Final Report

Pollution Control Plan for the Cities of St. Catharines and Thorold

Port Dalhousie and Port Weller Sewersheds

Prepared for

City of St. Catharines
City of Thorold
Regional Municipality of Niagara

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Executive Summary

Introduction

In Ontario, Pollution Control Planning has long been a fundamental practice exercised by municipalities to meet their objectives for successful wastewater management. The Pollution Control Plan (PCP) that the City of St. Catharines and the City of Thorold follow is a comprehensive planning tool that, when it was initially developed in the early 1990s, served many essential purposes. It provided the Cities of St. Catharines and Thorold (Cities) with a roadmap for the development of infrastructure projects that would help to alleviate the problems associated with infrastructure capacity, help address receiving water pollution and assist the municipalities with their goal of meeting the Ministry of the Environment (MOE) guidelines for Combined Sewer Overflow (CSO) management.

Objectives of the Current Undertaking

To plan for an upgrade or expansion of the existing sewage infrastructure to address current issues associated with CSO discharges to local receiving environments and manage anticipated growth, the Cities and the Region, are undertaking the completion of a Pollution Control Plan (PCP) update for the study area.

The Cities of St. Catharines and Thorold, along with the Region, have asked for an update to the 1990 St. Catharines Area PCP because many of the original recommendations for infrastructure renewal and CSO abatement have been implemented and the remaining recommendations need to be revisited. The update also allows new opportunities to be examined in the development of a new PCP strategy. The work carried out to-date which addresses the original recommendations also needs to be evaluated based on the current MOE requirements. The objective of the PCP is to develop a strategy to address current system constraints and issues related to CSO and to plan for future system requirements in the Cities of St. Catharines and Thorold. The PCP recommendations will conform with the MOE's Procedure F-5-5 and assess the relative impact of CSO discharges to local receiving stream environments.

The ultimate objective of the study is to develop an updated PCP strategy for the Cities that will provide them with guidance on the implementation of future infrastructure and CSO abatement projects, as well as best management practices, that will provide for anticipated growth within the municipalities and improve receiving water quality conditions.

Environmental Assessment Master Planning Process

This project was carried out as a Master Plan following the requirements of the Ontario's *Environmental Assessment (EA) Act.* Master Plans are long range plans which examine the current and future requirements of a given infrastructure system using environmental assessment planning principles. The Master Plans at a minimum must address Phases 1

and 2 of the Class EA process. Master plans develop a framework for planning a group of related projects required to accommodate demands on a system over a long period of time.

The Master Planning process allows a municipality to develop the need and justification for specific projects under a broad planning framework. A Master Plan should be reviewed every five years to determine the need for detailed review and updates. Specific projects identified in the Master Plan may require additional Class EA planning and approvals prior to their implementation.

Study Area Description

The Cities of St. Catharines and Thorold are located in Southern Ontario, on the Niagara Peninsula. As shown in Figure ES-1, the two cities are located near the southern shore of Lake Ontario, and are bordered to the east by the Welland Canal, just west of the Town of Niagara-on-the-Lake and east of the Town of Lincoln. The Study Area for the Pollution Control Plan encompasses the urban areas of St. Catharines and the northern portion of the City of Thorold as defined by the wastewater collection systems shown in Figure ES-2.

FIGURE ES-1
Locations of St. Catharines and Thorold

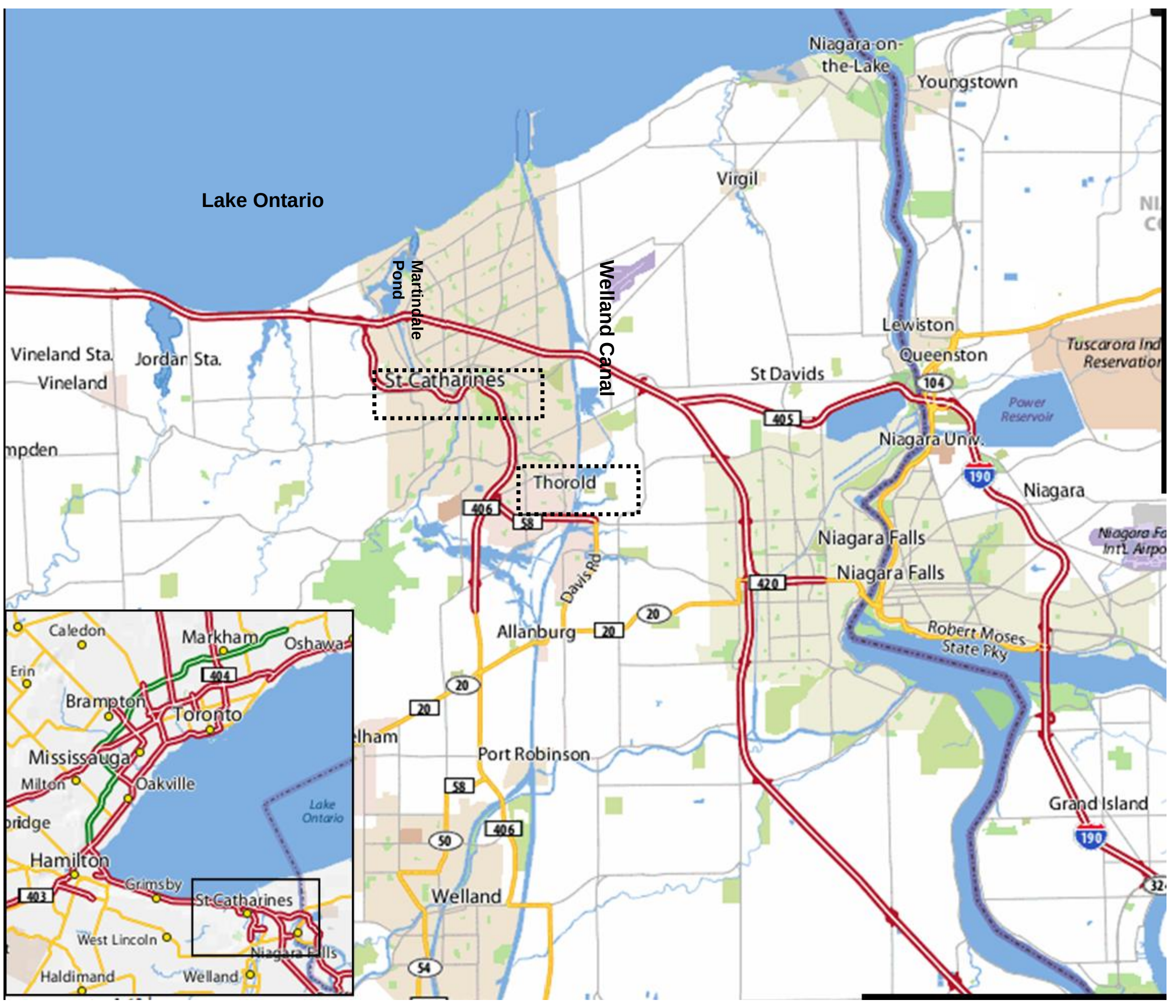
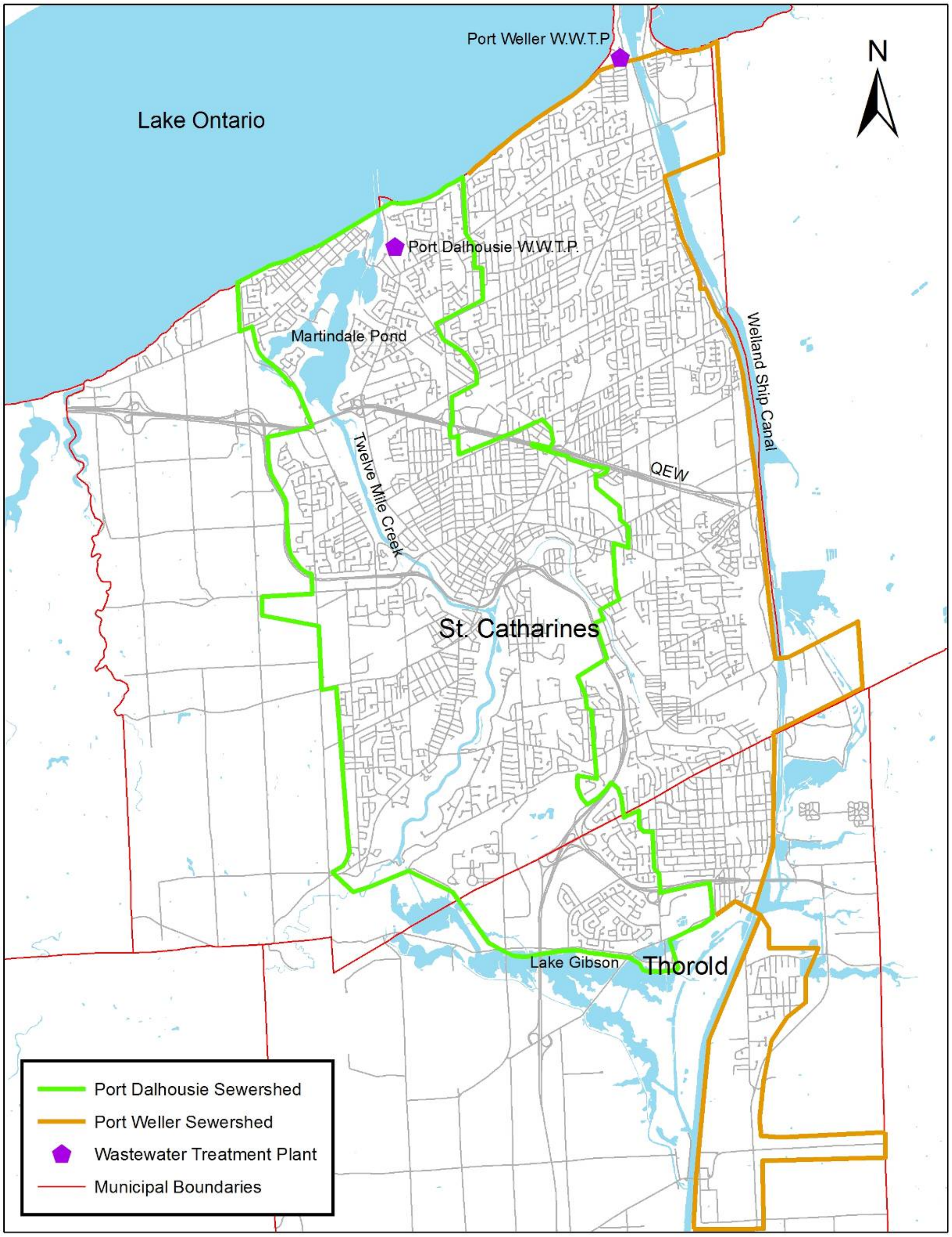


FIGURE ES-2
Pollution Control Plan Study Area

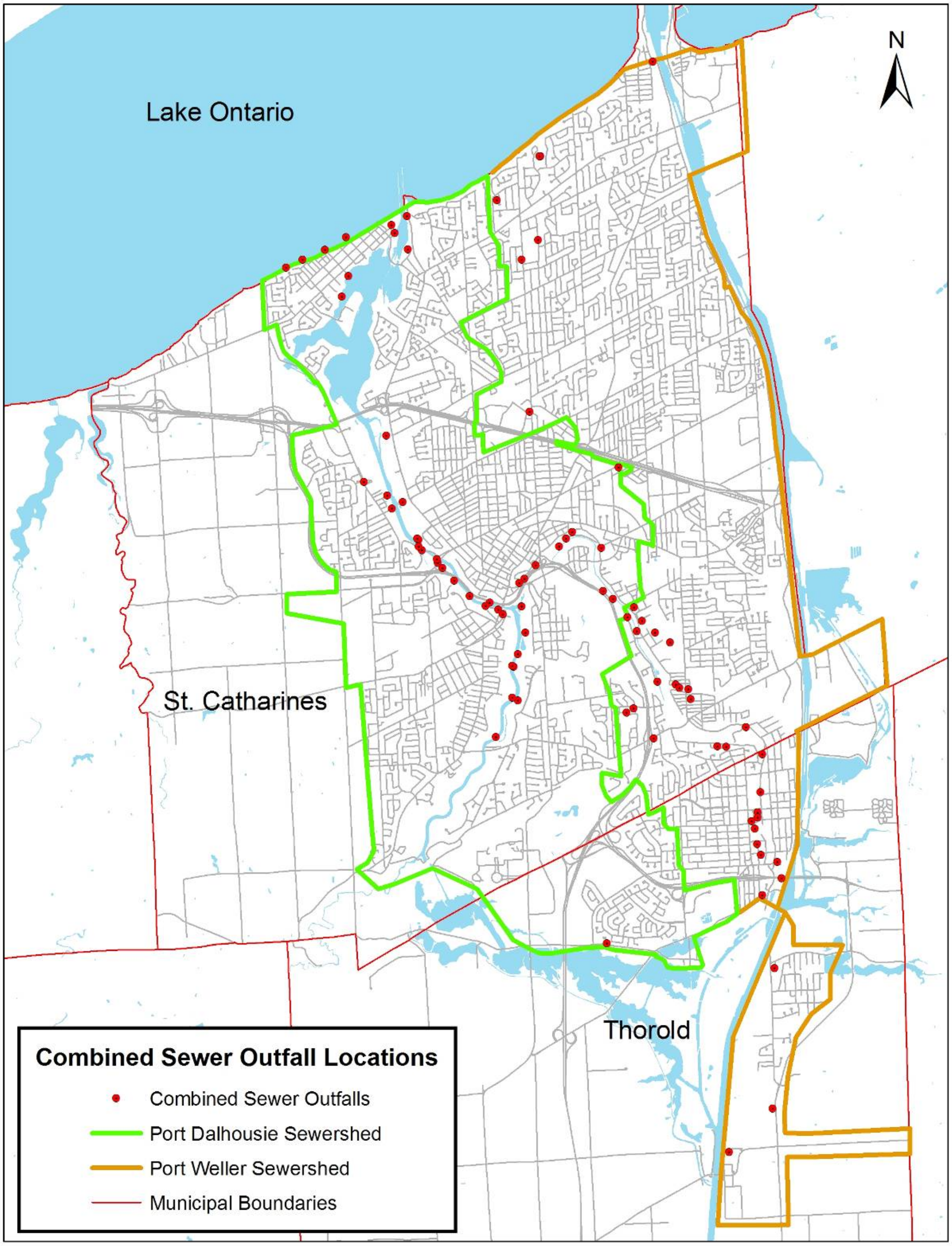


Combined Sewer Overflows

CSOs in each collection system relieve the sewer systems from surcharging and flooding during intense wet weather events

The approximate locations of the CSOs within each system are shown in Figure ES-3. Note that the locations shown in Figure ES-3 represent outfalls which discharge to the natural environment.

FIGURE ES-3
Combined Sewer Outfall Locations – Port Dalhousie and Port Weller Sewersheds



General System Model Description

To analyze the sanitary sewer flow, a hydrologic/hydraulic model was utilized. The model simulates dry and wet weather flows generated within the study area and is used to assess the existing sanitary system. The model was originally developed in 1989 and primarily represented the sanitary trunk sewer system. Subsequent studies have been undertaken and the model has been expanded to include additional areas of the sewer system. The model was used to assess flow control alternatives based on a specific level of control or historical storm events for both existing and future conditions.

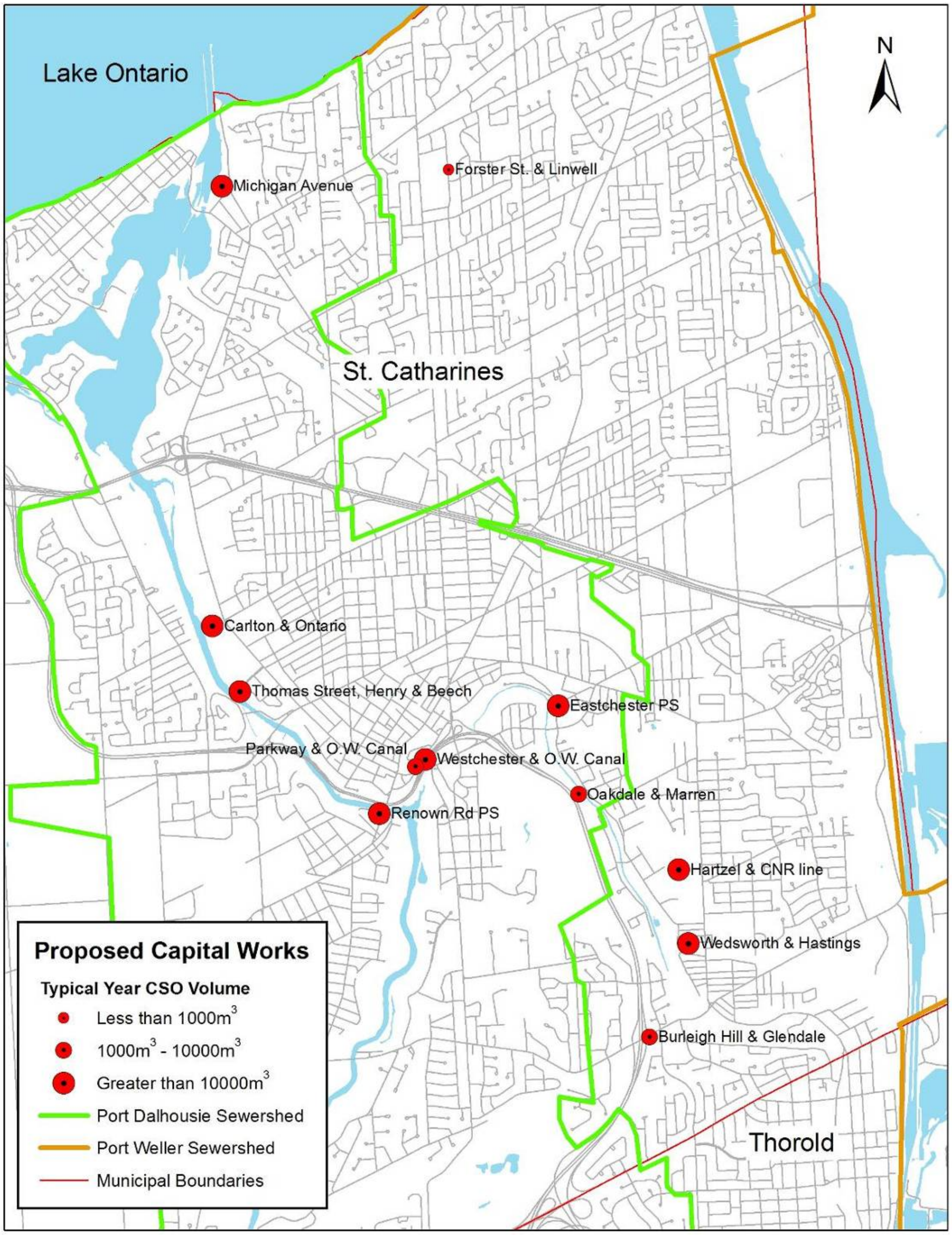
Recommended Projects

The following section describes recommended approaches for each of the 12 sites identified as critical locations for CSO abatement. The location of each of these projects is shown in Figure ES-4.

The recommended capital works described are in addition to those works which are currently in various design and construction phases.

1. **Carlton & Ontario**. Currently, an 8,680 m^3 storage facility is being recommended for Carlton & Ontario at a cost of $8,700,000. The size of this storage tank could be reduced if integration of upstream sewer separation and/or storage is found to be suitable during a more detailed site investigation and Class EA. As noted, the proximity to the Thomas St. outfall could make an integrated abatement approach feasible.
2. **Thomas Street, Henry & Beech, George & Beech**. A 4,470 m^3 storage facility is being recommended for Thomas Street. The size of this storage tank could be reduced if integration of upstream sewer separation and/or storage is found to be suitable during a more detailed site investigation and Class EA. As noted, the proximity to the Carlton & Ontario outfall could make an integrated abatement approach feasible.
3. **Westchester & O.W. Canal**. A 3,000 m^3 storage tank had been previously recommended and designed for this overflow location. The estimated cost for this project was $5,306,000, based on submitted construction tenders. It is being recommended that this location be examined in further detail to determine if there are any upstream opportunities that would reduce the size of the required storage.
4. **Parkway & O.W. Canal**. A 1,890 storage volume would be required for the Parkway outfall location to capture the volume from a two-year storm event. The estimated cost for this storage would be $3,800,000. It is recommended that a joint project be examined for the Westchester and Parkway locations to develop an efficient means of abating overflows at the two locations.
5. **Hartzel & CNR Line.** A 4,110 storage tank would be required for this overflow location, at an estimated cost of $4,100,000. A previous study found that locating land for a storage facility of this size would be challenging in the vicinity of the Hartzel & CNR overflow. It is recommended that the upstream area be examined in further detail to determine if there are opportunities for source control and/or sewer separation. The Wedsworth & Hastings overflow is located near this overflow location and the feasibility of a joint abatement approach should be examined.

FIGURE ES-4
Recommended Projects



6. **Wedsworth & Hastings.** A 1,790 m^3 storage facility is being recommended for this location at an estimated cost of $3,600,000. As indicated this overflow is located near the Hartzel & CNR Line overflow locations. The feasibility of a joint abatement approach as well as opportunity for upstream source control should be examined
7. **Renown Road PS.** A 4,300 m^3 storage facility is being recommended for the Renown Road PS at an estimated cost of $4,300,000. The size of this storage tank could be reduced if integration of upstream sewer separation and/or storage is found to be suitable during a more detailed site investigation and Class EA.
8. **Eastchester PS.** It is recommended that the flows to Eastchester PS be monitored after the Capner & Oakdale works are completed to determine their effect. No capital works are currently recommended to the Eastchester PS. Flows to the pump station should be monitored once the upgrades at the Capner & Oakdale CSO are completed.
9. **Michigan Avenue.** Due to the proximity to the treatment plant, it is recommended that no capital works be constructed at the Michigan Avenue CSO. The Michigan Avenue CSO overflows at a much higher rate than the treatment plant (26 events vs. six events during the typical year). Therefore, increasing the flow through capacity to the plant will allow more CSO to be treated during moderate events. The pipe capacity to the plant should be increased from the current 350 mm pipe to 525 mm pipe. The estimated cost for replacement of the sewer is $150,000.
10. **Forster & Linwell.** The feasibility of conveying flows to the new Guy Road storage facility should be examined on a site-specific level. This Forster & Linwell overflow is located adjacent to Guy Road Park.
11. **Oakdale & Marren.** A 640 m^3 tank is being recommended for this overflow location at an estimated cost of $1,300,000. There is limited opportunity for upstream source control as this overflow is located on the Regional trunk sewer.
12. **Burleigh Hill & Glendale.** A 380 m^3 storage facility is being recommended for this overflow location at an estimated cost of $760,000. The size of this storage tank could be reduced if integration of upstream sewer separation and/or storage is found to be suitable during a more detailed site investigation and Class EA.

System Upgrades

St. Catharines

It is recommended that flooding concerns within the City continue to be addressed as part of the FLAP program. Areas with multiple FLAP applications or complaints should be examined for targeting a reduction of wet weather in the system.

Thorold

The system constraints upstream and downstream of the Peel St. pump station should be examined. The upstream system should be examined to alleviate basement flooding, in addition to the constraints for conveying flows downstream of the station.

Data Management

St. Catharines

It is recommended that the following data management components be developed:

1. **Updated Combined Sewer Mapping.** The City of St. Catharines should continue to keep the combined sewer mapping database updated as system improvements are made.
2. **Capital Works Database.** A GIS based database should be developed to show system improvements which address problem areas and alleviate CSOs and basement flooding.

