCTV Inspection and Flushing

A CCTV inspection of the sanitary sewer, including maintenance holes, shall be undertaken by the developer/owner with City staff in attendance to identify any deficiencies including infiltration, deformation, and damages. All sanitary service lateral connections shall be inspected during the video of the mainline sewer. A digital and hardcopy record of the video inspection along with written certification from the developer's consulting engineer confirming that the sanitary system has been constructed as per the approved design drawings and approved plans must also be provided. The sanitary sewer and maintenance holes shall be thoroughly flushed and cleaned to remove any accumulated sewage and debris as required.

4.1.4. Deflection Testing

Mandrel deflection testing shall be conducted on all PVC or PE sanitary pipes with a nine (9) arm mandrel, and shall be carried out no sooner than 30 days after backfilling operations are complete. Mandrel contact length shall be adjusted based on pipe diameter, such that the device will not pass through the pipe where maximum allowable pipe deflections are exceeded as specified in the Ontario Provincial Standards. Pipe sections that do not allow the mandrel to pass freely shall be replaced.

4.1.5. Leakage Testing

Leakage testing shall be conducted on all new sewer pipes to ensure that total leakage is within acceptable limits as specified in the Ontario Provincial Standards. This section provides a brief overview of various leakage testing methods, however, the most current Ontario Provincial Standards for Field Testing shall be referred for more detailed descriptions and methodologies.

4.1.5.1. Infiltration Testing

Where the groundwater level is 600 mm or more above the crown of the pipe for the entire pipe section, leakage shall be determined by an infiltration test.

Infiltrations tests are typically conducted by constructing a watertight bulkhead at the upstream end of the pipe section and plugging all service laterals, stubs and fittings. Water flow from the downstream end of the pipe section is then measured by means of a V-notched weir or other flow measuring device. Infiltration exceeding 0.075 L/mm dia./100 m of pipe/hr will be deemed unacceptable. Dewatering shall be discontinued at least three (3) days prior to testing.

4.1.5.2. Exfiltration Testing with Water

Where the groundwater level is less than 600 mm above the crown at the highest point of the pipe section being tested, leakage shall be determined by an exfiltration test using water or low pressure air. For a water exfiltration test, the test section shall be filled with water until all air is removed from the line and a period of 24 hours for absorption or expansion will be allowed before starting the test, unless exfiltration requirements can be met by a test conducted prior to the 24 hour absorption period. Before testing, water shall be added to the upstream maintenance hole until there is a minimum head of 600 mm above the highest crown elevation or groundwater level, whichever is greater. The maximum allowable net internal head on the test section shall be 8 m. Once the water level has settled, the distance from the maintenance hole frame to the surface of the water shall be measured. The water shall be allowed to stand for one hour, at which point the distance from the frame to the surface of the water shall be measured again. Leakage shall be calculated using volumes and shall not exceed 0.075 L/mm dia./100 m of pipe/hr with an additional allowance of 3.0 L/hr/m of head above the invert for each maintenance hole included in the test section. Maintenance holes shall be tested separately if the test section fails.

4.1.5.3. Exfiltration Testing with Low Pressure Air

Where the groundwater level is less than 600 mm above the crown at the highest point of the pipe section being tested, leakage shall be determined by an exfiltration test using water or low pressure air. Low pressure air exfiltration testing may be required where differential head in the test section is greater than 8 m or freezing temperatures exist. The Ontario air control equipment, which includes a shut off valve, safety valve, pressure regulating valve, pressure reduction valve and monitoring pressure gauge with pressure range from 0 to 35 kPa with minimum divisions of 0.5 kPa and accuracy of approximately 0.25 kPa, are required as a minimum. Testing shall be conducted between consecutive maintenance holes, and test sections shall be plugged at each end. The test section shall be filled to a constant pressure of 24 kPa where the pipe is placed above the groundwater level, and increased by 3. kPa for every 300 mm that the groundwater level is above the pipe invert. After stabilization, the rate at which pressure drops shall be recorded. The most current Ontario Provincial Standard for Field Testing shall be referred to for minimum allowable rates of pressure drop based on pipe diameter.