Thorold

1. **Infrastructure Data Update/Electronic Mapping and Modeling.** It is recommended that the existing sanitary and storm sewer mapping be converted into an electronic format. The preferred format for infrastructure is GIS.

Regional Municipality of Niagara

1. **Pump Station Records/Database.** A database should be developed and kept up to date with current pump station information. Pump station capacities should be confirmed through draw fill tests.

St. Catharines/Thorold/Regional Municipality of Niagara

1. **Integrated Flow Monitoring Program.** The two cities and the Region should examine the possibility of an integrated flow monitoring program. This program would ensure that the placement of regional and municipal flow monitors would compliment each other resulting in an effective use of each monitor to gain a better understanding of the sewersheds. Data management protocols should be developed to ensure that the data collected from each of the monitors can be easily integrated for model calibration and analysis of the sewer system.
2. **Annual Report**. It is recommended that an annual report be prepared that provides a comprehensive compilation and summary of the infrastructure management activities carried out. The annual report should be a compilation of all system upgrades and updates on maintenance and management programs. The annual flow monitoring records should also be compiled in the report. Mapping upgrades for sewer improvements should also be a component of the report. The Cities and the Region should work together to develop this report. The report should determine and report on the success of the upgrades and improvements to programs as recommended in the PCP report as well as make recommendations based on improvements to programs and update the recommendations in the PCP report.
3. **PCP Updates**. It is recommended that the PCP be updated every five years to determine the implementation success of the PCP and the future needs. The next PCP Update should take place in 2012.

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1. Introduction

1.1 Background

In Ontario, Pollution Control Planning has long been a fundamental practice exercised by municipalities to meet their objectives for successful wastewater management. The Pollution Control Plan (PCP) that the City of St. Catharines and the City of Thorold follow is a comprehensive planning tool that, when it was initially developed in the early 1990s, served many essential purposes. It provided the Cities of St. Catharines and Thorold (Cities) with a roadmap for the development of infrastructure projects that would help to alleviate the problems associated with infrastructure capacity, help address receiving water pollution and assist the municipalities with their goal of meeting the Ministry of the Environment (MOE) guidelines for Combined Sewer Overflow (CSO) management.

The PCP has also provided the Cities with support and justification for funding applications to the Federal government, the Province and the Regional Municipality of Niagara (Region). This has allowed the City to garner monetary support for the long-term implementation of the PCP recommendations over the last 16 years. Following the recommended implementation plan, the Cities, the Region, and the Province have put forth a great deal of effort to reduce the impact of infrastructure on the environment.

1.2 Existing PCP

The City of St. Catharines, in partnership with the MOE, the Region and the City of Thorold completed the St. Catharines Area Pollution Control Plan (SCAPCP) in 1990. The purpose of the study was to develop a plan to improve water quality in the St. Catharines area. The objectives of the study were:

- To identify and quantify existing and potential sources of water pollution;
- To develop and evaluate a series of management options; and
- To select a preferred strategy with recommendations for implementation

Since that time, updates have been completed for each of the separate sewersheds. The Port Weller Sanitary Trunk Sewer Analysis was completed in 1998. The Port Dalhousie Trunk Sewer and CSO Study was completed in 2006.

1.3 Objectives of the Current Undertaking

To plan for an upgrade or expansion of the existing sewage infrastructure to address current issues associated with CSO discharges to local receiving environments and manage anticipated growth, the Cities and the Region, are undertaking the completion of a Pollution Control Plan (PCP) update for the study area.

The Cities of St. Catharines and Thorold, along with the Region, have asked for an update to the 1990 St. Catharines Area PCP because many of the original recommendations for

infrastructure renewal and CSO abatement have been implemented and the remaining recommendations need to be revisited. The update also allows new opportunities to be examined in the development of a new PCP strategy. The work carried out to-date which addresses the original recommendations also needs to be evaluated based on the current MOE requirements. Port Dalhousie and Port Weller sewershed studies, which were intended as updates to the original 1990 PCP, were carried out to examine these two areas specifically in regard to infrastructure capacities and CSO abatement requirements. The new PCP document also combines information from these two studies into the updated strategy.

The Regional Master Servicing Plan, completed in 2003, addressed wastewater infrastructure and treatment requirements at the Regional level. The results and recommendations from the Master Service Plan have also been incorporated into this new PCP Strategy document.

Aside from the number of projects already completed as part of the original PCP implementation and the subsequent infrastructure studies, there are significant new undertakings already underway or planned for the study area. The Region is undertaking the Northeast Wastewater Servicing Study, which will examine the wastewater treatment and linear infrastructure capacity for the Northeast portion of the Region, including portions of St. Catharines and Thorold. Under the Niagara Water Strategy (NWS), the Region is also undertaking a comprehensive assessment of CSO locations and prioritization of abatement requirements for these CSOs across the region. The draft results of these studies have been incorporated into the new PCP. All of this past and current work will be incorporated into the new PCP Strategy and the performance of the relevant system components, including all of their infrastructure improvements, will be evaluated against the current MOE guidelines.

The MOE guidelines for the management of CSOs have been refined since the development of the City's original PCP. The projects implemented by the City since the mid-1990s have been designed to meet the MOE Procedure F-5-5 and F-5-1 objectives. One of the objectives of the PCP update is to examine the relevant portions of the current system configuration and determine the success of the projects that have been implemented over the last 16 years in relation to Procedure F-5-5. The MOE is also emphasizing project elements that include additional receiving stream impact assessments for PCP strategy alternatives in relation to potential impacts on the natural environment and municipal water supplies.

The ultimate objective of the study is to develop an updated PCP strategy for the Cities that will provide them with guidance on the implementation of future infrastructure and CSO abatement projects, as well as best management practices, that will provide for anticipated growth within the municipalities and improve receiving water quality conditions.

1.4 Report Outline

The purpose of this report is to provide a complete overview of the planning process carried out for this Pollution Control Plan and to summarize the study findings and recommendations. As such, this report is organized in the following manner:

- **Section 2 –** outlines the Study Framework and the approach taken to developing the PCP.

- **Section 3 –**describes the existing conditions within the study area.
- **Section 4 –** describes the modelling exercise undertaken to assess the sewer system
- **Section 5 –** summarizes the CSOs in the study area, including frequency and volume of overflows
- **Section 6** –outlines the evaluation process used to select preferred solutions
- **Section 7 –** describes the Pollution Control Plan, including project descriptions and implementation recommendations
- **Section 8** – describes potential funding sources, data management considerations and implementation scheduling.
- **Section 9** – summarizes the recommendations for CSO control, system upgrades and treatment system considerations
- **Section 10 –** outlines the consultation undertaken as part of the planning process

2. Study Framework

2.1 Problem Statement

The Port Weller and Port Dalhousie sewersheds currently exhibit overflows and basement flooding during intense wet weather periods. The Cities of St. Catharines and Thorold have identified the need to undertake a system wide plan to determine the level of infrastructure required to service the two sewersheds currently and in the future.

2.2 Study Objectives

The objective of the PCP is to develop a strategy to address current system constraints and issues related to CSO and to plan for future system requirements in the Cities of St. Catharines and Thorold. The PCP recommendations will conform with the MOE's Procedure F-5-5 and assess the relative impact of CSO discharges to local receiving stream environments.

2.3 Ontario's Environmental Assessment Act

Ontario's *Environmental Assessment (EA) Act* was passed in 1975 and was first applied to municipalities in 1981. The *EA Act* requires the study, documentation, and examination of the environmental effects that could result from projects or activities.

The objective of the *EA Act* is to consider the possible effects of these projects early in the planning process, when concerns may be most easily resolved, and to select a preferred alternative with the fewest identified impacts.

The *EA Act* defines "environment" very broadly as:

a) Air, land, or water

b) Plant and animal life, including humans

c) Social, economic, and cultural conditions that influence the life of humans or a community

d) Any building, structure, machine, or other device or thing made by humans

e) Any solid, liquid, gas, odour, heat, sound, vibration, or radiation resulting directly or indirectly from human activities

f) Any part or combination of the foregoing, and the interrelationships between any two or more of them, in or of Ontario

In applying the requirements of the *EA Act* to projects, two types of EA planning and approval processes are identified:

- Individual EAs (Part II of the EA Act): Projects for which Terms of Reference and an individual EA are carried out and submitted to the Minister of the Environment for review and approval.
- Class EAs: Projects are approved subject to compliance with an approved Class EA process; provided that the appropriate Class EA approval process is followed, a proponent will comply with the requirements of the EA Act.

2.4 Class Environmental Assessment Process

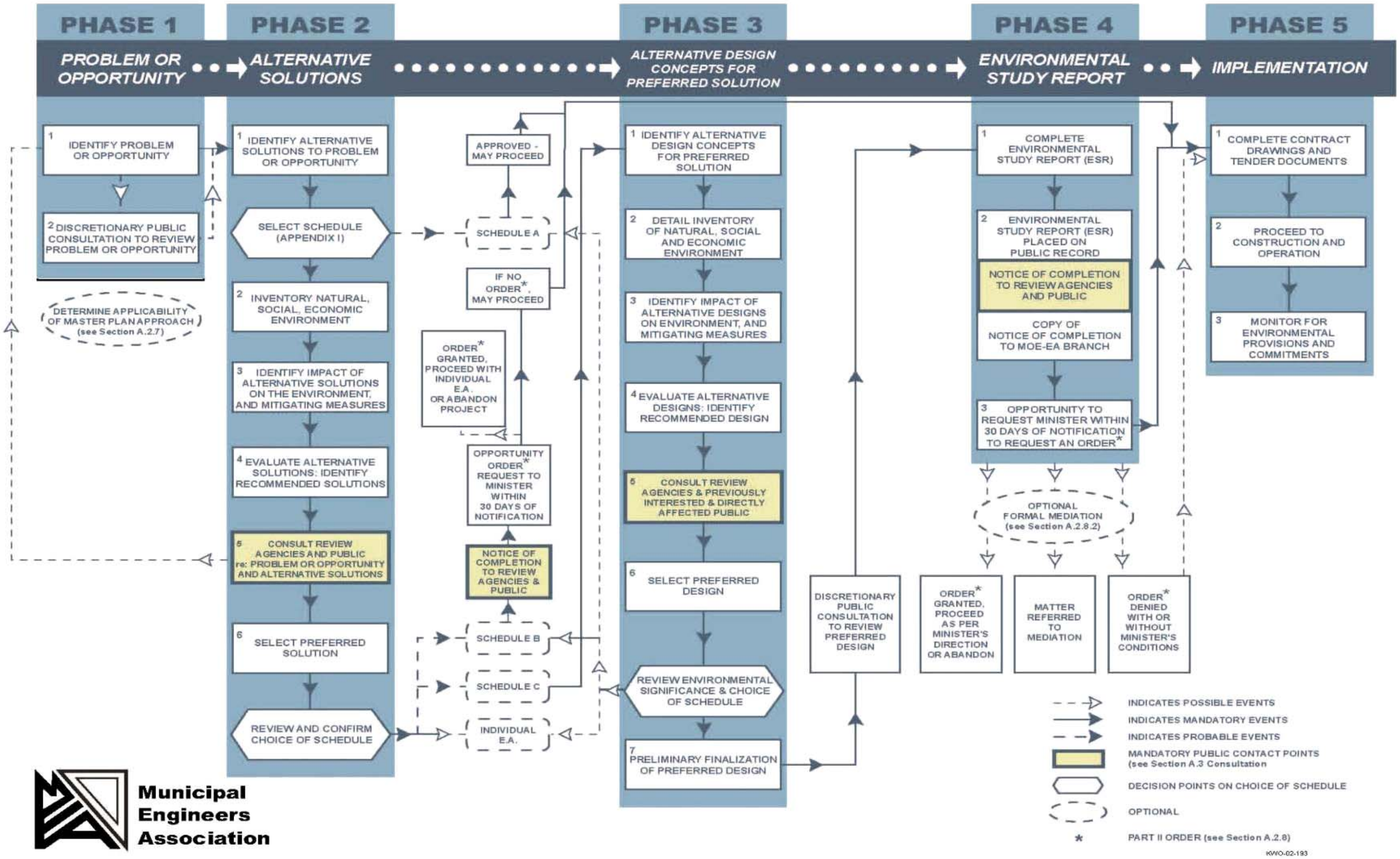
The *Municipal Class Environmental Assessment* (Class EA) document prepared by the Municipal Engineer's Association in June 2000, as amended in 2007, is an approved Class EA process. There are five phases of assessment in the Class EA document. The five phases include:

- Phase 1: Definition of the Problem
- Phase 2: Identification and Assessment of Alternative Solutions and Selection of a Preferred Solution
- Phase 3: Identification and Assessment of Alternative Sites/Design Concepts and Selection of a Preferred Site/Design
- Phase 4: Preparation of an Environmental Study Report (ESR)
- Phase 5: Implementation

The Class EA planning and design process is shown in Figure 2-1.

The Class EA document places projects into three possible schedules, depending on their characteristics (that is, Schedule A, B, or C projects). The schedule under which a project falls determines the planning and design phases that must be followed. Schedule A projects are minor operational and upgrade activities and may go ahead without further assessment once Phase 1 of the Class EA process is complete (that is, the problem is reviewed and a solution is confirmed). Schedule B projects must proceed through the first two phases of the process. Proponents must identify and assess alternative solutions to the problem, inventory impacts, and select a preferred solution. They must also contact relevant agencies and affected members of the public. Provided that no significant impacts are found and no requests are received to elevate the project to Schedule C or undertake the project as an Individual EA (Part II Order), the project may proceed to detailed design (Phase 5). Schedule C projects require more detailed study, public consultation, and documentation, as they may have more significant impacts. Projects categorized as Schedule C must proceed through all five phases of assessment. An ESR must be completed and available for a 30-day public review period, prior to proceeding to implementation (Phase 5).

FIGURE 2-1
Municipal Class Environmental Planning and Design Process



In the event that there are major issues that cannot be resolved upon completion of the final ESR, individuals may request the Minister of Environment to require the Regions to comply with Part II of the EA Act. Upon receiving a Part II Order request, the Minister reviews the request and study information and makes one of the following decisions: deny the request, refer the matter to mediation, or, require completion of an Individual EA. Many factors are considered by the Minister in making decisions, including the adequacy of the planning process, the potential for significant adverse environmental effects after mitigation measures are considered, the participation of the requester in the planning process, and the nature of the request.

2.5 Master Planning Process

Master Plans are long range plans which examine the current and future requirements of a given infrastructure system using environmental assessment planning principles. The Master Plans at a minimum must address Phases 1 and 2 of the Class EA process described in the previous section. Master plans develop a framework for planning a group of related projects required to accommodate demands on a system over a long period of time.

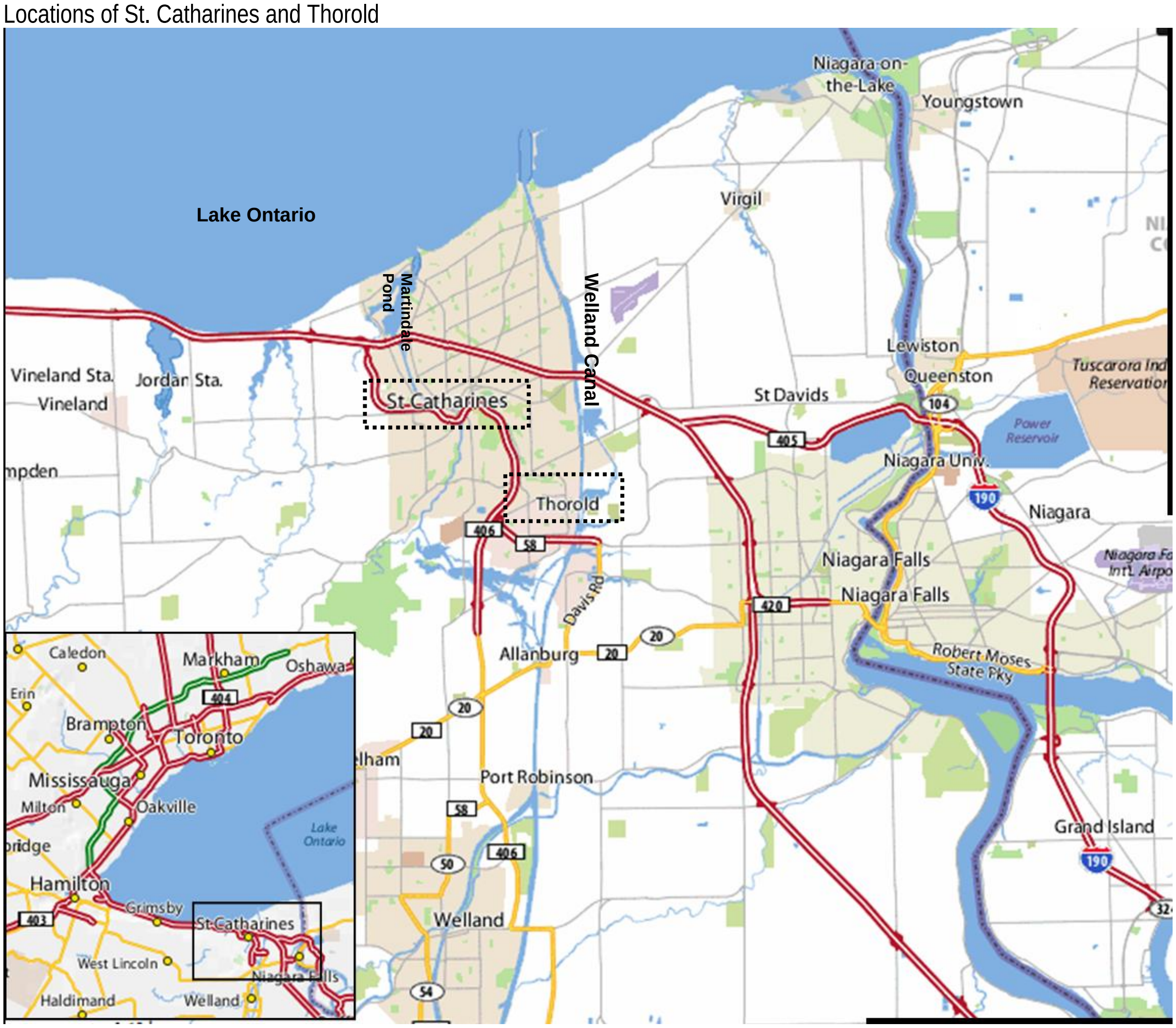
The Master Planning process allows a municipality to develop the need and justification for specific projects under a broad planning framework. A Master Plan should be reviewed every five years to determine the need for detailed review and updates. Specific projects identified in the Master Plan may require additional Class EA planning and approvals prior to their implementation.

3. Existing Conditions

3.1 Study Area Description

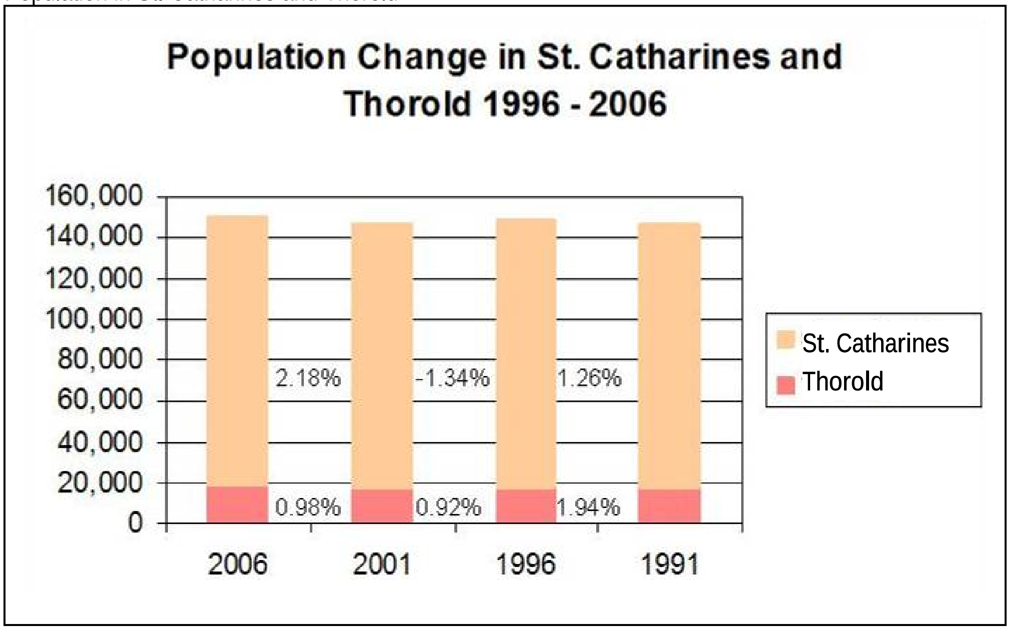
The Cities of St. Catharines and Thorold are located in Southern Ontario, on the Niagara Peninsula. As shown in Figure 3-1, the two cities are located near the southern shore of Lake Ontario, and are bordered to the east by the Welland Canal, just west of the Town of Niagara-on-the-Lake and east of the Town of Lincoln. The Study Area for the Pollution Control Plan encompasses the urban areas of St. Catharines and the northern portion of the City of Thorold as defined by the wastewater collection systems described in Section 3.2 of this report and shown in Figure 3-3.

FIGURE 3-1
Locations of St. Catharines and Thorold



The City of St. Catharines has a 2006 census population count of 131,989 people, which represents a 2.2% growth over the 2001 population of 129,170. The City of Thorold shows more modest growth, with a 2006 census population count of 18,224, up only 1% from the 2001 population of 18,048. The population growth rates are shown in Figure 3-2.

FIGURE 3-2
Population in St. Catharines and Thorold



3.1.1 Land Use

The Cities of St. Catharines and Thorold consist of primarily residential land uses, with some large industrial centres located near the edges of the urban area, and some smaller commercial and mixed-use areas scattered mostly through the northern and central areas of the Cities.

3.1.2 Residential Growth/Intensification

In the City of Thorold, planned residential growth consists of mainly low- and medium-density infill and Greenfield development. In the City of St. Catharines, compact infill development has been emphasized in the Official Plan. It is expected that, upon build-out, the City of St. Catharines will house a total population within the urban area of 148,800 residents, representing a 13% increase over the current population of 131,989.

Downtown St. Catharines has been designated an Urban Growth Centre by the Growth Plan for the Greater Golden Horseshoe, and as such, new development and redevelopment within the Centre must meet minimum density targets of 150 people and jobs per hectare. The Growth Plan for the Greater Golden Horseshoe also requires a minimum density of 50 residents and jobs per hectare for new development in designated Greenfield areas. This applies to both the City of St. Catharines and the City of Thorold.

3.1.3 Summary

Strong growth in jobs and strong growth in housing is not expected, nor planned for in the City of Thorold, with most growth accommodated through intensification/redevelopment and Brownfield/Greenfield development within the urban boundary. In St. Catharines, stronger growth is expected to fill out undeveloped parcels and brownfield lands within the urban boundary, while an emphasis on infill/intensification will help the City of St. Catharines to reach its density requirements, as outlined in the Growth Plan for the Greater Golden Horseshoe.

3.2 Existing Municipal Collection System and Treatment System Description

3.2.1 Treatment System

Wastewater within the study area is collected and treated through two separate systems. These two systems are referred to as the Port Dalhousie sewershed and the Port Weller sewershed. Wastewater from the western portion of St. Catharines and a portion of northwest Thorold is treated at the Port Dalhousie Wastewater Treatment Plant. Wastewater collected from the eastern portion of St. Catharines, a portion of northeast Thorold and a small portion of Niagara-on-the-Lake is treated at the Port Weller Wastewater Treatment Plant. The collection areas for each plant are shown in Figure 3-3.