4.1.6. Visual Inspection

All pipelines, maintenance holes, and service lines shall be inspected during all phases of construction. The level of inspection is at the discretion of the Engineer of Record and will be based partly on the contractor's ability, experience, and past performance. Prior to final acceptance, all maintenance holes shall be visually inspected for defects, debris, and infiltration. The inspection shall be conducted in conjunction with a City of Barrie representative.

4.2. Performance Evaluation of Forcemains Prior to Acceptance

Prior to acceptance of forcemains for lift stations and low pressure systems, the following protocol shall be followed to ensure that the system is operating per the design. All inspections shall be conducted in compliance with Ontario Provincial Standards and the Occupational Health and Safety Act (OHSA) (e.g. confined space entry protocol).

4.2.1. Visual Inspection

All forcemains shall be inspected by the Engineer of Record during all phases of construction.

4.2.2. Hydrostatic Leak Test

All forcemains shall undergo hydrostatic leak testing as per current Ontario Provincial Standards. The section being tested shall be subject to the specified continuous test pressure for two (2) hours, and leakage calculated as the amount of water that must be added to the test section to maintain the specified pressure. The maximum allowable leakage shall be no more than 0.082 L/mm dia./km of pipe/2 hr test period. Any forcemain sections that exceed the allowable leakage shall have leaks located and repaired. Forcemains shall be retested until sufficient results are obtained.

5. Engineering Submission Reporting Requirements

A complete submission package must be delivered to the City for detailed engineering review of Sanitary Sewage Collection Plans for both the conceptual/preliminary design stage and the detailed design stage. Submissions at the conceptual/preliminary design stage will consist of a Functional Servicing Report. Submissions at the detailed design stage will generally consist of a detailed Sanitary Sewage Collection Plan and associated sewer design sheet. All deliverables shall be submitted in hard copy and electronic modifiable files on a CD. Unprotected electronic files shall be submitted in the newest versions of Microsoft Office, Adobe, and AutoCAD. The specific content requirements for the two stages of Sanitary Sewage Collection Plan submissions are provided below. However, as the list is intended to deal with a broad range of development proposals, some of the items may not be applicable for infill development or small site plans. Exemptions may be made on a site-by-site basis, through pre-consultation with the City.

In general, printed and digital copies of the Sanitary Sewage Collection Plan must be submitted with each development proposal. Digital copies are to be submitted in original format and include report text, drawings and appendices, as well as the full set of engineering drawings (for detailed design). The report must be signed and sealed by a Licensed Professional Engineer of Ontario and include, as a minimum, the items outlined below.

5.1. Submissions to External Agencies

Submissions shall be made to the following external agencies as required.

5.1.1. Ministry of Environment (MOE) District and Approval Offices

The MOE District and Approval offices are typically circulated on applications for which an Environmental Compliance Approval (ECA), previously referred to as Certificate of Approval (C of A) is required for municipal and private water and sewage works such as sanitary sewage collection works including sanitary sewers, sewage pumping stations and forcemains.

5.1.2. Ministry of Natural Resources (MNR)

The MNR is typically circulated on applications in which a permit is required under the Lakes and Rivers Improvement Act for construction within a watercourse.

5.1.3. Ministry of Transportation (MTO)

The MTO is typically circulated on applications in which provincial roads/highways under the authority of the MTO may be directly or indirectly impacted by the proposed works (400 m on each side). For example, proposed development adjacent to provincial roads/highways that may impact future expansion of travel corridors or may impact flows under MTO culverts or level of flood protection typically require MTO review and approval.

5.1.4. Nottawasaga Valley Conservation Authority (NVCA)

The NVCA is typically circulated on all applications that potentially impact the ecological resources within the jurisdiction of the NVCA.