The Cities are serviced through networks of combined, partially separated and completely separated sanitary and storm sewers. These types of sewers are defined as follows:

- Combined – All sanitary and storm flows are collected within the same sewer.
- Partially Separated – Stormwater from the roadways is collected in a separate storm sewer. The partially separated sewer collects all sanitary flows and some stormwater from weeping tiles and roof leaders that have not been disconnected.
- Completely Separated Sanitary – Only sanitary flows are collected within this sewer, there are no storm connections. These types of sewers are mandatory for any new develop where new storm connections to the sanitary system are not allowed.

These types of sewer systems are shown graphically in Figures 3-4 to 3-6.

FIGURE 3-3
Pollution Control Plan Study Area

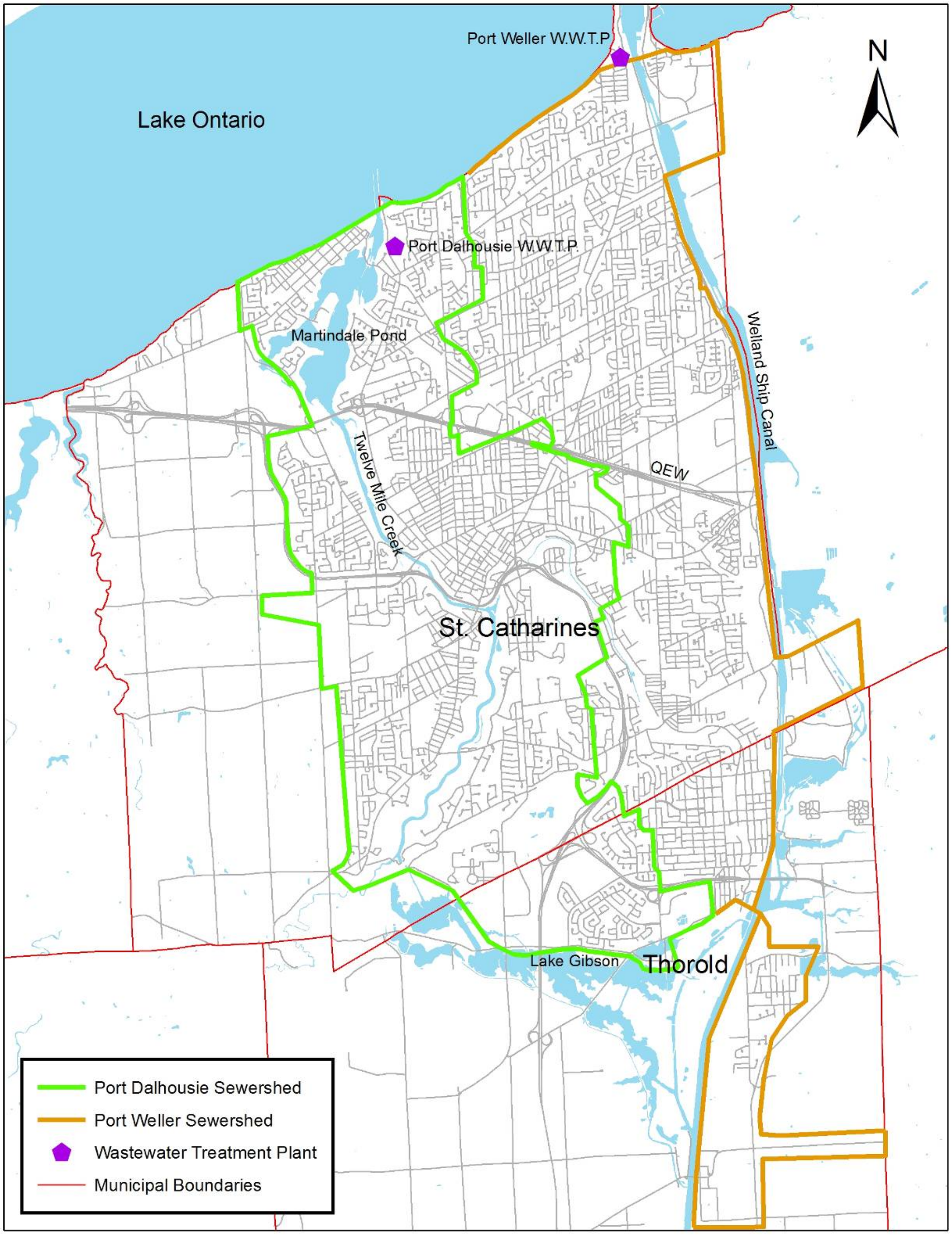


FIGURE 3-4
Combined Sewer

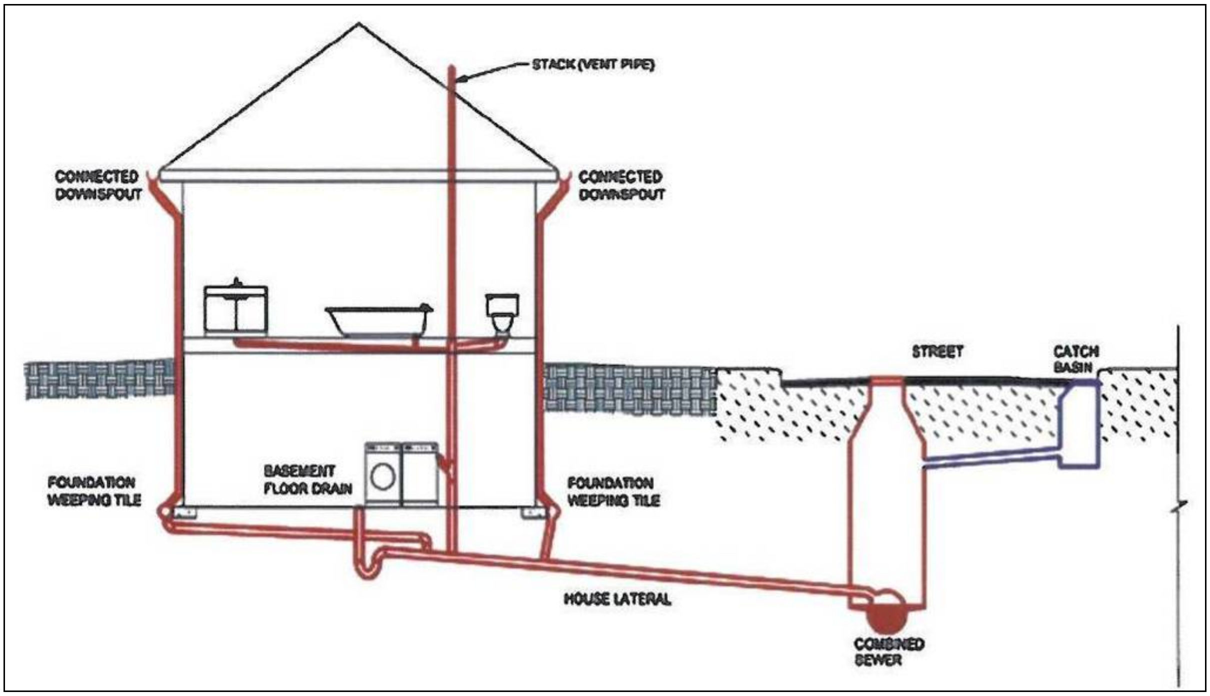


FIGURE 3-5
Partially Separated Sewer

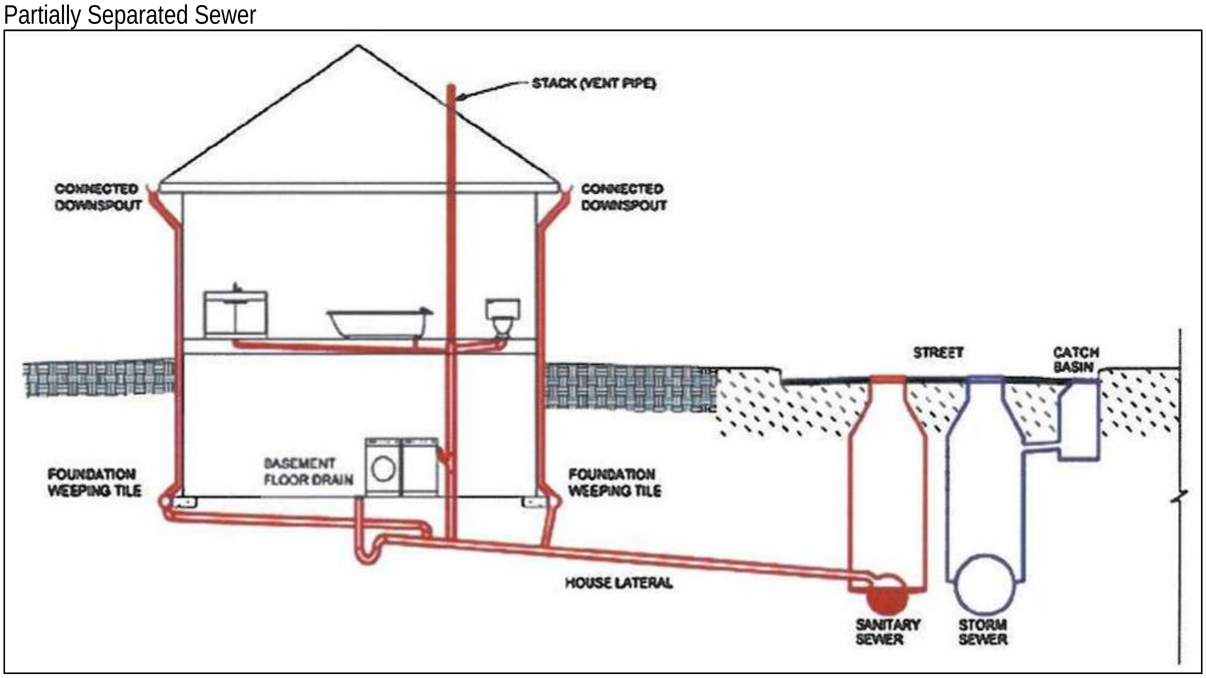
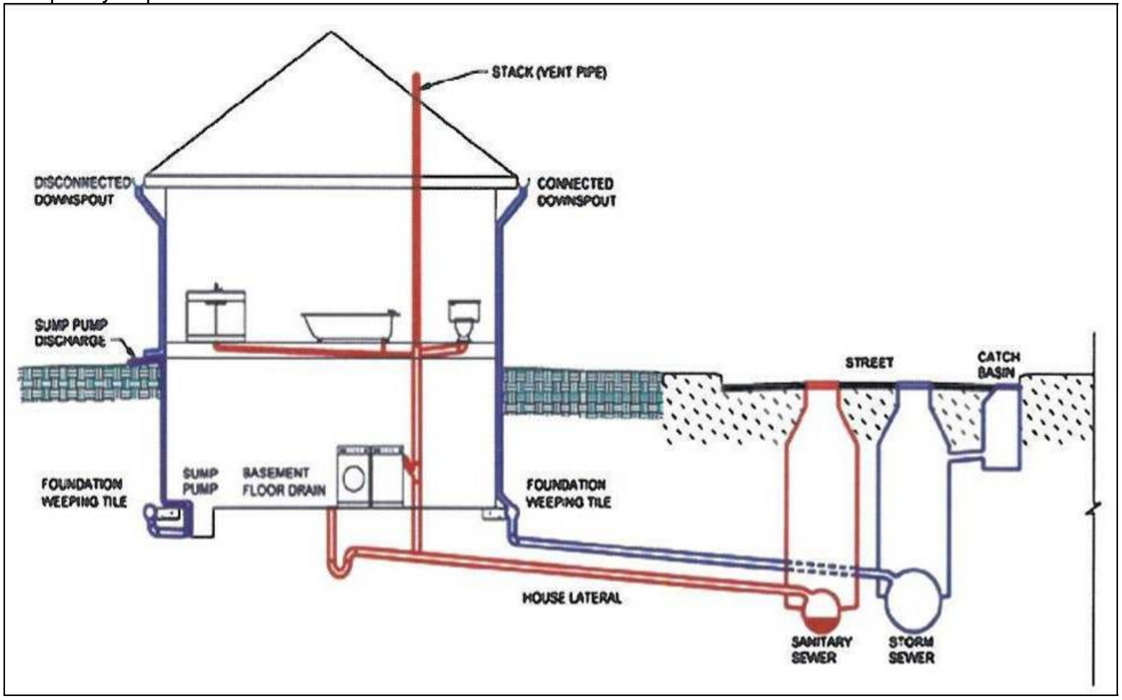


FIGURE 3-6
Completely Separated Sewer



The existing infrastructure is currently experiencing overflows from the combined sewer areas during intense wet weather events. Other areas in each City are also experiencing surcharging during intense wet weather events which in some cases results in basement flooding.

Port Dalhousie Wastewater Treatment Plant (WWTP)

The Port Dalhousie WWTP has an average rated capacity of 61.37 ML/day (710 L/s) and a peak storm capacity of 122.74 ML/day (1,421 L/s). The plant is located north of Lakeshore Road and east of Lighthouse Road. It is a conventional activated sludge treatment plant. It incorporates screening, grit removal, primary clarification, aeration and secondary clarification. Treated effluent is discharged into Port Dalhousie Harbour, at the mouth of Twelve Mile Creek. Flows in excess of the peak plant capacity are bypassed at a diversion chamber upstream of a Parshall flume where flows entering the treatment plant are measured. Bypassed flows are discharged directly to Lake Ontario.

Port Weller Wastewater Treatment Plant (WWTP)

The Port Weller WWTP has an average rated capacity of 56.18 ML/day (650 L/s) and a peak storm rating of 136.38 ML/day (1,578 L/s). The wastewater treatment plant is located north of Lakeshore Road and west of the Welland Ship Canal. It incorporates inlet screening, grit removal, primary clarification, aeration and secondary clarification followed by chlorination. Treated effluent is discharged to the Welland Ship Canal. The primary and waste activated sludge are treated by two-stage anaerobic digestion. Alum and polymer addition is provided to primary clarifiers to enhance solids settling, and phosphorus removal is achieved by alum addition to the aeration tank before secondary clarification.

Flows in excess of the pumping capacity are bypassed directly to the Welland Ship Canal at a diversion chamber located near the plant entrance.

3.2.2 Collection System

Port Dalhousie Sewershed

The Port Dalhousie sanitary sewer system consists of combined, separated and partially separated sewers. For newer developments, such as west St. Catharines, the storm and sanitary sewer systems are completely separated. For older areas and the downtown core, they are serviced by combined sewers, while the remaining areas have partially separated sewers. The combined and partially separated areas are shown in Figure 3-7.

Port Weller Sewershed

The Port Weller sewer system consists of combined, separated and partially separated sewers. Some areas of the Port Weller sewershed have separate storm sewers or roadside ditches which convey surface runoff and stormwater to nearby watercourses such as the former Welland Canal and Welland Ship Canal. The combined and partially separated areas are shown in Figure 3-7.

3.2.3 Pump Stations

There are 14 sanitary pump stations which convey wastewater in the Port Dalhousie sewershed. Within the Port Weller sewershed, eight pump stations convey wastewater to the WWTP. The locations of these pump stations in each drainage area are shown in Figure 3-8. Table 3.1 summarizes the pump stations by their respective collection system areas.

A detailed summary of all available pump station information as supplied by the Region for the Port Dalhousie sewershed and the Port Weller sewershed is presented in Appendix A. There were several discrepancies in this information between theoretical and actual capacity for the pump stations. Where actual capacity was available for a given pump station from draw/fill tests, this data was used in the model. Where actual capacity was not available, the theoretical capacity was used. The theoretical capacities for multiple pumps were calculated by the Region based on multiplication factors that increase the capacities based on the number of pumps.

FIGURE 3-7
Combined and Separated Areas – Port Dalhousie and Port Weller Sewersheds

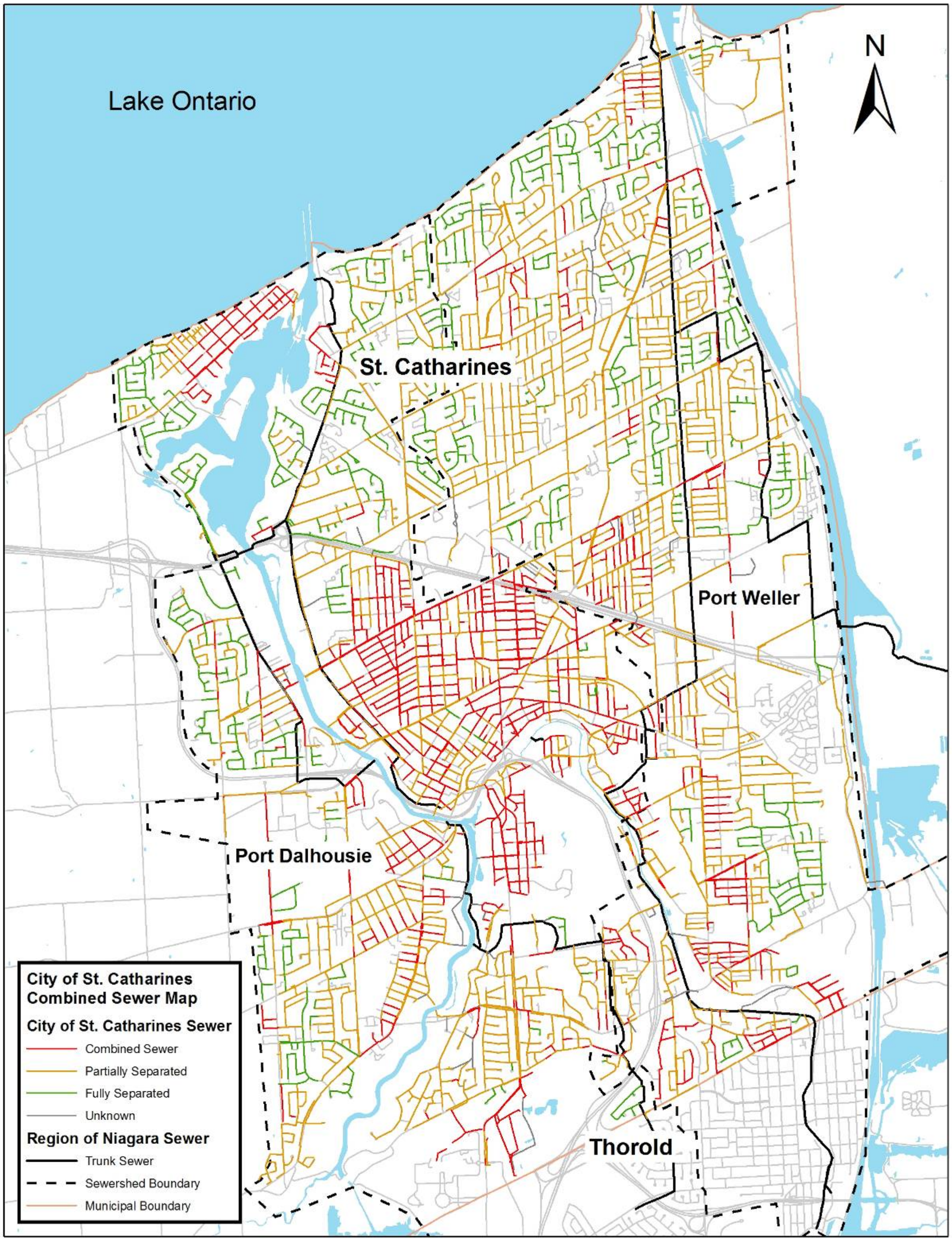
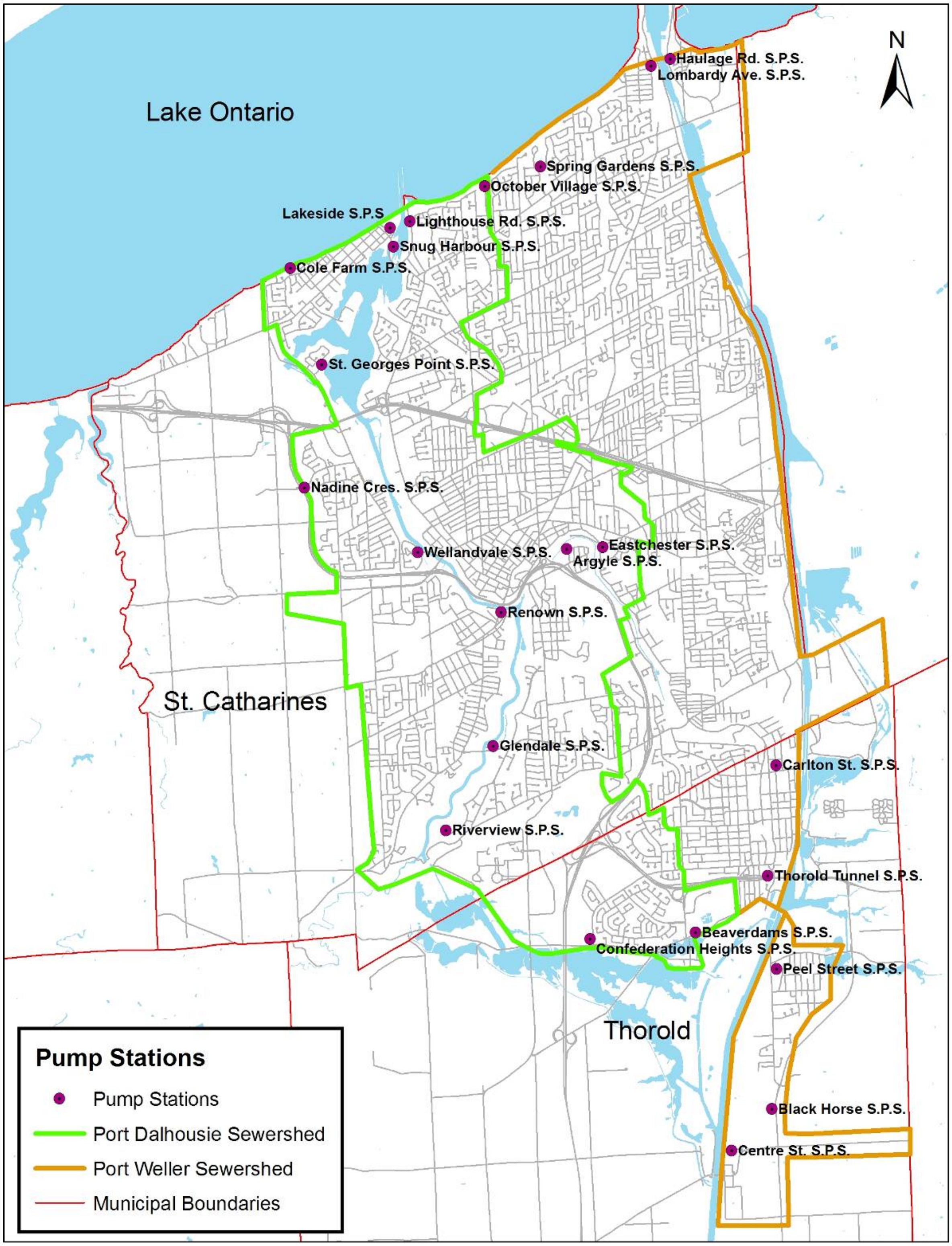