5.1.5. Lake Simcoe Region Conservation Authority (LSRCA)

The LSRCA is typically circulated on all applications that potentially impact the ecological resources within the jurisdiction of the LSRCA.

5.1.6. Other Agencies

As directed by the City of Barrie Engineering Department.

5.2. Reporting Requirements for Conceptual/Preliminary Design of Sanitary Sewage Collection Systems

5.2.1. Background Information

- Introductory material describing the property location, including both municipal and legal descriptions, planning status, proposed development scheme, construction phasing plan, intent of the report, and existing/historical land use.
- Reference for the information used to determine internal and external tributary areas, existing internal and external sanitary sewers, as well as references for soils, groundwater elevations, and water surface elevations (WSELs) adjacent to the site.
- Relevant recommendations and requirements from the Sanitary Master Plan must be summarized for the site.
- Information related to the Municipal Class EA process must be included, if applicable.
- A copy of the Draft Plan must be provided.

5.2.2. Sanitary Drainage Areas

Sanitary drainage conditions must be indicated including internal and external catchment areas and catchment IDs, and drainage patterns for the existing and proposed sanitary sewers within the site and applicable external lands.

5.2.3. Sanitary Sewage Collection System Design

A conceptual sanitary sewer design shall be provided to ensure sufficient sewer slope and pipe cover. Existing downstream sanitary sewers, pumping stations and/or forcemains shall be indicated and any capacity restriction shall be identified. Any interim servicing conditions shall be identified.

5.2.4. Primary Figures and Drawings

- Site Location Plan;
- Draft Plan;
- Hazard Area Mapping (if applicable);
- Sanitary drainage catchment areas and catchment I.D.'s on a topographic base showing future land use, and existing upstream and downstream sanitary systems;
- Conceptual drawings and location of any proposed sewage pumping stations, including location of forcemains, must be indicated on the conceptual drawings; and
- Full set of folded Engineering Conceptual / Preliminary Design Drawings, signed and sealed by a licensed Professional Engineer of Ontario.

5.2.5. Stand Alone Reports

- Geotechnical Report providing borehole information, including existing groundwater conditions for the site, if applicable;
- Environmental reports (e.g. fisheries impacts, hydrogeology, fluvial geomorphology), if applicable; and
- Groundwater or soil sample results from sampling and analysis, if applicable.

5.3. Reporting Requirements for Detailed Design of Sanitary Sewage Collection Systems

5.3.1. Background Information

- Introductory material describing the property location including both municipal and legal descriptions, planning status, proposed development scheme, construction phasing plan, intent of the report, and existing/historical land use.

- Reference for the information used to determine internal and external tributary areas and existing internal and external sanitary sewers as well as references for soils, groundwater elevations and water surface elevations (WSEL's) adjacent to the site.
- Information related to the Class EA process must be included, if applicable.

5.3.2. Sanitary Drainage Areas

Sanitary drainage conditions must be indicated, including internal and external catchment areas and catchment IDs, and drainage patterns for the existing and proposed sanitary sewers within the site and applicable external lands.

5.3.3. Sanitary Sewage Collection System Design

It must be shown that the proposed sanitary sewage collection system provides safe conveyance of peak design sanitary sewage flows from both the subject site and any external lands through the development to a sufficient outlet, with no adverse impact to either the upstream or downstream sanitary system. A sufficient outlet constitutes an existing sanitary sewer or a sewage pumping station with sufficient capacity to accommodate the additional sanitary flows from the development or the City of Barrie's Water Pollution Control Plant. Any interim servicing conditions shall be identified.

5.3.4. Sewage Pumping Station Design

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

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

5.3.5. Primary Figures and Drawings

- Site Location Plan;
- Sanitary drainage catchment areas and catchment I.D.'s on a topographic base showing future land use and existing upstream and downstream sanitary sewers;
- Siting and details for any proposed sewage pumping stations and forcemains; and
- Full set of folded Engineering Detailed Design Drawings, signed and sealed by a licensed Professional Engineer of Ontario.

5.3.6. Supporting Calculations and Modeling Details and Output

- Calculations demonstrating that all sanitary sewer outlets have sufficient capacity to accommodate the additional flow from the proposed development;
- Sanitary sewer design sheets must be provided;
- Conveyance capacity calculations for the existing downstream sanitary sewers. The designer shall assess the current loading on the downstream sanitary sewers, as well as future anticipated intensification in conjunction with the City;
- Sewage pumping station calculations including total dynamic head on pump, wet well residence time, wet well time to overflow, wet well pump cycle times and other calculations as required; and
- Transient analysis calculation for forcemains.

5.3.7. Stand Alone Reports

- Operation and Maintenance Manual for all sewage pumping stations , if applicable;
- Geotechnical Engineering Report providing borehole information for the site (if applicable);
- Environmental reports (e.g. fisheries impacts, hydrogeology, fluvial geomorphology), if applicable; and
- Reports shall be submitted in hard copy and PDF format.

6. References

City of Barrie, City of Barrie Standards, Revision 12.2, February 2006.

City of Barrie, Storm Drainage and Stormwater Management Policies and Design Guidelines, November 2009.

Municipal Engineers Association, Municipal Class Environmental Assessment¸ September 2007.

Ontario Ministry of Environment, Design Guidelines for Sewage Works 2008.

APPENDIX A

SUMMARY OF APPROVED CITY OF BARRIE SANITARY MASTER PLANS & INFRASTRUCTURE MAP

Summary of Recommendations from Approved Sanitary Master Plans for City of Barrie Sewersheds

The City of Barrie consists of nine (9) sanitary drainage areas, or sewersheds, as shown on the Sanitary Infrastructure Map included in this Appendix. The following provides a summary of the Sanitary Master Plans which have been completed and approved within the City of Barrie.

Drainage Area	Historic Sub Drainage Areas	Approved Master Plan Document(s)
NORTH	North	North Sanitary Drainage Area Master Plan, Skelton, Brumwell & Associates Inc., April 1995.
	Cundles	Cundles Sanitary Drainage Area Master Plan Draft Report, Skelton, Brumwell & Associates Inc., February 1990.
	Lakeshore	Lakeshore Sanitary Drainage Plan Master Plan, Skelton, Brumwell & Associates Inc., February 1990.
SOUTH	Painswick	Barrie South Sanitary Master Plan, AECOM Canada Ltd., August 2009.
	Hewitts	
	Bayview	
	Paddison Farms	
INDUSTRIAL	Industrial	Sanitary Drainage Area Master Plan Final Report, Skelton, Brumwell & Associates Inc., February 2006.
	Essa	Barrie South Sanitary Master Plan, AECOM Canada Ltd., August 2009.

APPENDIX B

SUMMARY OF APPLICABLE LEGISLATION, ACTS & REGULATIONS

Table 1
City of Barrie Sanitary Sewer Collection System Design Guidelines Update
Legislative and Policy Framework

No.	Legislation	Overview	Applicable Legislative Tools	Relevance to Updated Design Guidelines
A)	**Provincial**			