TABLE 3.1
Pump Stations within the Port Dalhousie and Port Weller Sewersheds

Sewershed	Pump Station	Overflow/Bypass	Receiving Water Body
Port Dalhousie	Cole Farm	Yes	Lake Ontario
	Snug Harbour	Yes	Port Dalhousie Harbour
	Lakeside	Yes	Lake Ontario
	Lighthouse	No	
	October Village	Yes	Lake Ontario
	St. Georges	No	
	Nadine Ave.	No	
	Welland Vale	Yes	Twelve Mile Creek
	Argyle	Yes	Twelve Mile Creek
	Eastchester	Yes	Twelve Mile Creek
	Renown	Yes	Twelve Mile Creek
	Glendale	Yes	Twelve Mile Creek
	Riverview	Yes	Twelve Mile Creek
	Beaverdams	Yes	Lake Gibson
	Confederation Heights	Yes	Beaverdams Creek
Port Weller	Black Horse	Yes	Davis Creek
	Carlton St.	Yes	Local Storm Sewer to Old Welland Canal
	Centre St.	Yes	Davis Creek
	Lombardy	No	
	Peel St	Yes	Beaverdams Creek
	Port Weller East (Haulage Rd.)	No	
	Spring Garden	Yes	Spring Garden Creek
	Thorold Tunnel	No	

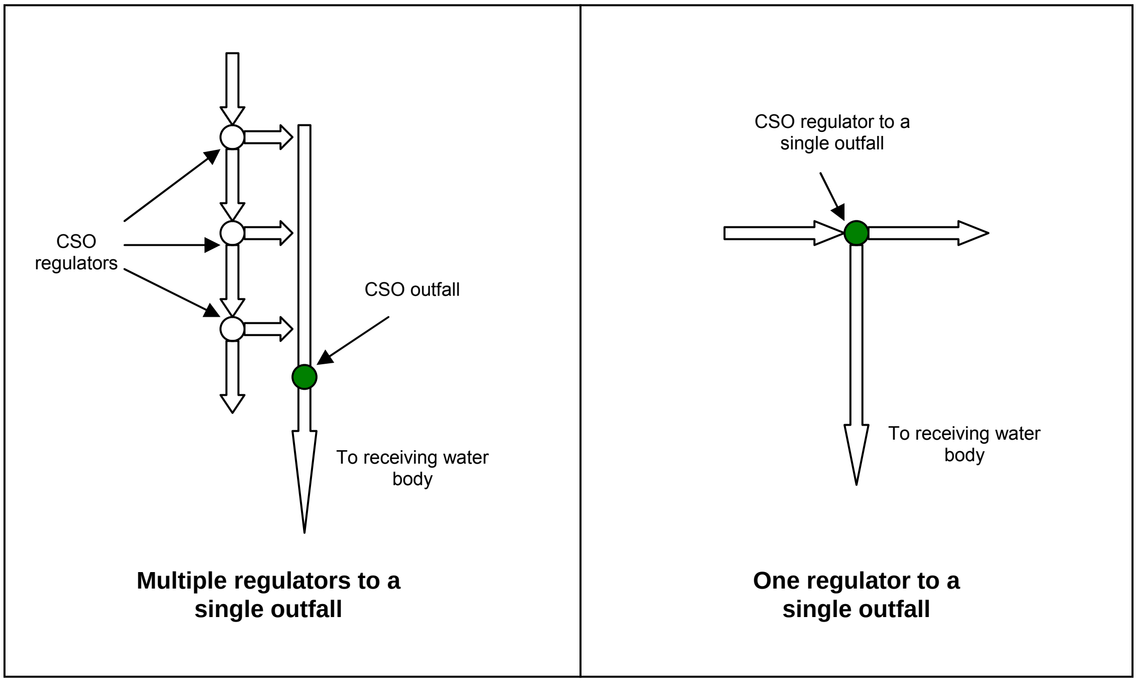
FIGURE 3-8
Regional Pump Stations – Port Dalhousie and Port Weller Sewersheds



3.2.4 Combined Sewer Overflows

CSOs in each collection system relieve the sewer systems from surcharging and flooding during intense wet weather events. CSOs are controlled by CSO regulators such as weir plates or overflow pipes. Multiple CSO regulators can contribute to a common outfall which discharges to the natural environment. Figure 3-9 shows an illustration of how multiple regulators can contribute to one outfall.

FIGURE 3-9
CSO Regulators and Outfalls



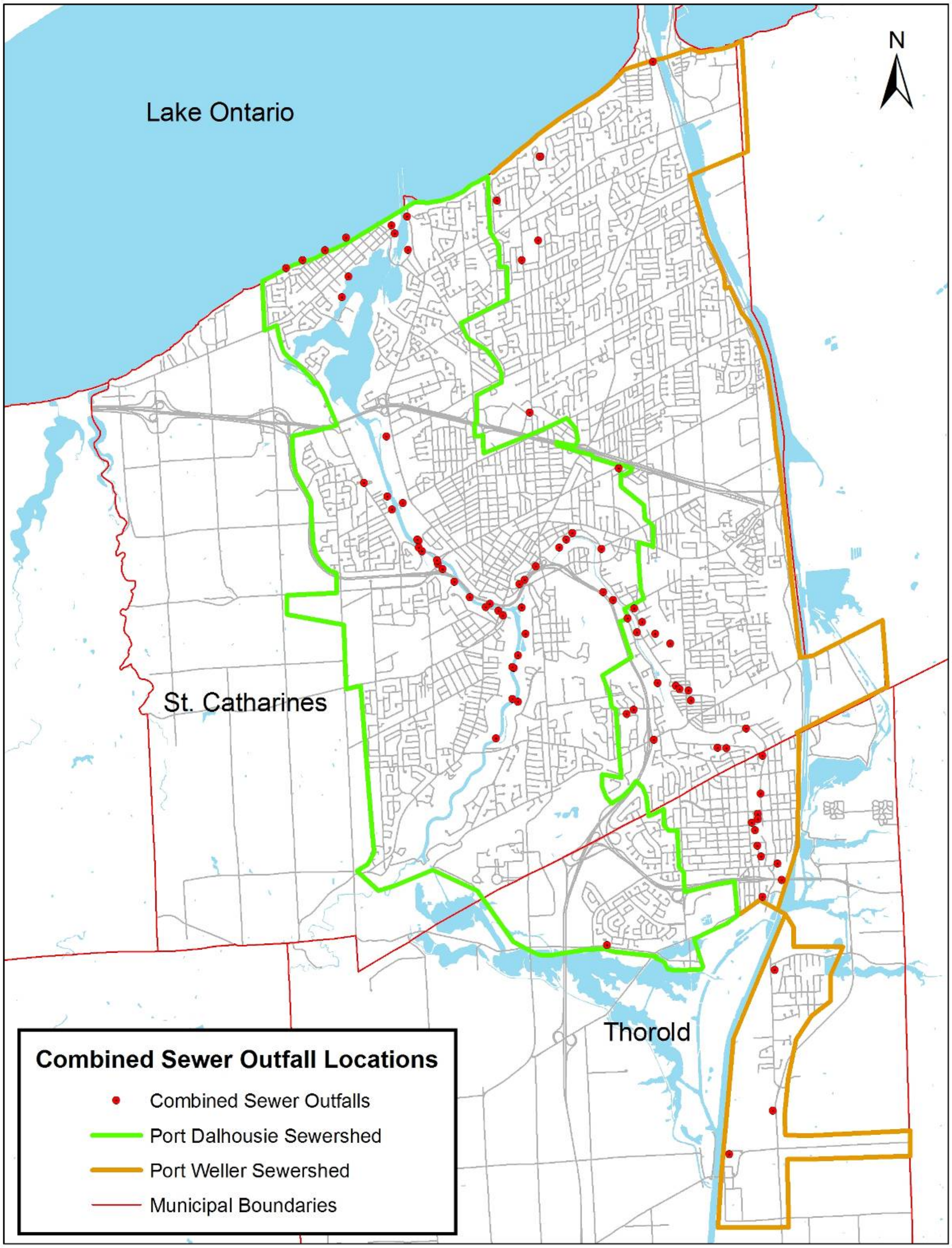
The approximate locations of the CSOs within each system are shown in Figure 3-10. Note that the locations shown in Figure 3-10 represent outfalls which discharge to the natural environment. These outfalls may receive flows from one or more than one CSO regulator. For the remainder of the PCP report, when the term CSO is used this refers to an outfall location, unless it is specifically noted that it refers to a CSO regulator.

Outfall names with associated identification numbers have been included in Appendix B.

3.2.5 Sanitary Sewer Overflows

A Sanitary Sewer Overflow (SSO) refers to an overflow within the sanitary sewer system that happens under dry weather flow conditions and is not influenced by wet weather. There are no SSOs located within the Port Dalhousie or Port Weller sewersheds.

FIGURE 3-10
Combined Sewer Outfall Locations – Port Dalhousie and Port Weller Sewersheds



Port Dalhousie Sewershed

There are 46 CSOs outfalls within the Port Dalhousie sewershed. These CSOs have the potential to discharge to a number of different local water bodies. In some cases, the CSOs overflow to a storm sewer before ultimately discharging to a surface water body. Table 3.2 summarizes the number of outfalls for each local receiving water body within the Port Dalhousie sewershed.

TABLE 3.2
Port Dalhousie Sewershed – Number of Outfalls per Receiving Water Body

Receiving Water Body	Number of Outfalls
Lake Ontario	8*
Martindale Pond	5
Twelve Mile Creek	28
Old Welland Canal	4
Lake Gibson	1

*Includes WWTP bypass

Port Weller Sewershed

There are 39 CSOs outfalls within the Port Weller sewershed. As with the Port Dalhousie system, these CSOs have the potential to discharge to a number of different local receiving water bodies. Table 3.3 summarizes the number of outfalls that may potentially discharge to each receiving water body.

TABLE 3.3
Port Weller Sewershed – Number of Outfalls per Receiving Water Body

Receiving Water Body	Number of Outfalls
Lake Ontario	3*
Spring Garden Creek	4
Dicks Creek	1
Ball Creek	1
Beaverdams Creek	1
Davis Creek	2
Old Welland Canal	26
Welland Canal	1

*Includes WWTP bypass

3.3 Municipal System Upgrades Summary

The Cities of St. Catharines and Thorold, along with the Region have been continually working on improving the infrastructure within the two wastewater treatment plants and their respective collection systems to mitigate the impact of wet weather flow (WWF). The following section summarizes the major capital upgrades undertaken for each of the collection systems. The timeframes which summarize the upgrades are based on the publication of the original PCP (1989) and the subsequent updates commencing in 1999 and 1997 for the Port Dalhousie and Port Weller sewersheds, respectively. The locations of the sewer improvements for both the Port Dalhousie and Port Weller sewersheds from 1996 to 2006 are shown in Figures 3-11 and 3-12 for the Cities of St. Catharines and Thorold, respectively.

FIGURE 3-11
Sewer Improvements within St. Catharines 1996 – 2006

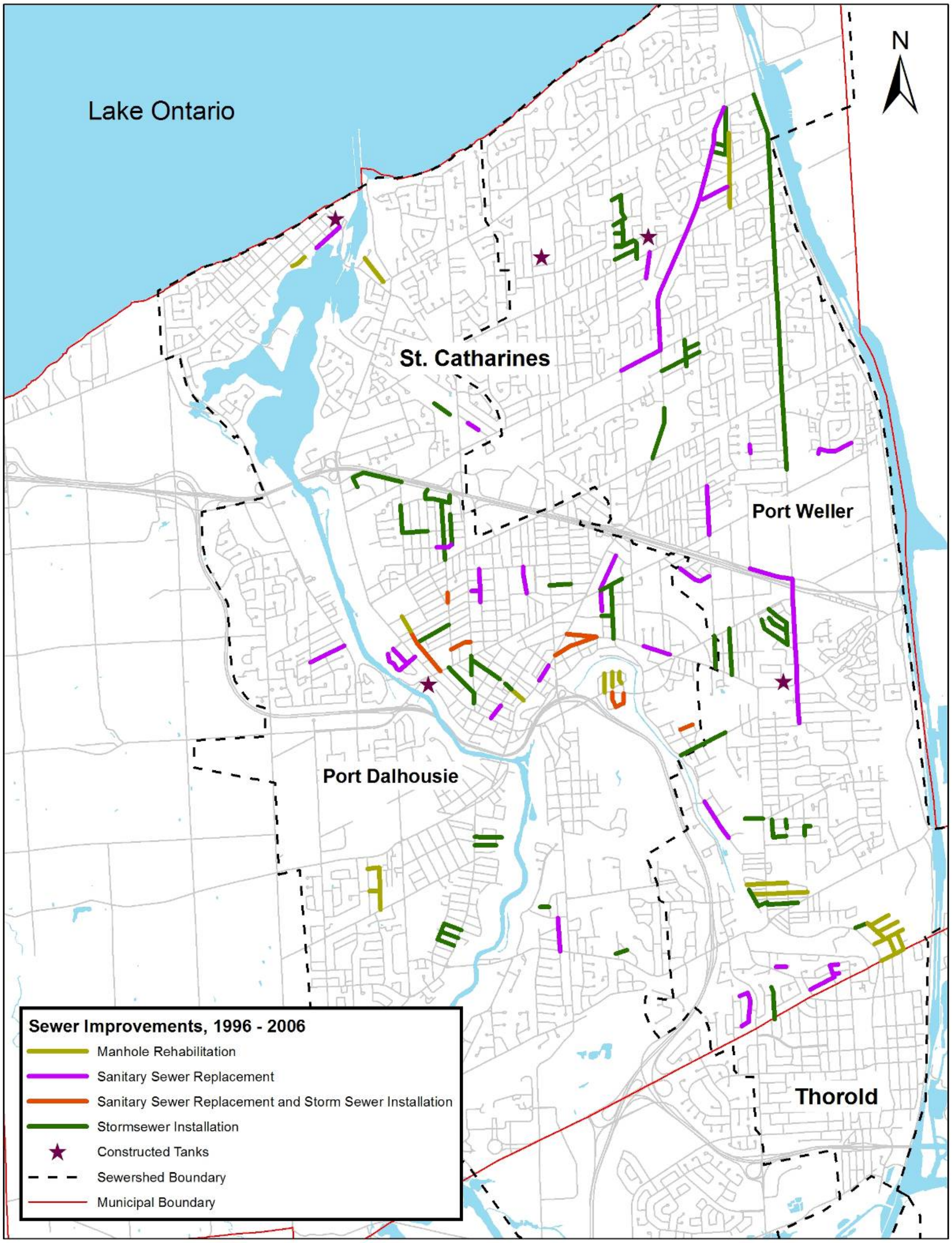
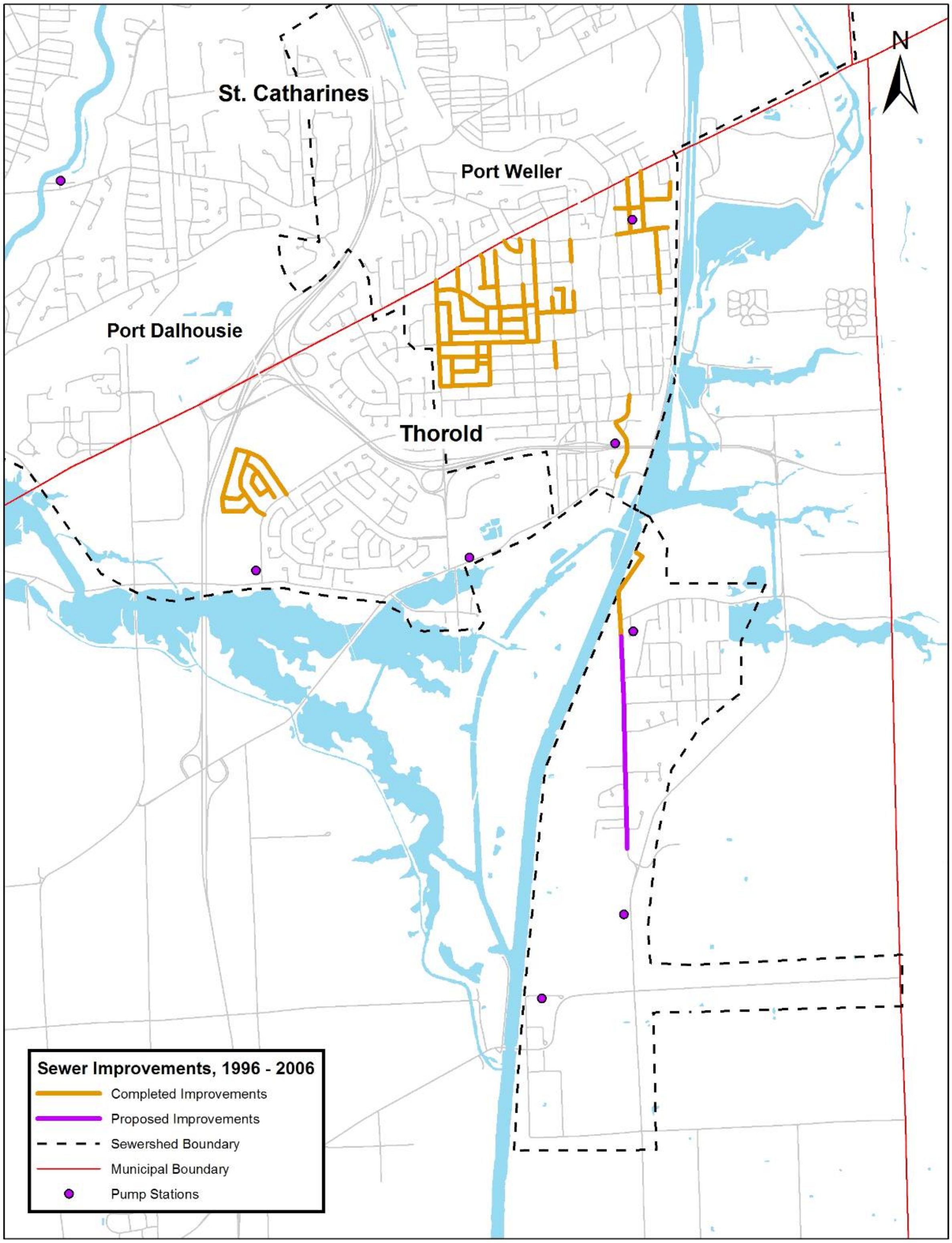


FIGURE 3-12
Sewer Improvements within Thorold 1996 – 2006



3.3.1 Port Dalhousie Sewershed

The Port Dalhousie Trunk Sewer System Update was initiated in 1999. As part of the update, field verification and inventory of the CSO regulators was completed. The field verification included measurements of overflow structure dimensions and elevations, and sketches of each CSO with flow directions. In addition to the capital projects included within this section, the Cities of St. Catharines and Thorold continue to improve their respective sewer systems through ongoing sewer separation and sewer maintenance.

Improvements 1989 – 1999

The Port Dalhousie model was updated in 1999 to reflect the sewer separation and roof leader disconnect programs as well as capital works improvements implemented from 1989 to 1999. Capital works improvements during this time period included:

- Corbett Avenue relief sewer – 450 m^3 storage
- Lakeside Pump Station and overflow storage – 850 m^3 storage
- Pump station refurbishments
- Annual sewer separations (The City of St. Catharines allocates an annual capital budget for sewer separation)

Improvements (2000 – 2007)

Since 2000, a number of sewer improvements have been made within the Port Dalhousie sewershed.

In addition to sewer improvements, the detailed design has been completed for the following project and has proceeded to construction as of the spring of 2007, with an anticipated completion in the spring of 2008:

- Welland/Ontario Sewage Storage Facility

In addition, the City of St. Catharines is undertaking a number of capital works improvement projects including:

- Capner/Oakdale Storage – Construction start Fall of 2007
- Page Street Sewage Storage Facility – Construction start Spring of 2008

3.3.2 Port Weller Sewershed

The Port Weller Trunk Sewer System Update was initiated in 1997. As part of the update, the 1989 St. Catharines Area Pollution Control Plan EPA SWMM model was converted to XP SWMM, updated and calibrated. The update included a field study, completed by the Region and the City of St. Catharines staff, to verify CSO dimensions, elevations and flow direction. Any discrepancies were integrated as part of the model update. The model was also updated to reflect sewer separation and roof leader disconnection conditions. At this time, the Port Weller model was also extended into several areas which experienced flooding problems during a historical storm event that occurred June 10, 1996.

Improvements 1989 – 1999

The Port Weller model was updated in 1997 to reflect the sewer separation and roof leader disconnect programs as well as capital works improvements implemented from 1989 to 1999. Capital works improvements during this time period included:

- Storage on Guy Road including a diversion sewer in 1993
- Further improvements to the Guy Road area in 1994/95 including an oversized concrete storage pipe at Guy Road between Duncan Road and Geneva Street.

Improvements 2000 – 2007

As part of the Port Weller Sewer System Update, the following locations were recommended for offline storage facilities:

- Lockview Park
- Kernahan Park
- Walkers Creek

Both the Kernahan Park and Walkers Creek sewage storage facilities have been constructed and commissioned to date, with construction starting on the Lockview Park location in the Fall of 2007 (2500 m^3).

Kernahan Park. The Kernahan Park storage tank was constructed in 2005/2006 in Kernahan Park, near the corner of Bunting and Queenston Road. The project included the construction of a two cell 600 m^3 storage tank. The tank accepts overflow from the Bunting Road sewer from a manhole located at the intersection of Bunting and Queenston Road. The facility was commissioned in June 2006. This project was undertaken in conjunction with sewer improvements along Bunting Road.

Walkers Creek. The Walkers Creek storage facility was constructed in 2004 adjacent to Strathcona Drive, near the corner of Vine Street and Linwell Road. The project included the construction of a 350 m^3 storage facility. The facility accepts overflow from the existing 525 mm sanitary sewer. The facility was commissioned in April/May 2004.

In addition, the detailed design has been completed for the following project and construction is anticipated to be completed in the spring of 2008:

- Guy Road Park CSO Storage facility Phase 3

Thorold

A portion of the City of Thorold’s sanitary sewer system is connected to the Port Weller sewershed through a Regional trunk sewer which is connected via a flume at Townline Road between John and Front Street. The remainder of the City of Thorold’s sanitary sewer system (west of Collier Road) discharges to the Port Dalhousie System.

Since the update of the Port Weller model in 1997, a residential area serviced by a combined sewer system underwent sewer separation with the installation of new sanitary sewer lines. The separation, completed in 1998, included the former combined system within an area bounded by St. David’s Road to the north, Pine Street to the east, Elgin Street at the south and Collier Street at the west. The design of this project was to completely separate the

combined areas into sanitary and storm systems. However, during construction, there were cases where some foundation drains were not able to be separated from the sanitary laterals due to obstructions near the houses. The sanitary sewer in this area is, therefore, only partially separated. The sanitary system was not designed for the excess wet-weather flow that resulted from only a partial separation and thus some basement flooding persisted in the area during intense wet weather events.

As a result, the City of Thorold installed six temporary overflows for wet weather relief. The City of Thorold has completed the detailed design for five (new CSO storage tanks along with some additional capacity improvements which will ultimately add 3,000 m^3 of storage to remedy the wet weather flow entering the sanitary system. The first phase of this project includes the installation of three CSO storage tanks totaling 1,400 m^3 of storage along with some capacity improvements with construction commencing in the fall of 2007.

Upon completion of the entire project, the six temporary overflows will be removed from the system to ensure conformance with the 90% capture of wet weather flow. The CSO storage facilities will have permanent overflows included in their design, and are designed to provide 90% capture of wet weather flow.

Significant efforts have been made by the City of Thorold to reduce wet weather flows through the Flood Relief Program. This work has predominantly occurred in Thorold South over the last few years consisting of the separation of roof leaders and sump pumps from the sanitary system. In addition, the detailed design of the replacement of the sanitary sewer along Allanburg Road has been completed and construction is anticipated in 2008. This project has been designed to improve flow and alleviate downstream capacity restrictions.

Region of Niagara Pump Station Upgrades

The Region of Niagara completed pump station upgrade projects for the Blackhorse PS (2005), Centre Street PS (2005), and Peel Street (2006), all located within the City of Thorold and pumping to the Port Weller sewershed. The Peel St. PS project included the construction of a 600 m^3 CSO storage facility to provide some protection from basement flooding issue in Thorold South. The City of Thorold funded the construction of this CSO tank and is the owner of this storage facility.

3.4 Existing PCP Best Management Practices/Programs

In addition to the capital works improvements described above, the Cities of St. Catharines and Thorold run a number of ongoing programs which aim to reduce the negative environmental impacts of the combined sewer system and storm runoff.

3.4.1 St. Catharines

St. Catharines initiated a number of Pollution Control Programs following the recommendations from the 1990 St. Catharines Area Pollution Control Plan. A majority of the programs were initiated in the early 1990s and are still conducted as a significant component of the City's ongoing system operations and maintenance. A brief description of each program is included in the following section.

Downspout Disconnection Program

The City updated its Sewer Use By-Law in 1991 to prohibit the connection and discharge of roof water into the municipal sanitary or combined sewer system. It also prohibits the connection of foundation drains or weeping tiles to these sewer systems, with the exception of those connections constructed or approved prior to the passage of the by-law.

The Disconnection Program includes a public education component as well as a field inspection program to ensure compliance with the by-law. The City also has initiated a rain barrel program that educates land owners about the benefits of collecting rainwater.

Pet Litter Control Program

The Pet Litter Control Program is an educational program to encourage pet owners to properly dispose of pet wastes with an aim to decrease the amount of pet waste carried to local water ways through stormwater runoff. The City also has a by-law (No. 95-302) in place to provide the City with options for more enforced control of pet litter.

Water Conservation Program

The City of St. Catharines runs an ongoing public education program on water conservation. This program includes newspaper advertisements, mall displays, website information and school presentations as well as a “Catch the Rain” program that offers rain barrels to residents at discount prices. The aim of this program is to encourage a reduction in residential water use which will provide a subsequent reduction in the dry weather flows in the sanitary sewers.

Dry Weather Seepage Abatement

Under the Dry Weather Seepage Abatement program storm sewer outfalls are surveyed for flow during dry weather periods. Based on the results of the bacterial testing, homes are investigated for cross connections and improperly functioning septic tanks and remediation measures are recommended and implemented.

Citizen’s Reports

When citizens report concerns with potential environmental implication, the City documents and responds to these concerns which may include issues regarding spills and foul odours.

Water Quality Surveys

City of St. Catharines staff collect and analyze samples from all creeks within the City boundaries. Samples are collected during both dry and wet weather conditions and the water quality results are summarized.

Beach Water Quality Program

In conjunction with the Niagara Region’s Public Health Department, City of St. Catharines staff take daily samples at the municipal beaches during the swimming season (June to September). Swimming advisories are posted when elevated levels of E. coli are present. The sampling also allows the City to examine water quality trends in relation to wet weather events.

Operations and Maintenance Program

The City of St. Catharines performs annual closed circuit television (CCTV) inspections at various locations within their sewer system. An annual budget is set aside to address findings from these inspections through spot repair, reaming and submerged outlet cleaning as well as catchbasin and street cleaning.

Emergency Bypass Pumping

During emergency conditions certain areas of the collection system, including pump stations, may reach capacity and in some cases capacity can be exceeded. The standard procedure for the City of St. Catharines is not to pump directly to the environment during wet weather events.

CSO Regulator Inspections

The City of St. Catharines performs annual inspections, cleaning and maintenance on sewer and storage tanks with overflow gates, weirs, bar screens, throttling valves and sluice gates. Additional maintenance and cleaning are done in response to any reports of active overflows, diversions or back-ups to ensure their proper operation.

Permanent Flow Monitoring

The City of St. Catharines currently has an ongoing program to monitor flows in the sanitary sewer collection system. The information collected through this program is used to update collection system models and to determine collection system constraints.

Catchbasin Cleaning

Catchbasin cleaning is carried out to remove solids from storm sewer catchbasins. Regular cleaning helps to reduce the discharge of contaminants from the storm sewer network to receiving streams. The City of St. Catharines currently has a regular catchbasin cleaning program.

Street Sweeping Program

Annual street sweeping programs are implemented in a number of municipalities to reduce the discharge of roadway contaminants to the storm sewer system. Street sweeping is normally carried out in the spring to remove excess winter sand applied to roadways and remove contaminants deposited from car exhaust or deposited on the road surface through lot runoff. The City of St. Catharines currently has an annual street sweeping program.

Household Hazardous Waste Collection

This source control focuses on the collection of deleterious chemicals that sometimes are disposed of in a manner that threatens stormwater or sanitary sewage quality. Household hazardous waste products include, among other products, drain openers, oven cleaners, wood and metal cleaners and polishes, automotive oil and fuel additives, grease and rust solvents, carburetor and fuel injection cleaners, starter fluid, batteries, paint thinners, paint strippers and removers, adhesives, herbicides, pesticides, fungicides, and wood preservatives.

Household hazardous waste collection is a preventative, rather than curative measure and may reduce the need for more elaborate treatment controls. Pollutants from household

waste may also end up in combined sewer discharge. This is a service provided by the Niagara Region for both Cities of St. Catharines and Thorold.

Pesticide Management

The City of St. Catharines has recently authorized a by-law that addresses the use of pesticides within the community. The control of pesticides helps prevent the contamination of stormwater runoff that can result from improper use.

Combined Sewer Separation

The City of St. Catharines has an ongoing program aimed at separating areas of the City with combined sewer systems. The annual program includes the construction of a storm sewer within a designated area, allowing the stormwater collected from the roadways to be diverted from the combined sewer to the new storm sewer. This reduces the flows within the combined sewer system.

3.4.2 Thorold

Downspout Disconnection Program

Similar to St. Catharines, the City of Thorold has a downspout disconnect by-law with an associated disconnect program. The intent of this program is to eliminate extraneous flows from the collection system, providing additional hydraulic capacity during wet weather periods.

Water Conservation Program

The City currently has a Water-use By-Law, which allows for water restriction to be enacted from June 1 to September 1 for watering of lawns or gardens, if required.

I/I Investigations and Cross Connection Program

The City conducted a smoke testing program to find potential areas of inflow and infiltration as well as locating improper connections. Smoke testing was used as part of the sewer separation project to identify roof leader connections.

Emergency Bypass Pumping

During wet weather periods certain areas of the collection system, including pump stations, may reach capacity and in some cases capacity may be exceeded. The standard procedure for the City of Thorold is not to pump directly to the environment during these events.

Pesticide Management

The City of Thorold has a by-law to regulate the use of pesticides and herbicides within the City of Thorold (By-Law No. 52-2003). This by-law prohibits the residential application of pesticides within the community. The control of pesticides helps prevent the contamination of stormwater runoff that can result from improper use.

Catchbasin Cleaning

Catchbasin cleaning is carried out to remove solids from storm sewer catchbasins. Regular cleaning helps to reduce the discharge of contaminants from the storm sewer network to receiving streams. The City of Thorold currently has a regular catchbasin cleaning program.

Street Sweeping Program

Annual street sweeping programs are implemented in a number of municipalities to reduce the discharge of roadway contaminants to the storm sewer system. Street sweeping is normally carried out in the spring to remove excess winter sand applied to roadways and remove contaminants deposited from car exhaust or deposited on the road surface through lot runoff. The City of Thorold currently has an annual street sweeping program.

Operations and Maintenance Program

The City of Thorold performs annual closed circuit television inspections at various locations within their sanitary sewer system. On average, approximately 20 percent of the sanitary sewer collection system is video inspected each year. The findings from these inspections are placed on a maintenance list and addressed according to their priority and as the sanitary maintenance budget allows.

Citizen's Reports

When citizens report concerns with potential environmental implication the City documents and responds to these concerns or directs them to the appropriate authority.

3.4.3 Region of Niagara

Wastewater Pumping Station Wet Weather Flow – Standard Operating Procedure (SOP)

The Region has an SOP which provides direction to operations staff on what to do at the regional pump stations during wet weather events. Regional staff are responsible for monitoring levels and where bypasses occur ensuring proper data is collected. If it appears that the levels at the pump station may cause upstream surcharging in the collection system, staff are to contact the local municipality who are responsible to relieving the upstream system. A copy of the Region's SOP can be found in Appendix C.

3.5 Ongoing Flood Alleviation Programs

3.5.1 St. Catharines and Thorold

In addition to the Pollution Control Programs, the City of St. Catharines implemented the Flood Alleviation Program (FLAP). The program provides flood protection to homeowners having recurring sanitary back-ups. Approximately 340 homeowners have received funding assistance through the FLAP program. These residents are eligible for the installation of a backwater valve, disconnection of weeping tiles from the sanitary sewer, installation of a sump pump and the reconnection of weeping tiles to the sump pump for discharge to the ground surface. The City of Thorold also administers a similar flood alleviation program.

3.6 Natural Environment

CSOs can potentially have a major impact on the quality of receiving water bodies in St. Catharines and Thorold. An assessment of that impact and the potential for infrastructure upgrades and improvements to mitigate some of the water quality degradation that is caused by CSOs is another focus of this PCP. In order to determine the potential impact of current discharges, it is necessary to determine the current condition and sensitivity of existing water bodies which receive these overflows. The current condition and sensitivity of the existing receiving water bodies is assessed using selected water quality parameters that provide a representation of the health of the aquatic habitat. Relevant available information on each of the receiving water bodies was collected from a number of sources.

3.6.1 Water Quality

A number of organic, chemical and bacteriological parameters were selected to represent the current baseline condition of each of the receiving water bodies. The summary of these parameters for each of the streams is included in Table 3.4. The Provincial Water Quality Objectives (PWQOs), where available for the parameters listed, have also been included for comparison purposes. Values which exceed the objectives are noted in bold in Table 3.4. It is to be noted that water quality information for nearshore Lake Ontario was not available at the time of this evaluation and was therefore not included. All parameters and results listed are in mg/L unless otherwise stated. It is to be noted that much of the iron in the local creeks is suspected to originate naturally as a product of weathering from rocks and soils (NPCA, 2005).

TABLE 3.4
Receiving Water Bodies – Water Quality

Parameter	PWQO (mg/L)	Water Bodies								
		Ball Creek	Spring Garden Creek	Dicks Creek	Twelve Mile Creek	Martindale Pond	Welland Canal	Old Welland Canal	Lake Ontario	Lake Gibson
E. coli	100 cfu/ 100 mL	***900***	***38600***	***4500***	***978***	***2000***	38	***8880***	***255***	**n/a**
Total Suspended Solids (TSS)	30*	8	***42***	***73***	**-**	24	**-**	**-**	**n/a**	**n/a**
Total Phosphorus (TP)	0.03	0.03	***0.22***	***0.17***	***0.06***	***0.06***	0.02	***0.54***	**n/a**	**n/a**
Ammonia	-	0.06	0.44	0.55	-	0.09	-	-	**n/a**	**n/a**
Cadmium	0.0002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**n/a**	**n/a**
Iron	0.3	0.04	***0.8***	***2.1***	0.25	***0.42***	0.15	0.28	**n/a**	**n/a**
Lead	0.025	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	**n/a**	**n/a**
Zinc	0.03	***0.12***	***0.31***	0.02	0.008	0.02	0.014	***0.09***	**n/a**	**n/a**

Notes:
1. Water quality information obtained from City of St. Catharines Creek Sampling Program for - Ball Avenue Creek, Briarsdale Creek, Carter Creek, Martindale Pond, Spring Garden Greek and Walkers Creek (based on 2 - 5 samples in 2005/06)
2. Water quality information obtained from Provincial Water Quality Monitoring Network for - Welland Canal, Twelve Mile Creek and Old Welland Canal
3. E. coli measurements for Lake Ontario from City of St. Catharines Municipal Beach Monitoring Program (2003 – 2006), value is an average concentration for all 3 beaches monitored during this period
*Concentration of TSS from Canadian Environmental Quality Guidelines, not PWQO

The potential impact of levels above PWQOs are discussed for each of the parameters below.

E. coli. Bacteria do not significantly affect the viability of aquatic habitats in relation to the survival of most aquatic species. E. coli and Fecal coliform are indicator bacteria which can be used to indicate whether or not other potentially harmful bacterial may be present. In high enough concentrations, bacteria may pose a health risk to humans via contamination of drinking water or recreational body contact with the water.

Phosphorus. Phosphorus, in the form discharged from combined sewer effluent, is not toxic to aquatic life (MOEE, 1979). It is, however, considered a nuisance chemical that may affect the surrounding aquatic environment. The interim Provincial Water Quality Objective (PWQO) for total phosphorus (TP) is 0.03 mg/L. At concentrations greater than this level, algal formation takes place. Increased algal growth, while providing more food for fish production, increases turbidity in the surface water and requires more oxygen during decomposition (MOEE, 1979). Phosphorus may also lead to taste and odour concerns for drinking water.

Ammonia. Total ammonia is comprised of two components, ionized and unionized ammonia. The form of ammonia that is most toxic to fish species is unionized ammonia (UIA). At high concentrations, unionized ammonia can become toxic to aquatic biota (MOEE, 1979). The percentage of UIA in an ammonia solution is dependant on temperature and pH. There is no PWQO for ammonia, only unionized ammonia. As pH and temperature increase, more of the ammonia is converted to the unionized form. For example, the fraction of total ammonia that is unionized at a pH of 7 and a temperature of 10°C is 0.0018, whereas at a pH of 8 and 20°C, the unionized fraction of ammonia is 0.0318. The PWQO for unionized ammonia is 0.02 mg/L. Ammonia may have an impact on water treatment processes. Elevated ammonia levels at water treatment plants may cause a slight increase in chlorine demand which could results in a change in taste and odour.

Total Suspended Solids. Suspended sediments are a healthy component of any stream. Streams transport sediments to carry valuable organic nutrients to downstream environments. If a stream is starved of its sediment load it will naturally scour the stream bottom or bank to maintain sediment load. If too much sediment is transported to a stream the stream will be depositional, which can harm aquatic invertebrates and can limit spawning areas. High levels of total suspended solids can be due to storm water impacts, poor housekeeping at construction sites, and erosion of watercourses. Each stream has its own particular healthy sediment load and transport characteristics that must be considered in the evaluation of overall stream health.

Metals. Some metals have been shown to cause chronic health effects in aquatic organisms. The toxicity of different metals, however, varies considerably. The impact of some metals on human health also varies. At higher concentration levels some metals may cause kidney damage and high blood pressure. The maximum concentration limits for metals, as they relate to human health, are higher than the PWQOs listed and metals are generally removed through conventional drinking water treatment.

Water Quantity

In addition to the water quality in a receiving water body, the quantity of flow affects a stream's ability to assimilate external discharges. Information on flow within the local stream systems was quite limited; therefore, stream flow as it relates to assimilative capacity has been described on a very general basis.

3.6.2 Local Water Users

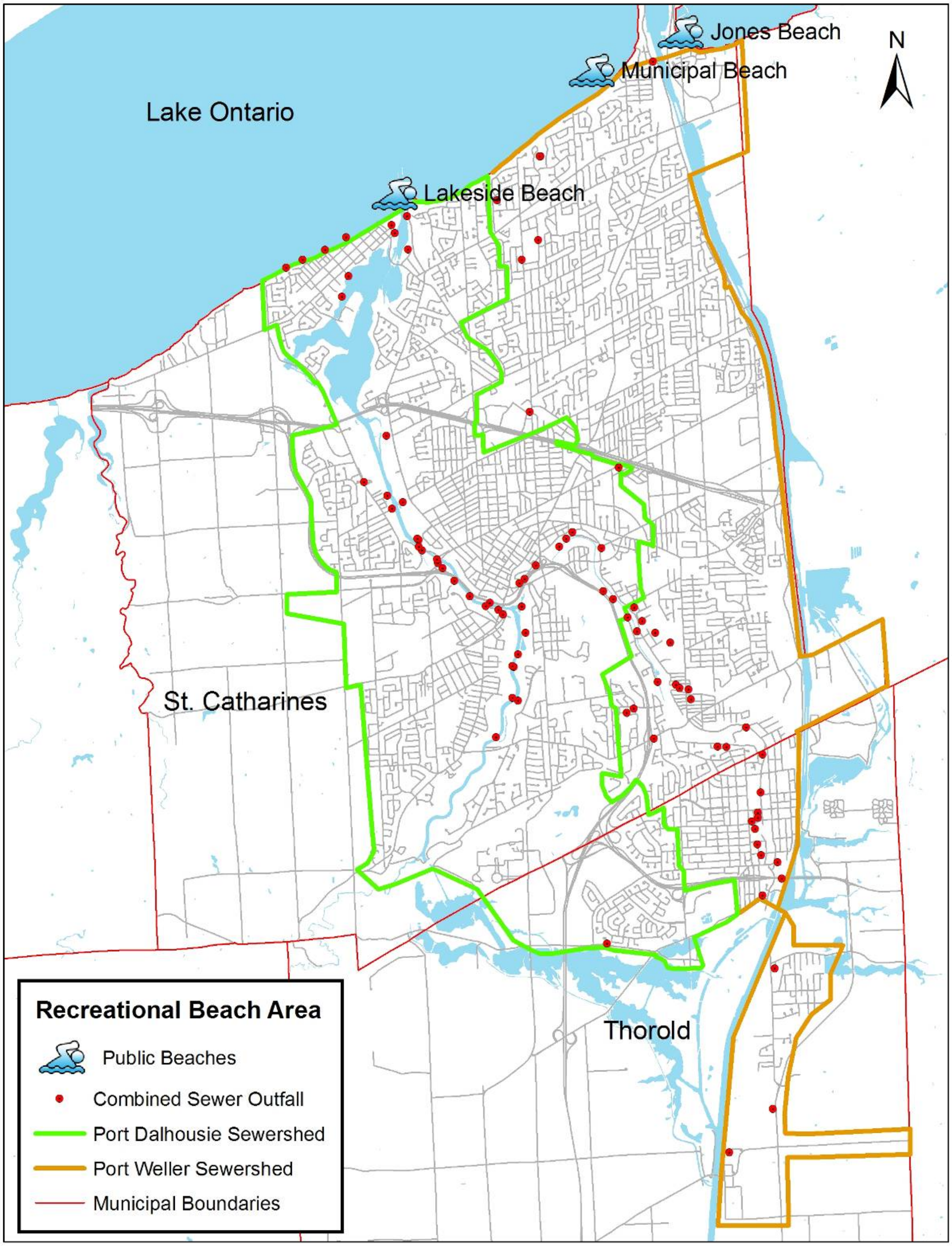
In addition to the effect on the aquatic ecosystem, CSOs may also have an impact on sensitive local water users. These water users may include water treatment plants which draw raw water from the receiving water body or recreational water users. There are, however, no water treatment plants within either the Port Weller or the Port Dalhousie sewersheds. The Decew Water Treatment Plant under normal operations draws water from Lake Erie via the Welland Canal. The CSOs which discharge to the Welland Canal are located downstream of this intake. However, the initial findings from the source protection studies show the Intake Protection Zones including all of Lake Gibson. There are no CSOs which currently discharge to Lake Gibson during the typical year scenario.

A number of identified recreational swimming beaches and local marinas are located within the two sewersheds. Lakeside, Municipal and Jones beaches are recreational beaches located along the shores of Lake Ontario. The location of these beaches is shown in Figure 3-13. Water quality at these beaches is monitored by the City of St. Catharines, in conjunction with the Region's Public Health Department, during each swimming season from June to August.

In addition to the local beaches, Martindale Pond is a popular location for rowing and is the site of the St. Catharines Rowing Club.

In addition to the water uses discussed above, the Welland Canal serves as an important water body for commercial transportation operations. Water quality, in the context of the PCP, has no impact on commercial transportation in the canal.

FIGURE 3-13
Recreational Beach Areas



3.7 Social Environment

3.7.1 Policies for Growth

The Cities of St. Catharines and Thorold have a number of policy documents outlining planned growth and intensification within each municipality. These documents, including official plans, secondary plans and the Places to Grow Act, were reviewed to examine the potential future impact on the current infrastructure. Detailed review of each policy document can be found in Appendix D. The summary of the findings is included within this section.

Residential Growth/Intensification

In the City of Thorold there are three main areas planned for future residential growth. These are brownfield residential redevelopment (former Exolon properties), Allanburg/ Blackhorse (Neighbourhood of Rolling Meadows), and Port Robinson West (target residential density of 20 Units per hectare net, with a planned build-out to house 12,500 residents in 2,700 units).

The Secondary Plan for the development of the Neighbourhood of Rolling Meadows mandates an average residential density target of 21 – 32 units per hectare net with a planned build-out to house approximately 10,000 residents. However, it should be noted that there is no servicing solution in place beyond 500 units for the Rolling Meadows proposed subdivision.

Community Improvement Plans exist for the Downtown Thorold, Port Robinson, Thorold South, Allanburg/Blackhorse, and Thorold Centre areas (see Schedule B-1).

In the City of St. Catharines, compact infill development has been emphasized in the Official Plan. It is expected that, upon build-out, the City will house a total population within the urban area of 148,800 residents, up 13% from the current population of 131,989.

Downtown St. Catharines has been designated an Urban Growth Centre by the Growth Plan for the Greater Golden Horseshoe, and as such, new development and redevelopment within the Centre must meet minimum density targets of 150 people and jobs per hectare.

The Growth Plan for the Greater Golden Horseshoe requires a minimum density of 50 residents and jobs per hectare for new development in designated Greenfield areas. This applies to both the City of St. Catharines and the City of Thorold.

Commercial/Industrial Growth/Intensification

The Central Area Secondary Plan for downtown St. Catharines allows for high density commercial/institutional redevelopment. As per the West St. Catharines Secondary Plan, a 50,000 sqare foot commercial centre will be located in the Martindale neighbourhood. In the Secondary Plan for the Hartzel Road - Merritton Area of St. Catharines, industrial land is rezoned to allow for mixed commercial and residential development.

Recreational/Tourism Growth/Intensification

In Thorold a hotel and convention centre is permitted in the Brock Business Park.

Summary

Strong growth in jobs and strong growth in housing is not expected, nor planned for in the City of Thorold, with most growth accommodated through intensification/redevelopment and Brownfield/Greenfield development within the urban boundary. In St. Catharines, stronger growth is expected to fill out undeveloped parcels and brownfield lands within the urban boundary, while an emphasis on infill/intensification will help the City to reach its density requirements, as outlined in the Growth Plan for the Greater Golden Horseshoe.

3.8 Technical Data Review

As part of this undertaking the following key technical documents have been reviewed:

1. St. Catharines Area Pollution Control Plan (1990)
2. The updates for the Port Weller and Port Dalhousie sewersheds (1999/2006)
3. Water and Wastewater Master Plan for the Region of Niagara (2003)
4. The Niagara Water Quality Protection Strategy Report (2003)
5. Combined Sewer Separation Project Remedial Works Class EA (2004)
6. City of St. Catharines CSO HRT Feasibility Study (2005)
7. The Evaluation and Audit of Sanitary Combined Sewer Overflows (2006)
8. Twelve Mile Creek Watershed Plan (2006)

A complete review of these documents has been included in Appendix E of this report. The following section summarizes key findings from each report.

Additional documents have been reviewed as part of the Pollution Prevention and Control Plan (PPCP) process. The information from these documents has been incorporated, but full summaries are not included. A list of references for additional documentation reviewed is included within the reference section of this report.

3.8.1 St. Catharines Area Pollution Control Plan (SCAPCP) (1990)

The SCAPCP was undertaken in partnership with the MOE, the City of St. Catharines, the Region and the City of Thorold. The purpose of the study was to develop a plan to improve water quality in the St. Catharines area. The objectives of the study were:

- To identify and quantify existing and potential sources of water pollution;
- To develop and evaluate a series of management options; and
- To select a preferred strategy with recommendations for implementation

The main deliverable from this initiative was a 20 year strategy including recommendations for capital work upgrades and ongoing programs.