1.	Ontario Water Resources Act (OWRA) (1990, amended 2010) Section 53	• Administered by MOE
		• OWRA is designated to conserve, protect and manage Ontario's water resources for efficient and sustainable use. The act focuses on both groundwater and surface water throughout the province.
		• Regulates sewage disposal and "sewage works" and prohibits the discharge of polluting materials that may impair water quality.
		• Regulates water takings in excess of 50,000 litres/day.
			• Regulation 435/93 – Water Works and Sewage Works
			• Regulation 364/98 – Fees – Approvals
			• Regulation 525/98 – Approval Exemptions (subsections 53 of the Act (i.e. 1 and 3) do not apply to a sewage works that is part of a large municipal residential system)
			• Design Guidelines for Sewage Works 2008, Section 5: Design of Sewers and Section 7: Pumping Stations
			• Certificates of Approval
			  ○ Guideline for Applying for approval of Municipal and Private Water and Sewage Works
			  ○ Approval authority and delegation to Municipalities; and
			  ○ By-pass controls and limits, Pumping stations, and contingencies.
			• Guideline F-6, Sewer and Watermain Installation, separation distances
			  ○ "sewers/sewage works and watermains located parallel to each other shall be constructed in separate trenches maintaining a minimum clear horizontal separation distance of 2.5 metres"
			• Ground water interference, dewatering, Permit to Take Water (PTTW)
			• Water Management – Policy, Guidelines and Provincial Water Quality Objectives
			• Operator certification
				• Approval requirements;
				• Ground water management and PTTW requirements; and
				• Reference Guideline F-6-1: "Procedures to Govern the Separation of Sewers and Watermains".

2.	Conservation Authorities Act (1990, amended 2010)	• Provides Conservation Authorities authority:
		  ○ To control the flow of surface waters in order to prevent floods or pollution or to reduce the adverse effects thereof;
		  ○ To alter the course of any river, canal, brook, stream or watercourse, and divert or alter, as well as temporarily or permanently, the course of any river, stream, road, street or way, or raise or sink its level in order to carry it over or under, on the level of or by the side of any work built or to be built by the authority, and to divert or alter the position of any water-pipe, gas-pipe, sewer, drain or any telegraph, telephone or electric wire or pole.
			• Ontario Regulation 97/04 "Development, Interference with Wetlands and Alteration to Shorelines and Watercourses" Generic Regulation
			• Section 28: Development, Interference, and Alteration Regulations: Ontario Regulations 172/06 (Nottawasaga Valley Conservation Authority) and 179/06 (Lake Simcoe Region Conservation Authority)
			• The City must follow permitting requirements when working in regulated flood plain areas.
				• Pipe water crossings (construction methods, clearance between pipe overt and stream bed, groundwater management – dewatering); and
				• Work within floodplain.

Table 1
City of Barrie Sanitary Sewer Collection System Design Guidelines Update
Legislative and Policy Framework

No.	Legislation	Overview	Applicable Legislative Tools	Relevance to Updated Design Guidelines
3.	Environmental Assessment Act (1992, amended 2010)	• Under the Environmental Assessment Act, the Environmental Assessment (EA) program promotes good environmental planning by reviewing alternatives, and determining and managing the potential effects of a project prior to implementation. • Applies to proponents such as municipal and provincial governments, and public organizations such as conservation authorities. • The EA program ensures that public concerns are heard. EA balances economic, social, cultural, and natural environmental needs so that projects benefit Ontario.	• Municipal Engineers Association, Municipal Class EA (October 2000, as amended in 2007), covers the requirements under the EA by prescribing streamlined planning procedures for certain classes of municipal infrastructure projects that are repetitive and generally have predictable impacts. • Applies to municipal infrastructure (i.e. new sewer or SPS) projects including some linked to municipal water and wastewater master plans. • Co-ordinate with federal environmental assessment requirements.	• Design of sanitary sewer collection system shall consider Class EA findings and recommendations, where applicable; and • Approval requirements.

4.	Water Opportunities and Water Conservation Act (2010)	• The purposes of this Act are:
		  ○ To foster innovative water, wastewater and stormwater technologies, services and practices in the private and public sectors;
		  ○ To create opportunities for economic development and clean-technology jobs in Ontario, and
		  ○ To conserve and sustain water resources for present and future generations.
		• Includes a regulation-making authority to require municipal water sustainability plans, and allows the Minister of the Environment to establish performance indicators and targets for municipal water, wastewater, and stormwater services.
		• Through regulation (pending), municipalities would prepare a municipal water sustainability plan which would include an asset management plan, a financial plan, a water conservation plan, strategies for maintaining and improving the municipal water service, a risk assessment, and other prescribed information.
			• Regulations to be developed
			  ○ Waiting enactment.
				• Asset management;
				• Water conservation programs and targets influence conveyance system sizing; and
				• Will require targets for I/I with a focus on reduction.