The recommendations from the report included:

- Annual programs
  - Dry Weather Seepage Abatement Program
  - Enhanced Anti-pet litter By-Law Enforcement

  - Monitoring
  - Annual Review and Public Consultation

- Recommendations for implementation of capital work upgrades and ongoing programs in the near term (five years)
- Long term recommendations for capital work upgrades and ongoing programs

3.8.2 Port Weller Sanitary Trunk Sewer Analysis (1999)

The Port Weller Sanitary Trunk Sewer Analysis was commenced in 1997 in response to basement flooding caused by a severe thunderstorm in 1996. It was also an update to the original SCAPCP. As part of the update, the Port Weller sewer system model was updated to reflect the sewer separation and roof leader disconnect programs as well capital works improvements implemented from 1989 to 1997. The system was evaluated based on real and design storm events and the system constraints and bottle necks were identified. Recommendations were made to address issues within the sewer system. The recommendations from the report are summarized in Table 3.5.

TABLE 3.5
Recommendations from Sewer System Update Report (1999)

Recommendation
Capacity Upgrade – Walkers Creek – Complete
Capacity Upgrade – Hartzel Road – Deferred
Capacity Upgrade – Bunting Road, Battersea to QEW – Complete
Capacity Upgrade – Regional Trunk, Petrie St. to QEW – Complete
Capacity Upgrade – Briarsdale/Brookdale – Deferred
Capacity Upgrade – Bunting/Cushman Road, Carlton to Goldsmith Avenue
Storage – Lockview Park – Design
Storage – Kernahan Park – Complete
Storage – Walkers Creek – Complete

3.8.3 Port Dalhousie Trunk Sewer and CSO Study (2006)

The Port Dalhousie Trunk Sewer System Update was initiated in 1999 as an update to the 1990 SCAPCP. The purpose of the study was to re-evaluate the sewer system and determine current capacities and identify constraints within the system. The deliverable from the study was a long-term plan to address these constraints and reduce the impact of CSOs.

3.8.4 Water and Wastewater Master Plan Update (2003)

The Water and Wastewater Master Plan (MSP) was an initiative lead by the Region. The project included an assessment of water and wastewater infrastructure across the entire region, of both regionally and municipally owned and operated infrastructure. The MSP includes recommendations to address the issues outlined within the report.

In addition to the main reports, the working papers completed as part of the MSP process were reviewed. In particular, the working papers relating to the Port Dalhousie and Port Weller WWTP were reviewed and summaries of these papers have been included in Appendix E.

The MSP recognized that CSOs are a major issue within the Niagara Region. A general review of CSO controls was completed with the recommendation to proceed with the following “best practices”:

- Roof leader/foundation drain disconnection
- Sewer separation
- In-line/off-line storage
- Disinfection of CSOs
- Sewer rehabilitation/replacement

3.8.5 Niagara Water Quality Protection Strategy Final Reports (2003)

The Niagara Water Quality Protection Strategy (NWQPS) was initiated in 2002 by the Region, the NPCA and the MOE. The strategy development included a watershed characterization which addressed land and water use, study area features and functions and potential contaminant sources.

A detailed assessment was performed by dividing the watersheds into Local Management Areas (LMAs). Each land parcel was summarized in terms of area statistics, key resources, major land use/activities, contaminant sources, form and function, key issues, general approach for water protection and key actions.

In addition to the local assessments, a list of core issues which are common to the majority of the Niagara watersheds was developed. In order to address the core issues a number of action items were developed. The key action items relating to municipal infrastructure pollution control planning efforts include:

- Review of CSO policies (programs)
- Mandate sewer separation (new development areas)
- Develop Regional storm sewer pollution elimination program
- Establish sewer system computer models to identify system deficiencies
- Assess the impacts of sanitary sewer overflows on ecosystem; develop appropriate methods to manage impacts including holding tanks and other technologies
- Undertake sewer repair or replacement, pipe lining or internal grouting
- Undertake inflow/infiltration control studies (plans)
- Phase out combined sewer overflows (where appropriate)

3.8.6 Combined Sewer Separation Project Remedial Works Class EA (2004)

As described previously in this report, a residential area in North Thorold serviced by a combined sewer system underwent sewer separation. During and following commission basement flooding continued in the area during intense wet weather events, necessitating the installation of six temporary overflow connections. In order to address ongoing system surcharging, basement flooding and overflow issues, the City of Thorold completed a Class

Environmental Assessment (EA) study. The report recommended the construction of multiple storage tanks to alleviate the pressure to the system during intense wet weather events. The City of Thorold commenced the construction of three of these storage tanks in 2007, with anticipated completion by mid-2008. The modified sanitary system will be monitored for effectiveness and efficiencies. Upon completion of this review, the need and appropriateness for further storage facilities will be examined if necessary.

3.8.7 City of St. Catharines CSO HRT Feasibility Study (2005)

The objective of the CSO HRT Feasibility Study was to evaluate high rate treatment (HRT) options for handling CSOs in the Port Dalhousie and Port Weller sewersheds. Off line storage tanks have been and remain a popular approach for wet weather CSO control. The cost of these storage facilities is often high. In some cases, alternate options, such as HRT, may be a technically feasible alternative.

The objectives of the report were to:

- Examine the approach, designs and methods used from recent HRT studies and demonstrations in other jurisdictions
- Identify sites suitable for monitoring and an evaluation of HRT technologies, conduct flow monitoring and water quality sampling for specific areas
- Establish the type and combination of HRT technologies that are most suitable and the expected performance, efficiency, and the number and size of treatment units required, and prepare preliminary conceptual design layouts and cost estimates for the selected sites
- Determine the effectiveness of the HRT technologies identified in terms of meeting MOE guidelines and overall effect on receiving waters
- Provide the opportunity for public input through an open house, in anticipation of future Environmental Assessment projects

The following recommendations were made from this study:

- HRT was found to be technically feasible for the CSO sites considered (Renown Road, Thomas Street, Hartzel & CNR, and Wedsworth & Hastings) and in general was the most cost effective option. If HRT is considered at sites in St. Catharines, the recommended technology is the RTB with polymer assisted settling.
- If HRT is to be installed, consideration should be given to staging the installations to allow for optimization of the process and review the need for polymer aids. The recommended schedule included a year of further characterization and possible pilot testing and then proceeding with installations at Renown Road, Thomas Street, Hartzel & CNR, and Wedsworth & Hastings in succession.
- Monitoring of the Twelve Mile Creek should be undertaken at the recreational area to monitor and confirm the impact of CSO treatment on water quality.

3.8.8 Evaluation and Audit of Sanitary Combined Sewer Overflows – *Draft* (2006)

This study was initiated as part of the implementation of the Niagara Water Strategy (NWS). The purpose of the evaluation was to examine current CSO management initiatives across the Region and to develop a prioritization of projects to assist in funding allocation. In addition, recommendations were made on how CSO management might occur in a more coordinated approach throughout the Region. At the time of this background data review, only a draft version of the Evaluation and Audit of Sanitary Combined Sewer Overflows report was available and was included in the review.

CSO reduction targets were developed with input from the CSO Study Panel. These targets are:

- Conformance with the F-5-5 requirements within the next 15 years
- Inflow and infiltration reduction as follows
  - 100% of downspouts disconnected within two years
  - Complete foundation drain and sump pump disconnections in high volume areas within eight years
  - Establishment of by-laws and incentive programs within one year

As part of the study an Action Plan was developed. The main elements of the CSO Management Action Plan included:

- Ongoing and Future CSO Control projects
- Third Party Funding
- Extraneous Flow Reduction Program
- Pollution Control Plan Updates
- Installation of Permanent Flow Monitors
- Inspection and Maintenance
- Public Awareness Program
- CSO Control By-Law

The Region has approved the Niagara Watershed CSO Management Action Plan that included the adoption of a policy respecting the control and management of CSOs and cost sharing by local municipalities and the Region. The Region has enacted the funding portion of this plan and approved $6.2 million in funding in November 2007. In addition, they also plan on providing $6.4 million per year for this program which also involves an application process.

3.8.9 Twelve Mile Creek Watershed Plan (2006)

The Twelve Mile Creek watershed covers part of the Town of Pelham, City of Thorold, City of St. Catharines, and the Town of Lincoln. The Niagara Peninsula Conservation Authority's (NPCA) Twelve Mile Creek Watershed Plan compiled watershed issues from previous studies and public input to form a set of watershed objectives to guide the development of subwatershed restoration strategies and an implementation plan. The Twelve Mile Creek Watershed Plan Implementation Committee helps to guide the implementation process and ensures the interests and concerns of all stakeholders are met.

The watershed objectives which relate to the pollution control plan include:

Water Resources

- Protect all municipal drinking water supplies and designated vulnerable areas
- Ensure that stormwater management practices optimize storm water volumes and minimize contaminant loads, and maintain or increase the extent of vegetative and pervious surfaces

Urban Development

- Promote environmentally-sound land use decision-making in the watershed for current and future urban development
- Identify opportunities to optimize restoration and rehabilitation as part of urban growth and development

Communication and Education

- Increase awareness of the linkages between healthy water, healthy lifestyles, and the economic viability of rural and urban land uses
- Promote the efficient and sustainable use of water resources, including practices for water conservation and sustaining water quality

Recommended Management Actions relating to the Pollution Control Plan include:

- Create and implement downspout disconnection by-laws for the Town of Pelham and the City of Thorold
- Create, fund, and implement an urban Rain Barrel Program
- Disseminate material pertaining to alternative fertilizer use for residential lawns

3.9 Policy Review

Municipal pollution control planning and implementation relies on a number of regulatory tools that provide direction and guidance on municipal and provincial objectives related to the management and control of contaminants that enter the environment through municipal infrastructure. These tools also provide enforcement and compliance requirements that ensure that the direction and guidance is followed. Municipal direction is usually provided through enactment of By-laws that restrict the use of municipal infrastructure. Provincial direction is given through Policy and Procedure or Guidance documents that outline the Ministry of the Environments requirements for conformance.

Those Municipal and Provincial regulatory tools relevant to Municipal Pollution Control Planning are briefly described in this section.

3.9.1 Municipal Policy

City of St. Catharines

The City of St. Catharines regulates stormwater generated at source through various by-law components that regulate the use of municipal sewers. The City's by-law 91-364, which regulates storm and sanitary drainage prohibits:

- The connection of discharge of roof leaders into the sanitary or combined sewer system;
- The connection of foundation drains or weeping tiles to the sanitary sewer system, with the exception of those connections constructed or approved prior to the passage of the by-law;
- The construction of new combined sewers; and
- Rain water leaders that discharge below the ground at a point not directed away from the foundation wall of a building.

In addition to the sewer use by-law the City of St. Catharines has recently approved a by-law regulating the use of pesticides within the City boundaries.

Certificate of Approval (C of A) – New Connections to the Combined Sewer System

In 2006, the MOE issued a Cerificate of Approval for new sanitary sewer service connections to the existing combined sewer system under certain conditions. The CofA states that St. Catharines shall not approve any new sanitary service connections to the main combined sewer unless:

- St. Catharines has completed a technical evaluation that there is sufficient hydraulic capacity of the combined sewer downstream of the approval to accept the sewage flows; and
- Is able to demonstrate that a net reduction in untreated combined sewage overflow volume from City of St. Catharines sanitary sewer system to the natural environment will occur on an annual basis.

City of Thorold

The City of Thorold's By-Law No. 1864 (94) regulates the use of public and private sewers to drains and connection of building sewers, the discharge of waters and waste to the sanitary and storm sewer system within the City. The by-law prohibits:

- The connection of discharge of roof leaders into the sanitary or combined sewer system;
- The connection of foundation drains or weeping tiles to the sanitary sewer system, with the exception of those connections constructed or approved prior to the passage of the by-law;
- The construction of new combined sewers; and
- Rain water leaders that discharge below the ground at a point not directed away from the foundation wall of a building.

In addition to the sewer use by-law the City of Thorold has a by-law regulating the use of pesticides and herbicides within the City boundaries (By-Law No. 52-2003).

3.9.2 Regional Policy

Regional Municipality of Niagara – Sewer Use By-law (No. 39-2002)

The intent of the Regional Sewer Use By-law is to regulate the maintenance and management of the sanitary and storm sewer systems. The By-law outlines what may and may not be discharged to the sewer systems and in what quantity and concentration. The By-law also prohibits any new connections of roof leaders or foundation drains to any sanitary or combined sewer which ultimately discharges to the Regional Sewage works.

3.9.3 Provincial Policy

The Province of Ontario regulates the use of municipal infrastructure through the MOE. The MOE has developed a number of relevant Procedures that provide guidance on the discharge of contaminants to receiving waters in Ontario.

Procedure F-5-1

The goal of Procedure F-5-1 is to ultimately abate all discharge of untreated wastewater to receiving water bodies. A copy of the relevant section of this document is appended to this report in Appendix F. In dealing with combined sewer system the Procedure requires that all municipalities serviced by combined sewerage should prepare a staged program leading towards the ultimate goal of total containment for treatment of all sewage flows.

Procedure F-5-5

Procedure F-5-5 outlines the treatment requirements for municipal and private combined and partially separated sewer systems. The goals of the Procedure are to:

- Eliminate the occurrence of dry weather overflows
- Minimize the potential for impacts on human health and aquatic life resulting from CSOs
- Achieve, as a minimum, compliance with body contact recreation water quality objectives at beaches impacted by CSOs for at least 95% of the four-month period (June 1 to September 30) for an average year

In order to meet the goals of Procedure F-5-5, a municipality or operating authority is required to:

- Develop a Pollution Prevention and Control Plan (PPCP)
- Meet minimum CSO controls

PPCP Requirements

Specific components of a PPCP deal with the characterization of the sewage system. This includes:

- Monitoring
- Modeling

- Determination of location of CSOs
- Concentrations and mass of pollutions resulting from CSOs
- Data collected on frequency of dry weather overflows
- Data collected on frequency of wet weather overflows
- Records kept on:
  - Location and physical description of CSO outfalls in the collection system
  - Location and identification of receiving water bodies for all combined sewer outfalls
  - Combined sewer system flow and wastewater treatment plant capacities under both present and future peak flow rates during dry and wet weather conditions.
  - Capacity of all regulators
  - Location of cross connections
- Operation procedures developed for CSS including:
  - Combined sewer maintenance programs
  - Regulator inspection and maintenance program

In addition, alternatives for CSO control must be examined and include:

- Source control
- Inflow/infiltration reduction
- Operation and maintenance improvements
- Control structure improvements
- Collection system improvements
- Storage technologies
- Treatment technologies
- Sewer separation

Implementation plans with cost estimates and schedule of all practical measures to eliminate dry weather overflows and minimize wet weather overflows are included in the PPCP, which also demonstrates how the minimum CSO prevention and control components are achieved.

Minimum CSO Controls

For any combined sewer system (CSS) the minimum CSO controls include:

- Elimination of CSOs during dry-weather periods except under emergency conditions
- Programs that focus on pollutant reduction activities at source
- Establishment of proper operation and regular inspection and maintenance programs for the CSS
- Establishment of a floatables control program
- Maximizing the use of the collection system for the storage of wet weather flows which are conveyed to the WWTP for treatment when capacity is available
- Maximizing the flow to the WWTP for treatment of wet weather flows

- During a seven month period commencing within 15 days of April 1, capture and treat for an average year all the dry weather flow plus 90% of the volume resulting from wet weather flow that is above the dry weather flow
- Any additional controls provided for beaches affected by CSOs or where required by receiving water quality
- Establishment of a monitoring program specified in PPCP

MOE PPCP Checklist

As a tool for review of PPCPs, the MOE has developed a standard checklist. Use of the MOE checklist for the evaluation of PPCPs is a standard practice in Ontario. The checklist highlights to the degree that a PCP conforms to MOE Procedure F-5-5 and provides a comprehensive check on the validity of the PPCP. A copy of the MOE checklist has been filled out for the Port Dalhousie and Port Weller sewersheds and has been included in Appendix F.

4. Sewer System Assessment

4.1 General System Model Description

To analyze the sanitary sewer flow, a hydrologic/hydraulic model was utilized. The model simulates dry and wet weather flows generated within the study area and is used to assess the existing sanitary system. The model was originally developed in 1989 and primarily represented the sanitary trunk sewer system. Subsequent studies have been undertaken and the model has been expanded to include additional areas of the sewer system. The model was used to assess flow control alternatives based on a specific level of control or historical storm events for both existing and future conditions.

4.1.1 Hydrologic/Hydraulic Model

The hydrologic and hydraulic modelling was carried out using XPSWMM, which is based on the USEPA (United States Environmental Protection Agency) SWMM (Storm Water Management Model) solving engine. The hydrologic model defines the drainage area characteristics and simulates the inflow hydrographs while the hydraulic model defines the sewer system network and simulates how the sewer system responds to given flow conditions. The inflow hydrographs are routed through the sewer system's infrastructure and a time series history of the flow characteristics is generated. The hydraulic model is capable of simulating pumping stations, weirs, and flow diversions in addition to pipe flow conditions.

Model Revisions

The XPSWMM model version was updated to version 10.5 for both the Port Weller Sewershed and Port Dalhousie Sewershed models. Recent capital works projects including the Bunting Road sewer upgrade, Kernahan Park storage, and Walker's Creek storage were incorporated prior to calibration of the model.

4.2 System Modelling Calibration

The hydrologic model was re-calibrated utilizing data from five temporary flow monitoring locations operated by the City of St. Catharines and nine permanent flow monitoring locations operated by the Region.

The existing dry and wet weather hydrologic parameters were revised to obtain the best calibration to the flow monitoring data available.

4.2.1 Flow Monitoring

The City of St. Catharines maintains five flow monitors within the Port Weller and Port Dalhousie sewersheds. Table 4.1 lists the location, identification number, and period of record of the five monitoring stations used for this study. The locations of the monitoring stations were installed to address specific drainage areas with the City's two sewer systems.

TABLE 4.1
City of St. Catharines Flow Monitoring Stations, General Information

Sewershed	Station ID Number	Location	Period of Record	
			Start	Stop
Port Dalhousie	SO_1	14a Lakeport Road	August 6, 2003	February 2, 2007
	SO_5	Page Street	November 12, 2003	February 2, 2007
Port Weller	SO_2	Sunnylea CNR Line	November 14, 2003	February 2, 2007
	SO_3	Niagara Street	November 4, 2003	February 2, 2007
	SO_4	Park Avenue	October 27, 2003	February 2, 2007

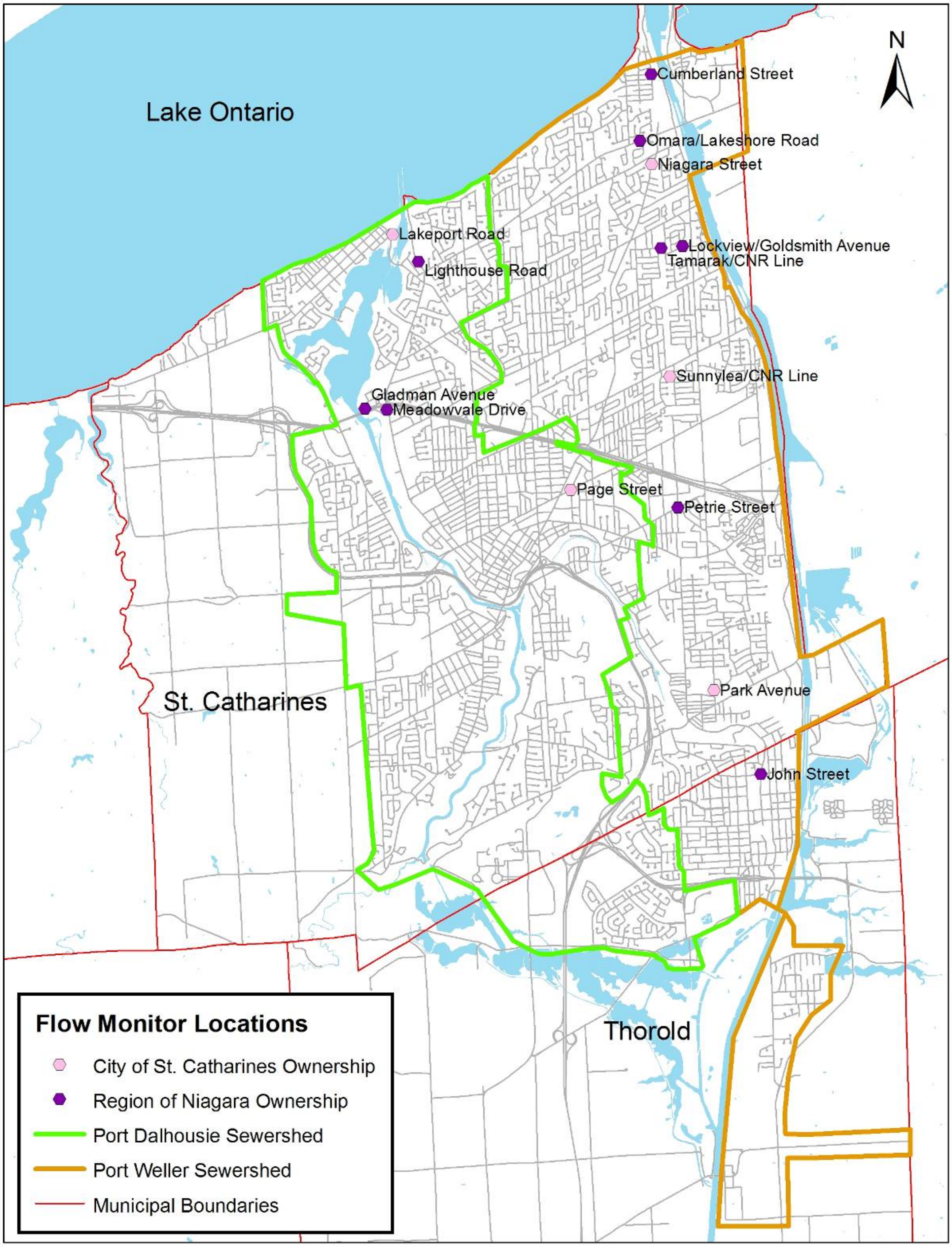
The Region has installed 16 monitors in the Port Dalhousie and Port Weller Sewersheds, nine of which were operational, one with consistently poor flow data, and six of which were undergoing reconstruction at the time of this study. The Region's flow monitors were used for calibration and verification of the model results. Table 4.2 provides the site number, location and installation date for the Region's flow monitors used for this study. Figure 4-1 shows the location of the City's and Region's flow monitors.

TABLE 4.2
Region of Niagara Flow Monitoring Stations, General Information

Sewershed	Site Number	Location	Installation Date
Port Dalhousie	3	Lightouse Road	Prior to January 1, 2004
	4	Gladman Avenue	April 16, 2004
	5	Meadowvale Drive	Prior to January 1, 2004
Port Weller	10	Cumberland Street	October 22, 2004
	11	Omara/Lakeshore Road	Prior to January 1, 2004
	13	Lockview/Goldsmith Avenue	June 30, 2004
	14	Tamarak/CNR Right-of-Way	Prior to January 1, 2004
	15	Petrie Street	June 24, 2004
	16	John Street	October 22, 2004

Historical average flow data from 2001 at the Port Dalhousie WWTP and Port Weller WWTP was obtained from the 2003 Region of Niagara Master Plan. The Region provided updated average flow data at both plants for 2001 to 2006. Total daily flow at the treatment plants was also obtained from the Region for the months of April and May 2005 to verify flow for the selected dry weather calibration periods, which are detailed in the following section.

FIGURE 4-1
Flow Monitoring Locations



4.2.2 Rainfall Monitoring

Rainfall data is an important input parameter in a hydrologic model. The volume and flow rate of the extraneous flow in the sanitary and combined sewer is directly related to the volume and intensity of rainfall, existing land use and sewer system condition. Therefore, accurate and representative rainfall is critical to the hydrologic and hydraulic analysis. The City of St. Catharines maintains five (5) weather stations, which are illustrated in Figure 4-2 as follows:

- City Hall (blue radius),
- Greenhouse (purple radius),
- Linwell (yellow radius),
- Merritton (red radius), and
- Pelham (green radius).

4.2.3 Treatment Plant Flows

Flow data received for the Port Dalhousie WWTP and Port Weller WWTP was assessed to determine if any significant change in the average daily flow at the plants had occurred in recent years. Flow data available at the plants was limited to total daily flow.

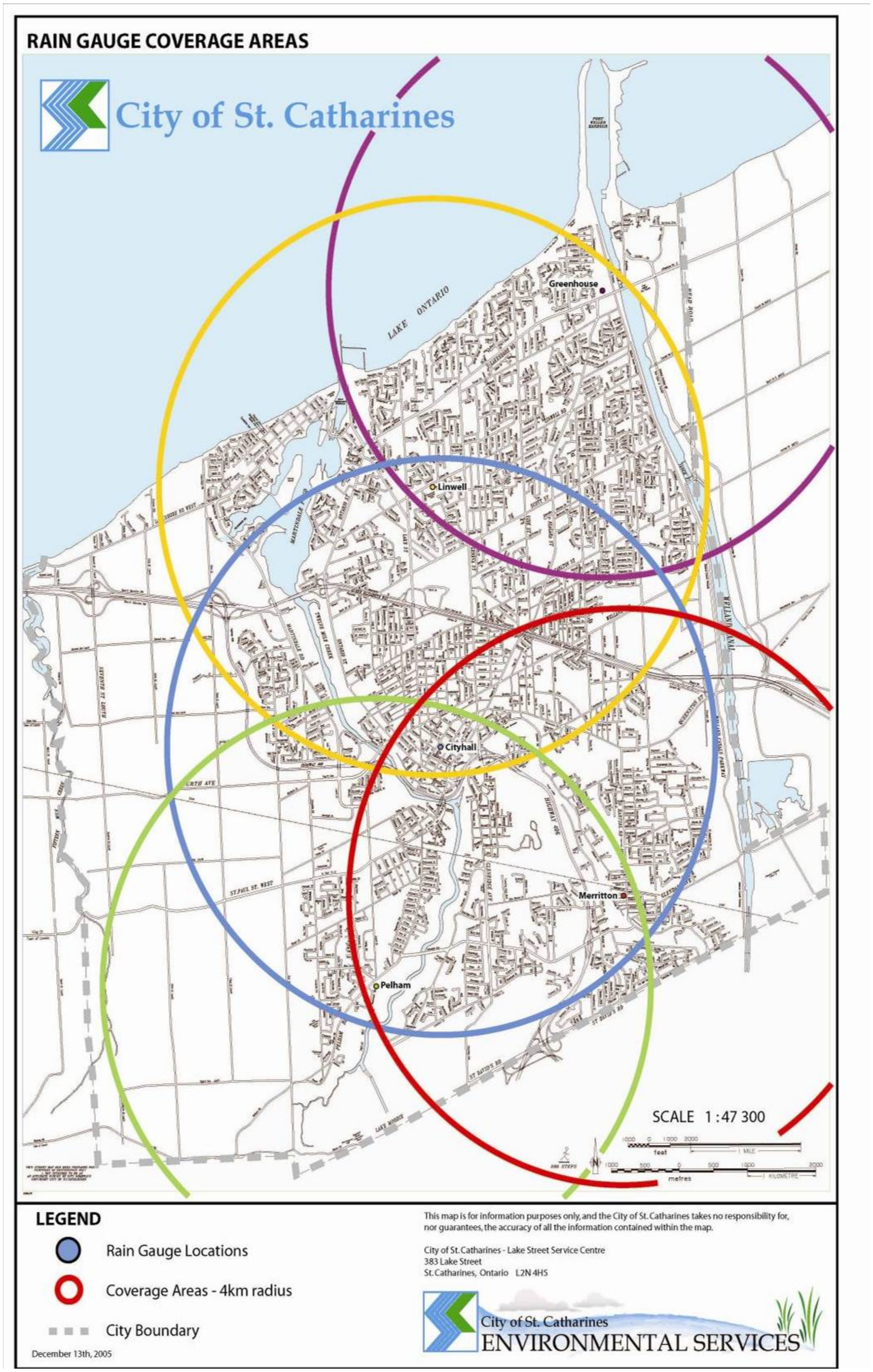
Port Dalhousie WWTP Average Daily Flow

Table 4.3 summarizes the average daily flows (ADF) at the Port Dalhousie WWTP from 2001 to 2006 obtained from the Region. The ADF for this time period was 42.9 MLD (496 L/s). The average flow for each year from 2001 to 2006 remained fairly constant at the Port Dalhousie WWTP. The highest average daily flow observed for a given month from 2001 to 2006 was 63.9 MLD (740 L/s) for the month of April 2004.

TABLE 4.3
Port Dalhousie WWTP Average Daily Flows (2001 to 2006)

Month	Average Flow (MLD)						Average (2001–06)
	2001	2002	2003	2004	2005	2006	
January	41.0	41.0	39.1	37.7	45.3	48.5	42.1
February	51.7	53.8	38.1	43.0	51.6	47.8	47.7
March	53.1	46.1	54.1	56.8	48.8	41.4	50.1
April	49.2	57.9	55.9	63.9	60.8	38.9	54.4
May	45.0	53.2	53.0	52.7	33.6	34.9	45.4
June	40.3	39.8	45.5	40.9	30.7	33.3	38.4
July	35.3	36.5	38.0	38.6	31.8	33.9	35.7
August	35.9	35.1	35.7	38.3	32.6	30.8	34.7
September	40.4	36.5	39.2	39.5	41.5	39.0	39.4
October	45.2	38.1	37.1	33.7	45.6	48.0	41.3
November	37.3	41.4	46.6	39.1	46.7	38.8	41.7
December	45.6	39.6	44.5	45.3	41.5	48.4	44.2
Average	**43.3**	**43.2**	**43.9**	**44.1**	**42.5**	**40.3**	**42.9**

FIGURE 4-2
Weather Stations



Port Weller WWTP Average Daily Flow

Table 4.4 summarizes the average daily flows at the Port Weller WWTP from 2001 to 2006 obtained from the Region. The average daily flow for this time period was 41.9 MLD (485 L/s). The average daily flow at the Port Weller WWTP also remained fairly constant for each year from 2001 to 2006. The highest average daily flow observed for a given month from 2001 to 2006 was 65.1 MLD (754 L/s) for the month of April 2004.

TABLE 4.4
Port Weller WWTP Average Daily Flows (2001 to 2006)

Month	Average Flow (MLD)						Average (2001–06)
	2001	2002	2003	2004	2005	2006	
January	39.7	42.3	37.1	35.8	58.3	52.1	44.2
February	49.5	54.5	34.1	43.2	53.7	50.0	47.5
March	50.1	45.6	55.0	60.1	49.0	41.8	50.3
April	44.8	55.3	54.0	65.1	62.3	37.0	53.1
May	38.8	51.5	49.6	53.7	33.7	33.8	43.5
June	35.3	35.8	43.8	39.1	31.2	32.0	36.2
July	29.8	32.2	36.2	37.9	30.5	31.7	33.1
August	31.0	33.3	32.4	35.6	31.3	28.3	32.0
September	36.0	33.9	35.8	37.8	41.3	38.0	37.1
October	44.2	33.3	33.9	28.9	47.1	52.1	39.9
November	36.4	38.4	45.8	35.4	55.6	39.5	41.9
December	44.7	36.5	44.9	47.0	43.7	49.6	44.4
Average	40.0	41.1	41.9	43.3	44.8	40.5	**41.9**

4.2.4 Dry Weather Flow Data Analysis

The performance of the Port Dalhousie WWTP and Port Weller WWTP sewersheds under dry weather conditions was determined by analyzing the flow monitoring results from each system. The analysis provides insight into areas that may be problematic and can also be used for comparison to current design standards.

Dry Weather Flow Analysis Approach

Dry weather flow (DWF) in the sanitary sewer is typically made up of domestic sanitary flow and dry weather infiltration (DWI). The average domestic flow per capita applied in sanitary sewer design is typically higher than actual to account for future conditions that may generate additional domestic flows such as redevelopment/renovation, or higher water consumption per capita. Buried sewer infrastructure typically has a life expectancy of 50 years to 100 years; thus the infrastructure must be designed to account for future uncertainties.

The recorded DWF from each flow monitoring station was analyzed and the average daily domestic DWF determined based on a defined approach. The dry weather base flow, typically occurring between 3:00 a.m. and 5:00 a.m., was measured from the monitoring data. During this early morning period, it is considered that 10% of the dry weather base flow is due to domestic flow and 90% of the flow is due to infiltration. The 10% domestic flow consideration is to account for flow that occurs due to toilet flushes, etc. during the

early morning time frame. From this calculation, the DWI into the sewer due to groundwater condition is determined. The monitored dry weather flow (DWF) volume for the day minus the dry weather infiltration (DWI) volume for the day is equal to the average daily domestic DWF.

The average daily domestic DWF per capita was calculated for each flow monitoring area. The MOE guidelines for sanitary sewer design are 225 to 450 litres per capita per day (Lpcd). Areas that exhibit high domestic DWF per capita can be a result of increased residential, commercial, or industrial water usage.

The DWI determined for each flow monitor can be compared to the MOE design standard of 0.14 to 0.28 L/s/ha to identify areas with significant infiltration into the sanitary system.

Port Dalhousie Sewershed Analysis

To determine the average DWF for Port Dalhousie the performance of the Port Dalhousie sewershed was analyzed using flow monitoring data from the selected dry weather flow period of May 19 to May 26, 2005. The Lighthouse flow meter captures the majority of the Port Dalhousie sewershed flow. However, further analysis of the other flow monitoring data revealed that the average daily flow at the Lighthouse monitor was less than the sum of the average flows at the Meadowvale, Gladman, and Lakeport flow monitors, which are all upstream of the Lighthouse flow monitor. These three monitors do not capture the flow from the entire Port Dalhousie sewershed. In order to represent the flow from the entire Port Dalhousie sewershed additional dry weather flow would need to be included to the existing dry weather flow. An additional unmonitored dry weather flow (45 L/s) was added to the sewershed calculation to ensure the summation of the flow monitoring data was equal to the daily flow recorded at the Port Dalhousie WWTP. The flow recorded at the Port Dalhousie WWTP is a totalized daily flow and therefore is useful for comparison of the flows but cannot be used to calculate the domestic dry weather flow or the dry weather infiltration.

The average monitored dry weather flow for the Port Dalhousie system is summarized below:

- Average monitored DWF at Meadowvale, Gladman, Lakeport flow monitors (266.14 + 35.63 + 9.61 = 311 L/s)
- Additional DWF for unmonitored areas (45 L/s)
- Average DWF for Port Dalhousie system (311+ 45 = 356 L/s)

The average monitored dry weather flow of 356 L/s (30.8 MLD) for the Port Dalhousie system was then consistent with the total daily flow collected at the Port Dalhousie WWTP for the same period.

The dry weather base flow and dry weather infiltration values for the Port Dalhousie system were determined from the early morning flow monitoring data and are summarized below:

- Average monitored dry weather base flow at Meadowvale, Gladman, Lakeport (166.81 + 11.64 + 3.19 = 182 L/s, or 58.5% of 311 L/s)
- Additional base flow for unmonitored areas (0.585 * 45 = 26 L/s)
- Average dry weather base flow for Port Dalhousie (182 + 26 = 208 L/s)

- Average Dry Weather Infiltration (DWI) for Port Dalhousie (0.9 * 208 = 187 L/s)
- Average DWI Rate for Port Dalhousie (187 L/s ÷ 2628.5 ha = 0.07 L/s/ha)

The average DWI rate of 0.07 L/s/ha is less than the MOE design rate of 0.14 to 0.28 L/s/ha. It should be noted that the infiltration rates were calculated using data from 2005 which could be classified as having a dry summer condition. The groundwater table is lower in the summer and there is typically less groundwater infiltration, and it is unknown whether 2005 was a typical year so the antecedent condition may or may not be typical.

The average domestic flow for the Port Dalhousie system was calculated as shown:

- Average domestic flow for Port Dalhousie (356 – 187 = 169 L/s)
- Average domestic flow per capita for Port Dalhousie (169 L/s * 86400 s/d ÷ 70,758[1] ppl = 206 Lpcd)

The average domestic flow per capita of 206 Lpcd is slightly below MOE design criteria of 225 to 450 Lpcd. The MOE design water consumption rates include safety factors and are generally higher than the actual flow per capita seen in the system.

For comparison purposes, the 2006 Port Dalhousie CSO Study, based on flow data collected from 1999-2001, found an average dry weather flow for the system of 38.0 MLD (440 L/s). The average DWI during this time was found to be 134 L/s. The average domestic dry weather flow per capita was found to be 380 Lpcd. It should be noted that the 2006 Port Dalhousie CSO study used an assumption of DWI = 80% of the lowest baseflow, with the remaining flow representing the average domestic dry weather flow.

The dry weather flow data was also summarized for each flow monitor. The average dry weather infiltration rate ranged from 0.015 to 0.145 L/s/ha while the average DWF per capita ranged from 118 to 502 Lpcd. A summary of the flow data of the analysis results is presented in Table 4.5.

Port Weller Sewershed Analysis

The performance of the Port Weller sewershed was analyzed using flow monitoring data from the selected dry weather flow period of May 19 to May 26, 2005. The Cumberland flow meter captures the majority of the Port Weller sewershed flow. Flow data was not available at the Cumberland flow monitor for the selected dry weather period. Therefore, the sum of the Tamarak, Omara, Lockview, and Niagara Street flow monitors was used to represent the flow from the Port Weller sewershed. These four monitors do not capture the flow from the entire Port Weller sewershed. In order to represent the flow from the entire Port Weller sewershed additional unmonitored dry weather flow (45 L/s) was added to the sewershed calculation to ensure the summation of the flow monitoring data was equal to the daily flow recorded at the Port Weller WWTP. The flow recorded at the Port Weller WWTP is a totalized daily flow and therefore is useful for comparison of the flows but can not be used to calculate the domestic dry weather flow of the dry weather infiltration to the flow data based on existing dry weather flow in the model.

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[1] 2001 Population data was used since the flow data analyzed was from 2003 to 2005. The 2006 Census data shows a 2.2% increase in population for St. Catharines and a 4.9% increase in population in Thorold. This population increase would slightly decrease the flow per capita.

The average monitored dry weather flow for the Port Weller system is summarized below:

- Average monitored DWF at Tamarak, Omara, Lockview, Niagara St flow monitors (218.91 + 73.00 + 55.28 + 32.92 = 380 L/s)
- Additional DWF for unmonitored areas (45 L/s)[2]
- Average DWF for Port Weller system (380+ 45 = 425 L/s)

The average monitored dry weather flow of 425 L/s (36.7 MLD) for the Port Weller system was consistent with the total daily flow collected at the Port Weller WWTP for the same period.

The total base flow and dry weather infiltration for the Port Weller system was determined from the early morning flow monitoring data and is summarized below:

- Average monitored dry weather base flow at Tamarak, Omara, Lockview, Niagara St. (143.69 + 44.28 + 22.47 + 16.28 = 227 L/s, or 59.7% of 380 L/s)
- Additional base flow for unmonitored areas (0.597 * 45 = 27 L/s)
- Average dry weather base flow for Port Weller (227 + 27 = 254 L/s)
- Average Dry Weather Infiltration (DWI) for Port Weller (0.9 * 254 = 229 L/s)
- Average DWI Rate for Port Weller (229 L/s ÷ 3519.7 ha = 0.07 L/s/ha)

The infiltration rate was calculated to be 0.07 L/sec/ha which is similar to the Port Dalhousie system and is well below MOE design guidelines.

The average domestic flow for the Port Weller system was calculated as shown:

- Average domestic flow for Port Weller (425 – 229 = 196 L/s)
- Average domestic flow per capita for Port Weller (196 L/s * 86400 s/d ÷ 80,127[3] ppl = 211 Lpcd)

The average domestic flow per capita was found to be 211 Lpcd, which is similar to the Port Dalhousie system and is slightly below MOE design criteria of 225 to 450 Lpcd.

For comparison purposes, the 1999 Port Weller Trunk Sewer Analysis – Phase 2, the Port Weller system was summarized as having a total measured DWF of 56.4 MLD (653 L/sec). The average domestic dry weather rate per capita was from this study was recorded as 448 Lpcd, and the average infiltration rate 0.13 L/sec/ha. From the results of the current study, the average dry weather flow at the Port Weller WWTP has decreased significantly since the 1999 study.

The average flow per capita was also calculated for each flow monitor and ranged from 55 to 300 Lpcd based on the selected dry weather flow from 2005. A summary of the analysis results for the Port Weller sewershed is summarized in Table 4.5.

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[2] The additional dry weather flow value for Port Weller and Port Dalhousie are the same (45;L/s) but there is no connection between the two value, it is only a coincident.

[3] 2001 Population data was used since the flow data analyzed was from 2003 to 2005. The 2006 Census data shows a 2.2% increase in population for St. Catharines and a 4.9% increase in population in Thorold. This population increase would slightly decrease the flow per capita.

TABLE 4.5
Dry Weather Flow Calibration Summary

Sewershed	Flow Monitor	Monitor Name	Location	Area (ha)	Estimated Population	Dry Weather Flow Monitoring Period	Monitored Average Dry Weather Flow (L/s)	Monitored Average DWF Base Flow (L/s)	Monitored Average DWF Infiltration (L/s)	Monitored Domestic DWF (L/s)	Monitored Dry Weather Infiltration Rates (L/s/ha)	Monitored Average DWF per Capita Lpcd
Port Dalhousie	S01	Lakeport	Lakeport Road	43	1160	May 19 – May 25, 2005	9.61	3.19	2.87	6.74	0.067	502
	S05	Page St.	South of Welland Avenue/Page Street intersection	103	2765	Apr 8 – Apr 11, 2004 Apr 15 – Apr 17, 2005	24.61	16.57	14.91	9.70	0.145	303
	3	Lighthouse	Lighthouse Road	2426	65312	May 19 – May 25, 2005	231.31	105.23	94.71	136.60	0.039	181
	4	Gladman	Gladman Avenue	682	18365	May 19 – May 25, 2005	35.63	11.64	10.48	25.15	0.015	118
	5	Meadowvale	Meadowvale Drive	1969	53010	May 19 – May 25, 2005	266.14	166.81	150.13	116.01	0.076	189
	Port Dalhousie Sewershed[1]			**2629**	**70758**	**May 19 – May 25, 2005**	**356**	**208**	**187**	**169**	**0.07**	**206**
Port Weller	S02	Sunnylea CNR	Easement east of Apollo Court	1728	39341	May 19 – May 25, 2005	92.88	49.43	44.49	48.39	0.026	106
	S03	Niagara St.	Niagara Street, south of Parnell Road	206	4694	May 19 – May 25, 2005	32.92	16.28	14.65	18.27	0.071	336
	S04	Park Ave.	End of Park Avenue	32	717	May 17 – May 23, 2005	1.74	1.37	1.23	0.51	0.039	61
	10	Cumberland	Cumberland Street	3360	80127	Apr 26 – May 02, 2005	260.63	145.52	130.97	129.66	0.039	140
	11	Omara	Omara/Lakeshore Road	600	13659	May 19 – May 25, 2005	73.00	44.28	39.85	33.15	0.066	210
	13	Lockview	Lockview/Goldsmith Avenue	479	10905	Apr 26 – May 02, 2005	55.28	22.47	20.23	35.05	0.042	278
	14	Tamarak	Tamarak/CNR Right-of-Way	1970	44857	May 19 – May 25, 2005	218.91	143.69	129.32	89.59	0.066	173
	15	Petrie	Petrie Street	1545	35177	May 19 – May 25, 2005	127.56	72.47	65.23	62.33	0.042	153
	16	John	John Street	739	10569	May 19 – May 25, 2005	60.30	33.31	29.98	30.32	0.041	248
	Port Weller Sewershed[2]			**3520**	**80127**	**May 19 – May 25, 2005**	**425**	**254**	**229**	**196**	**0.07**	**211**

[1] Port Dalhousie Sewershed results based on Lighthouse, Gladman, and Meadowvale flow monitors, plus an additional 45 L/s DWF allowance for unmonitored areas

[2] Port Weller Sewershed results based on Tamarak, Omara, Lockview, and Niagara St flow monitors, plus an additional 45 L/s DWF allowance for unmonitored areas

4.2.5 Wet Weather Data Analysis

Wet weather flow is comprised of inflow and infiltration that enters the sanitary/combined sewer system due to precipitation. The shape of the wet weather hydrograph obtained from the flow monitors provides significant evidence as to whether the source of the extraneous flow is the result of inflow or infiltration.

Rainfall Analysis

To calibrate the hydrologic model, storm events were selected for analysis from January 2004 until December 2006. A total of 26 storms qualified based on the first selection criteria of storm events whose total precipitation was greater than 25 mm. Flash storms (duration less than two hours) and extended low intensity storms (approximately 25 mm rainfall and duration greater than 36 hours) were discarded. These selection criteria resulted in eight storm events that were suitable for analysis. Table 4.6 provides a summary of all of the rainfall events, their duration and total accumulated rainfall that occurred for our selected time frame.

TABLE 4.6
Summary of Storm Events

Storm Event	Start		End		Duration†	Depth† (mm)
	Date	Time	Date	Time		
1	May 22, 2004	20:20	May 24, 2004	6:20	34:05	31
2	July 30, 2004	12:50	July 31, 2004	10:50	22:05	57.5
3	Sept. 8, 2004	17:20	Sept. 9, 2004	12:30	19:15	74.25
4	Aug. 30, 2005	19:50	Aug. 31, 2005	9:05	13:20	64.5
5	Sept. 25, 2005	19:40	Sept. 26, 2005	14:10	14:35	29.25
6	June 27, 2006	0:35	June 27, 2006	10:50	10:20	36.5
7	Sept. 2, 2006	9:05	Sept. 3, 2006	19:50	10:50	34.5
8	Oct. 11, 2006	1:55	Oct. 12, 2006	6:50	29:00	34.5

† Rainfall from Linwell weather station used as a basis for the comparison.

The storm events recorded during the study were plotted on the Intensity Duration Frequency (IDF) curves for the City of St. Catharines. A sample plot for the September 25 to 26, 2005 storm event can be seen in Figure 4-3 along with the St. Catharines IDF curves. Table 4.7 summarizes the return period for each storm event at each precipitation station.