Table 1
City of Barrie Sanitary Sewer Collection System Design Guidelines Update
Legislative and Policy Framework

No.	Legislation	Overview	Applicable Legislative Tools	Relevance to Updated Design Guidelines

5.	Ontario Environmental Protection Act (1990, amended in 2010)	• The act grants the Ministry of the Environment broad powers to deal with the discharge of contaminants which cause negative effects.
		• The act specifically:
		  ○ Prohibits the discharge of any contaminants into the environment which cause, or are likely to cause negative effects, and in the case of some approved contaminants, requires that they must not exceed approved and regulated limits; and
		  ○ Requires that any spills of pollutants be reported and cleaned up in a timely fashion.
		• Ontario's Environmental Protection Act has the authority to establish liability on the party which is at fault, including liability for corporate officers or directors who have failed to take all reasonable care to prevent unlawful discharges of contaminants into the environment.
			• Ontario Regulation 419/05 "Air Pollution – Local Air Quality"	• Not directly applicable to design of collection systems, with the exception of SPS overflows.
				• Air emissions for generators

6.	Lake Simcoe Protection Act (2009)	• The Lake Simcoe Protection Act provides the authority for the establishment of (and amendments to) the Lake Simcoe Protection Plan.	• The Lake Simcoe Protection Plan aims at restoring and protecting the threatened ecology of Lake Simcoe and its watershed. Particular emphasis on treatment and water quality • (Draft) Policy 4.15-DP: Subject to other policies of the Plan, a new on-site sewage system or subsurface sewage works shall not be permitted within 100 m of the Lake Simcoe shoreline, other lakes in the Lake Simcoe watershed, or any permanent stream. • (Draft) Policy 4.3-DP: No new municipal sewage treatment plant shall be established in the Lake Simcoe watershed. • Lake Simcoe Phosphorus Reduction Strategy • Protect Natural Heritage Features – (e.g. shoreline, watercourses) from construction	• Design of sewer collection systems to consider impacts from construction
7.	Lakes and Rivers Improvement Act (1990, amended 2009)	• Generally regulates public and private use of lakes and rivers; regulates construction, repair and use of dams; prohibits deposit of refuse, matter or substances into lakes and rivers contrary to the purposes of the Act; administered by the Ministry of Natural Resources.	• Lakes and Rivers Improvement Works Permit	• Water course crossings

Table 1
City of Barrie Sanitary Sewer Collection System Design Guidelines Update
Legislative and Policy Framework

No.	Legislation	Overview	Applicable Legislative Tools	Relevance to Updated Design Guidelines
8.	Clean Water Act (2006, amended 2009), Source Water Protection Plans	• "Requires that local communities – through local Source Protection Committees - assess existing and potential threats to their water, and that they set out and implement the actions needed to reduce or eliminate these threats"	• City of Barrie is participating in the preparation of Source Protection Plans (terms of reference are available, Plans will be ready in 2012).	• Not directly applicable to design of collection systems, with the exception of SPS overflows. • Indirectly supports need to design sewers to ensure tight system to minimize leaks and overflows.
9.	Sustainable Water and Sewage Systems Act (2002, amended 2006)	• Administered by MOE • "Ontario's Sustainable Water & Sewage Systems Act requires municipalities to assess the costs of providing water and sewage utilities and to devise a method to finance the full cost of providing these services. By placing the full cost of water and sewer services on the communities benefiting from them, the Act hopes to inspire grassroots efforts in water conservation and environmental protection."	• Not in effect as no regulations have been passed. • Province has issued a guideline "Toward Financially Sustainable Drinking Water and Wastewater Systems" as a base for financial planning.	• Confirm if applicable to design of collection systems.
10.	Drainage Act (1990, amended 2010)	• Sets out all procedural requirements for drain construction and maintenance in Ontario. • Municipal drains are not exempt from Conservation Authorities Act.	• More of a concern for storm sewers than sanitary sewers.	• Water course crossings
11.	The Planning Act (1990, amended 2009)	• The Planning Act sets out the ground rules for land use planning in Ontario, and describes how land uses may be controlled and who may control them. • Under the Planning Act, the Minister of Municipal Affairs and Housing may, from time to time, issue provincial statements on matters related to land use planning.	• Ontario Provincial Policy Statement (2005) provides direction on matters of provincial interest related to land use planning and development, and promotes the provincial "policy-led" planning system. • Section 1.6.4 Sewage and Water: • Planning for sewage and water services shall direct and accommodate expected growth in a manner that promotes the efficient use of existing municipal sewage and water services; ensure that these systems are provided in a manner that can be sustained by the water resources upon which such services rely; is financially viable and complies with all regulatory requirements and protects human health and the natural environment; promote water conservation and water use efficiency; integrate servicing and land use considerations at all stages of the planning process.	• Requirement to accommodate future growth and planned development.
12.	Public Lands Act (1990, amended 2011)	• Generally regulates the use, management, sale, and disposition of public lands and forecasts; regulates public and private roads on public lands; empowers the province to construct and operate dams; administered by the Ministry of Natural Resources.	• Public Lands Act Work Permits (Section 14) Policy # PL 3.03.04	

Table 1
City of Barrie Sanitary Sewer Collection System Design Guidelines Update
Legislative and Policy Framework

No.	Legislation	Overview	Applicable Legislative Tools	Relevance to Updated Design Guidelines
13.	Place to Grow Act (2005, amended 2009)	• The Places to Grow Act gives the government of Ontario the authority to: ○ Designate any geographic region of the province as a growth plan area; ○ Develop a growth plan in consultation with local officials, stakeholders, public groups, and members of the public; and ○ Develop growth plans in any part of Ontario. • The legislation makes sure that growth plans reflect the needs, strengths, and opportunities of the communities involved, and promotes growth that balances the needs of the economy with the environment.	• Growth Plan for the Greater Golden Horseshoe Policy 3.2.5, Water and Wastewater Systems, states that new expansion of existing municipal water systems should only be considered where: ○ Strategies for water conservation and other water demand management initiatives are being implemented in the existing service area; and ○ Plans for expansion or for new services are to serve growth in a manner that supports achievement of the intensification target and density targets. • Simcoe Area: A Strategic Vision for Growth, discussion paper which lays out a strategy and directions to plan for more prosperous and sustainable growth in the Simcoe area. The strategy supports: ○ Curbing urban sprawl and focusing development into existing cities and towns that can accommodate new growth to create vibrant, complete communities; ○ Building on Simcoe's diverse economic base to create new jobs; ○ Protecting greenspaces and agricultural areas and creating a cleaner Lake Simcoe; and ○ Outlining a clear future for the City of Barrie as the area's largest urban centre. • Amendment 1: ○ Identifies urban nodes, including Barrie, in which to maximize the use of wastewater systems in an environmentally and financially sustainable manner.	• Discourage/prohibit development of private services (e.g. septic tank and tile bed systems).

Table 1
City of Barrie Sanitary Sewer Collection System Design Guidelines Update
Legislative and Policy Framework

No.	Legislation	Overview	Applicable Legislative Tools	Relevance to Updated Design Guidelines
B)	**Federal**			
14.	Fisheries Act (1985, amended 2011)	• Established to manage and protect Canada's fisheries resources. It applies to all fishing zones, territorial seas, and inland waters of Canada and is binding to federal, provincial and territorial governments. As federal legislation, the Fisheries Act supersedes provincial legislation when the two conflict.	• Applies to direct discharges of sewage, disturbance during construction, Alteration to water courses. Administered by Conservation Authorities. • Section 35 (1) "No person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat." • Section 35 (3) "No person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions… where results from the deposit of the deleterious substance may enter any such water."	• Water course crossings
15.	Navigable Waters Protection Act (NWPA) (1985, amended 2011)	• The NWPA minimizes the interference of navigation on navigable waters throughout Canada by: ○ Prohibiting construction in navigable waters; ○ Regulating the removal of wreck and other obstacles to navigation; and ○ Prohibiting the throwing or depositing of any material into navigable waters.	• Section 5 (1) "No work shall be built or placed in, on, over, under, through or across any navigable water without the Minister's prior approval of the work, its site and the plans for it."	• Water course crossings
C)	**Municipal**			
16.	City of Barrie, Sewer Use By-Law (89-167)	• Prohibits, regulates, and inspects the discharge of water and sewage into the sanitary and storm sewers within the City of Barrie. • The Sewer Use By-Law establishes limits for various water quality parameters such as phosphorus, nutrients, and suspended solids.	• Section 2 (1) Discharges to Sanitary Sewers • Section 3 (1) Discharges to Storm Sewers	• Prohibits storm drain connections to sanitary sewer. • Limits chemical parameters of sewage to be compatible with pipe materials.

Table 1
City of Barrie Sanitary Sewer Collection System Design Guidelines Update
Legislative and Policy Framework

No.	Legislation	Overview	Applicable Legislative Tools	Relevance to Updated Design Guidelines

17	City of Barrie Standard Details, Revision #12.2 (February 2006)	• Standard drawings, details and drawing notes including for sanitary sewers and service connections.	• Information on engineering drawing submission requirements
			• Design standards for sanitary sewers and service connections including:
			  ○ Minimum diameter;
			  ○ Minimum drop across maintenance holes;
			  ○ Minimum cover ;
			  ○ Minimum vertical and horizontal pipe separation;
			  ○ Minimum grade for the furthest upstream sanitary manhole run;
			  ○ Materials, installation and construction details;
			  ○ Location of sanitary sewers within ROW;
			  ○ Location of sanitary lateral connections;
			  ○ Minimum and maximum service connection slope;
			  ○ Etc.
			• Standard details for:
			  ○ Roads (various widths/types) including sanitary sewer location (R301-R314);
			  ○ Drop structures (S604, S605);
			  ○ Service locations (W537, W538); and
			  ○ Maintenance hole adjustment units (S606).
			• References OPSD's commonly used by the City.
			• Sanitary Sewer Design sheets for the City's three (3) current design flow levels.
			• Water Distribution Specification
			• Product Approval Procedure
				• Should be consistent with Standard Details
				• Changes to Design Guidelines will need to be reflected in the Standard Details and vice versa

D)	**Other Jurisdictions/Other Municipalities**			
18.	Toronto Region Conservation Authority (TRCA) Watercourse Crossing Design and Submission Requirements (including new and replacement structures and extensions) (September 200)	• As per Conservation Authority Act (see No. 2) • Where crossings are proposed as a component of land development or infrastructure projects, proponents should address TRCA objectives and policies with respect to crossings throughout the development process.	• Appendix G – Checklists (title page) • Erosion and Sediment Control Design and Submission Requirements • Functional Servicing Plan Requirements in Support of Draft Plan Approval • Geotechnical Engineering Design and Submission Requirements • Master Environmental Servicing Plan Requirements in Support of Secondary Plans • Watercourse Crossing Design and Submission Requirements	• Example document describing water crossing requirements (LSRCA may better address this).

APPENDIX C

SANITARY SEWER DESIGN SHEETS