FIGURE 4-3
Sample IDF Curve

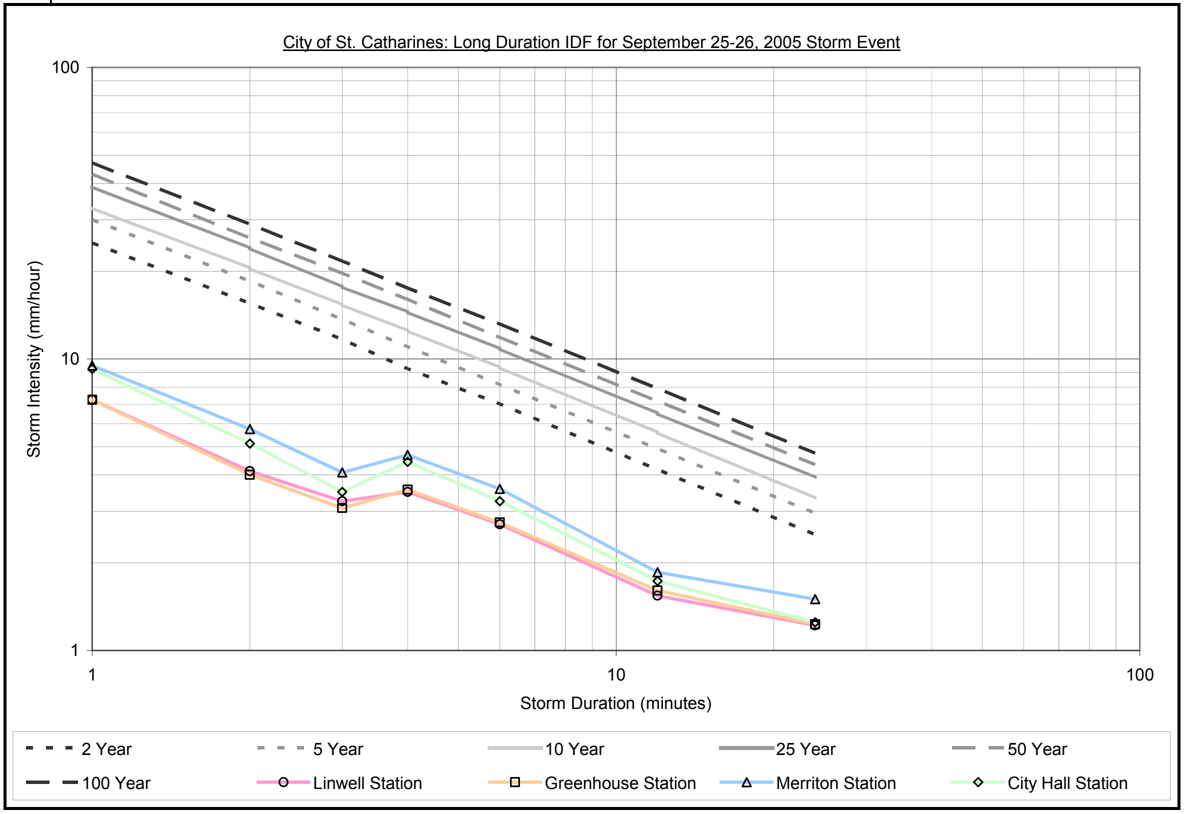


TABLE 4.7
Storm Event Return Periods

Precipitation Station	Storm Event Data							
	May 22 – 24, 2004	July 30 – 31, 2004	Sept 8 – 9, 2004	Aug 30 – 31, 2005	Sept 25 – 26, 2005	June 27, 2006	Sept 2 – 3, 2006	Oct 11 – 12, 2006
Linwell	Below 2-yr. event	2-yr	10-yr	10-yr	Below 2-yr. event	Below 2-yr. event	Below 2-yr. event	Below 2-yr. event
Greenhouse	Below 2-yr. event	No data	10-yr	10-yr	Below 2-yr. event	2-yr	Below 2-yr. event	No data
Merriton	Below 2-yr. event	Below 2-yr. event	25-yr	50-yr	Below 2-yr. event	Below 2-yr. event	Below 2-yr. event	Below 2-yr. event
City Hall	Below 2-yr. event	Below 2-yr. event	No data	10-yr	Below 2-yr. event	No data	Below 2-yr. event	Below 2-yr. event

Wet Weather Flow Data Analysis

The analysis and calibration of the wet weather flow model utilized the five flow monitoring stations maintained by the City. The nine Regional flow monitoring stations were used primarily for verifying the wet weather flow model. This methodology was adopted based on scheduling constraints and data availability. Flow data was compiled from each of the five monitoring stations during the wet weather events. The flow data was

compared to the rainfall hyetograph for each storm to ensure a proper response had occurred. Table 4.8 outlines whether data recorded at the flow monitoring stations was not available, good, or unreliable for each of the eight storm events.

TABLE 4.8
Summary of Flow Monitoring Data by Storm Events

Storm Event	Dates	Flow Monitoring Station				
		S01 Lakeport Rd.	**S02 Sunnylea**	**S03 Niagara St.**	**S04 Park Rd.**	**S05 Page St.**
Corresponding Weather Station		Linwell	Linwell	Greenhouse	Merritton	City Hall
1	May 22-24, 2004	√	√	√	√	√
2	July 30-31, 2004	√	√	-	√	√
3	Sept. 8-9, 2004	√	√	√	√	-
4	Aug. 30-31, 2005	√	√	√	√	√
5	Sept. 25-26, 2005	√	√	√	√	√
6	June 27, 2006	√	√	√	√	-
7	Sept. 2-3, 2006	√	√	√	√	√
8	Oct. 11-12, 2006	√	√	-	√	√

Legend:

-	No data available for this date
√	Good data with noticeable response
X	Unreliable data

The following four storm events having total precipitation as shown below were selected for analysis based on the size of the storm event as well as the accuracy of the flow monitoring data recorded.

- May 22, 2004 (31 mm)
- August 30, 2005 (64.5 mm)
- September 25, 2005 (29.25 mm)
- September 2, 2006 (34.5 mm)

4.2.6 Model Calibration

After an analysis of the dry weather flow and wet weather flow data was completed, the models were calibrated to match the observed flows.

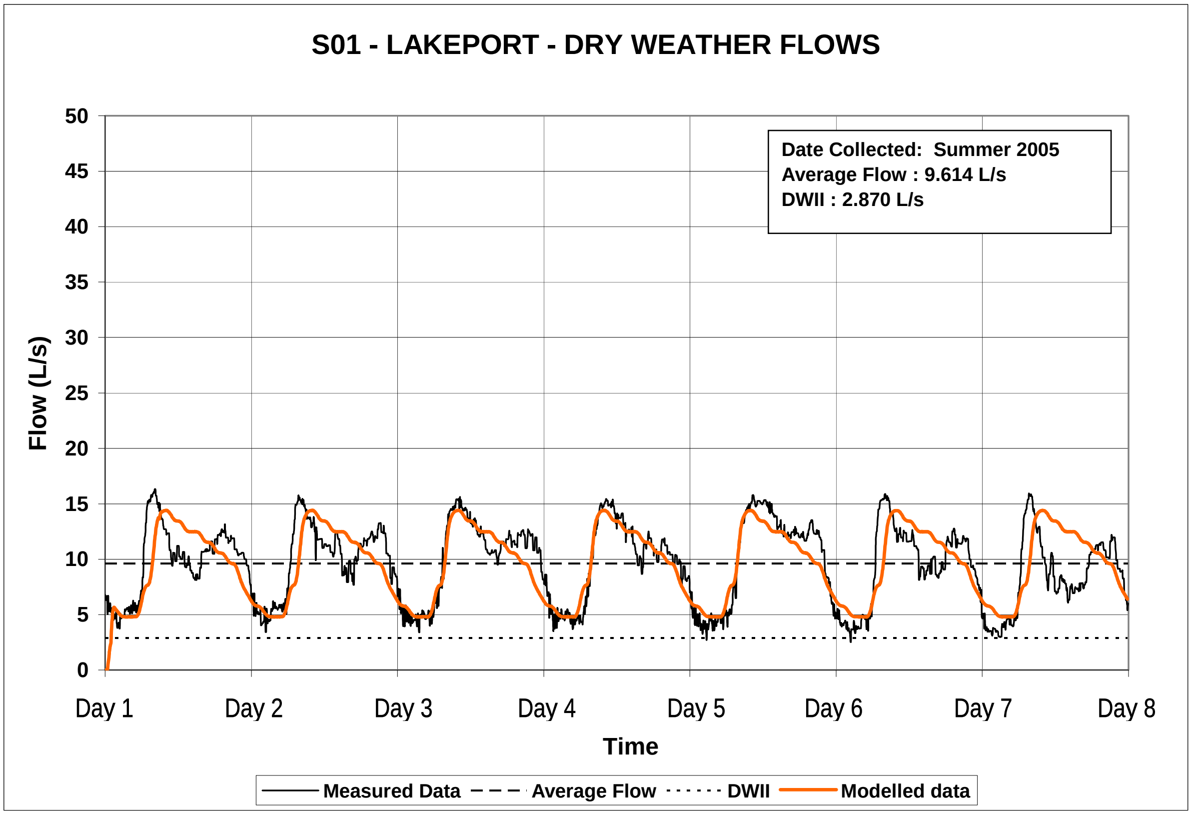
Dry Weather Flow Calibration

Typical dry weather flow hydrographs were created from the flow monitoring data to develop a baseline flow for the system. Dry weather was defined by a 24-hour period, starting at midnight in which there was no rainfall. There also had to be 6 to 12 hours, ideally without or only minimal rainfall prior to the midnight start. Minimal rainfall was considered as a trace or less than 2 mm of rainfall. The days were also separated into weekdays and weekends since residential areas generally have increased sanitary sewer flow on the weekends while industrial or commercial areas will see a decrease in flow. A sample dry weather flow hydrograph is shown in Figure 4-4. To plot seven days of dry

weather flow with a consist pattern for analysis; data was compiled from days that were not necessarily sequential. The season that the data was collected is noted on Figure 4-4 with a general timescale in the x-axis.

The dry weather flow used for previous studies was originally developed using water consumption data. Flow monitoring data has then been used in previous studies to verify and calibrate the flow rates. For the purpose of this study, the City flow monitors were used to calibrate specific areas of concern within the system. The Regional flow monitors were used to verify and calibrate the flow across the two collection areas.

FIGURE 4-4
Sample DWF Calibration Plot



The data from each flow monitor was compared to upstream and downstream flow monitoring where available to ensure accuracy of the data. Plots of the flow monitoring data were then compared to the simulated model results and the dry weather flow adjusted to match the flow monitoring data. The calibration plots for each of the flow monitoring stations are included in Appendix G and compare the dry weather flow monitored to the model simulated dry weather flow. Table 4.9 summarizes the changes that were made to the DWF model in this calibration process at the corresponding flow monitoring station.

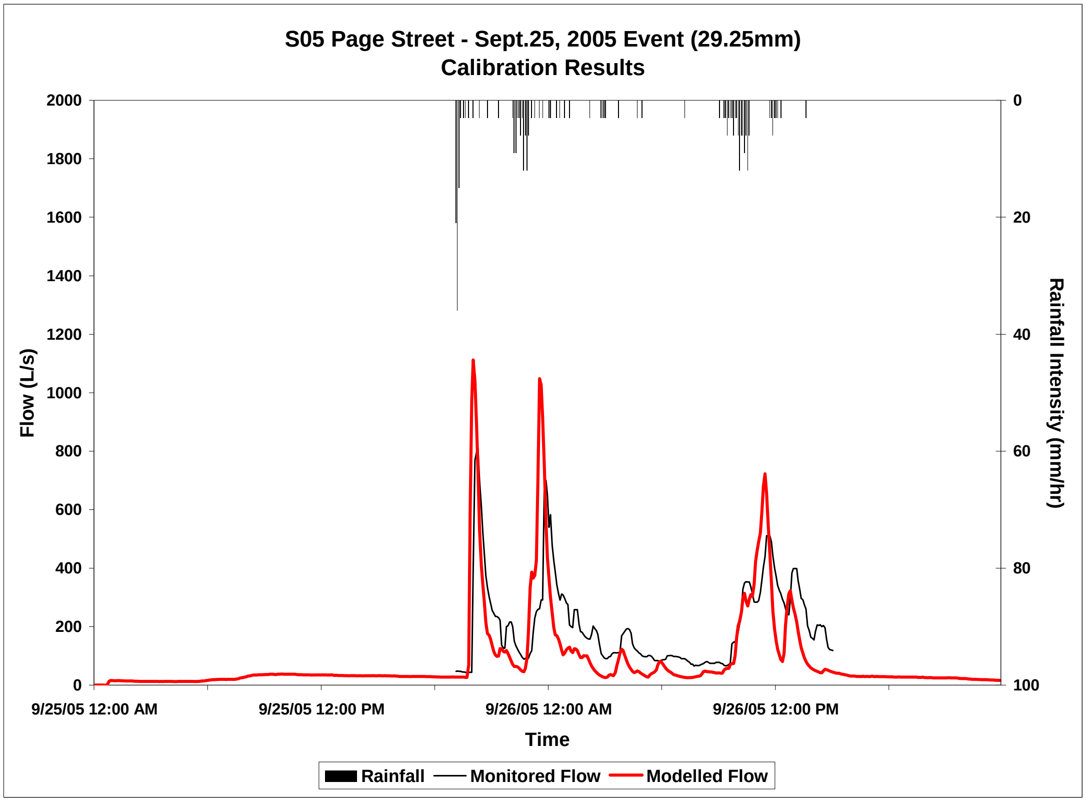
TABLE 4.9
Dry Weather Flow Calibration Summary

Sewershed	Site Number	Description	Calibration Results
Port Dalhousie	S01	Lakeport	Flow decreased from 14.4 L/s to 9.6 L/s
	$S0_5$	Page St.	Flow increased from 19.7 L/s to 24.2 L/s
	3	Lighthouse	Flow decreased due to Gladman, Meadowvale
	4	Gladman	Flow decreased from 78.6 L/s to 43.7 L/s
	5	Meadowvale	Flow decreased from 420 L/s to 310 L/s
Port Weller	SO_2	Sunnylea	Flow data questionable, decreased due to Petrie
	SO_3	Niagara St.	Flow increased from 18.8 L/s to 35.3 L/s
	SO_4	Park Road	No change, good comparison
	10	Cumberland	Flow decreased due to Petrie
	11	Omara	No change, flow controlled by upstream PS
	13	Lockview	Flow at Glendale Siphon adjusted to 17 L/s
	14	Tamarak	Flow decreased due to Petrie, good comparison
	15	Petrie	Flow decreased from 148.9 L/s to 127.6 L/s
	16	John	Flow decreased due to Petrie, good comparison

Wet Weather Flow Calibration

Wet weather flow hydrographs were created for each flow monitor with the monitored data during each of the three storm events. The flow monitoring data that the City of St. Catharines and Region collected was checked for quality and mass balance continuity relative to their locations. Flow monitors that exhibited poor or missing flow monitoring data during the storm events were not used during the calibration process. The measured data was also compared with rainfall data for the associated rainfall gauge to check for proper response to the storm event. A sample wet weather hydrograph showing the rainfall event and the comparison between the monitoring and the simulated model flow is presented in Figure 4-5.

FIGURE 4-5
Sample WWF Calibration Plot



Flow volumes, peak flows, and the hydrograph shape were all considered during calibration. The volumes generated by the model were the most important factor during calibration with a target of +/- 10% of the monitored volumes. The September 25, 2005 event was the primary storm event used during the calibration since it exhibited characteristics similar to the storm events found in the typical year analysis. Hydrographs of the remaining storms were generated and analyzed as a verification of the wet weather flow calibration.

Parameters such as percent impervious and infiltration rate were evaluated and adjusted for the subcatchments upstream of each flow monitor during calibration. The other parameters primarily reflect the physical characteristics of the subcatchments developed previously and therefore were not adjusted. A technical memorandum summarizing the hydrologic parameter development and revision has been included in Appendix G. Scatter plots for each storm event illustrating the variance of the simulated flow volumes to the monitored flow volumes are presented in Appendix G. In general, the modelled flow versus the measured flow hydrographs have comparable peak flows. However, the total flow volume for a number of monitoring locations was not as easily replicated. This is a constraint of the modelling software as it does not breakdown the hydrologic response experience due to inflow and slow and fast infiltration in the system but lumps this response together in one variable. Therefore, if you calibrate to the peak inflow, this can compromise the calibration with respect to volume. The comparison hydrographs of the monitored versus modelled flow at each flow monitor are presented in Appendix G. Table 4.10 summarizes the changes that were made to the model in the calibration processes.

TABLE 4.10
Wet Weather Flow Calibration Summary

Sewershed	Site Number	Description	Calibration Results
Port Dalhousie	$S0_1$	Lakeport	Decreased WWF
	$S0_5$	Page St.	Increased WWF
	3	Lighthouse	No change
	4	Gladman	No change
	5	Meadowvale	No change
Port Weller	SO_2	Sunnylea	Flow data questionable
	SO_3	Niagara St.	No change – peak flows comparable
	SO_4	Park Road	No change – good comparison
	10	Cumberland	No change
	11	Omara	No change
	13	Lockview	No change
	14	Tamarak	No change – peak flows comparable
	15	Petrie	No change – peak flows comparable
	16	John	No change

The Port Weller model did not require any changes to be made to the wet weather flow model. The Sunnylea flow monitor ($S0_2$) could not be used in the calibration processes as the flow monitoring data was questionable. The remaining City monitors showed good correlation with the measured data.

The Port Dalhousie model also did not have significant changes made to the wet weather flow model. However, if you compare the monitored flow to the model flow the flows in the model are conservative. To achieve a good correlation between the model and the monitored flow in the Port Dalhousie model the wet weather flow needed to be significantly reduced. The flow monitors in the Port Dalhousie model were located at the downstream end of the system therefore a reduction would have had to be applied uniformly to the entire upstream area. This did not seem like a logical approach since there have not been any significant changes in these areas that would justify this dramatic change in the wet weather flow contribution. The lower flows at the downstream flow monitors during wet weather could be attributed to changes in the upstream system. A detailed inspection of all the CSO structures coded in the model was performed by the City of St. Catharines in the late 1990s. If there has been a change to the any of the upstream overflows that has not been accounted for in the model this could result in reduced flow measured at the downstream flow monitors. Since a reduction in the wet weather flow of this magnitude would significantly reduce the CSO volumes simulated in the model the decision was to not change the wet weather flow parameters in the model. The wet weather flow model for the Port Dalhousie sewershed is considered to be a conservative estimate of the wet weather flow system.

4.3 System Modelling Results

After calibrations of the models were completed, several model scenarios were run to assess hydraulic capacity and freeboard concerns within the system.

4.3.1 Existing System

The existing system was evaluated under dry weather flow conditions to determine areas with hydraulic capacity concerns. The model also confirmed that there are no overflows occurring within either sewershed under dry weather conditions.

The hydraulic capacity results are presented in Figure 4-6. The results graphically show the ratio of maximum flow in the pipe to the pipe capacity that would be expected in the existing sewer system during dry weather flow. A maximum capacity ratio less than 1.0 indicates that the pipe has capacity to convey additional flow. A ratio greater than 1.0 indicates that the pipe is operating under surcharge conditions. The graphical display of the hydraulic gradeline (HGL) below ground, or freeboard was also calculated under DWF conditions to determine areas with increased risk of basement flooding. Basements are typically 1.8 m (6 feet) deep and therefore for evaluation purposes if the HGL is 1.8 m deep or greater the potential for basement flooding is less than if the HGL is less than 1.8 m below the ground surface. The DWF freeboard results for the existing system during dry weather flow conditions are presented in Figure 4-7.

As illustrated in Figure 4-6 there are no hydraulic capacity constraints in the existing system for current dry weather flow. Figure 4-7 illustrates a number of areas that show the hydraulic gradeline to be less than 1.8 m below the ground surface. These areas were investigated and are a result of shallow invert depths in the system. These areas are not under an increased risk of flooding during dry weather flow but the local sewer depth is shallow. The areas contain topographic challenges that cannot be alleviated by increasing sewer capacity.

To simulate the average year wet weather flow conditions an average year storm with a return period of one year was used to identify areas of concern during typical wet weather flow conditions. Plots of the hydraulic constraints and freeboard are shown in Figures 4-8 and Figure 4-9, respectively. Again, Figure 4-9 shows the freeboard level which can indicate an elevated risk of flooding during the average year storm but, as in Figure 4-7, there are a number of areas that already have relatively shallow sewers, these areas were further investigated to determine the actual risk of flooding.

FIGURE 4-6
Hydraulic Capacity – Dry Weather Flow (Existing Conditions)

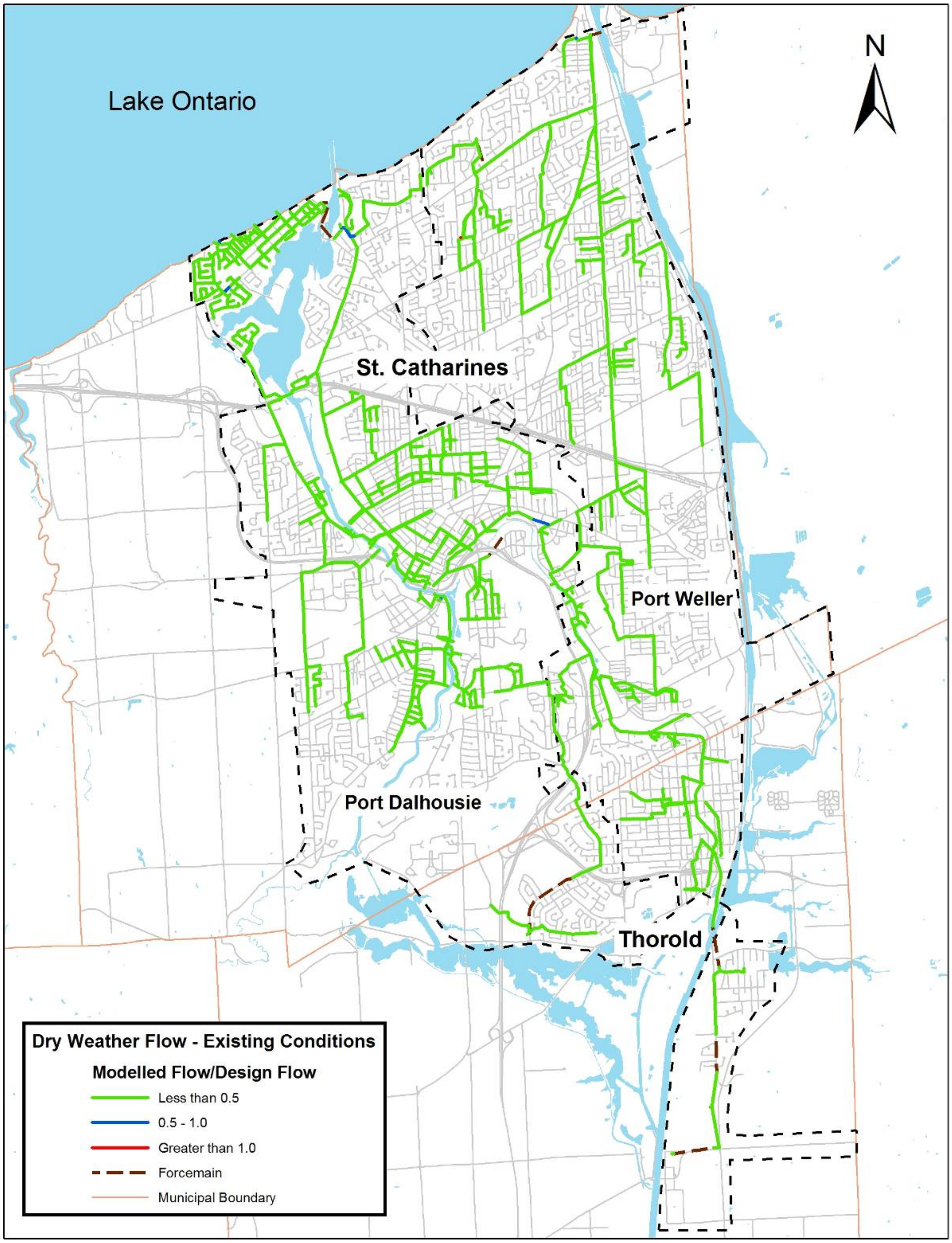


FIGURE 4-7
Freeboard – Dry Weather Flow (Existing Conditions)

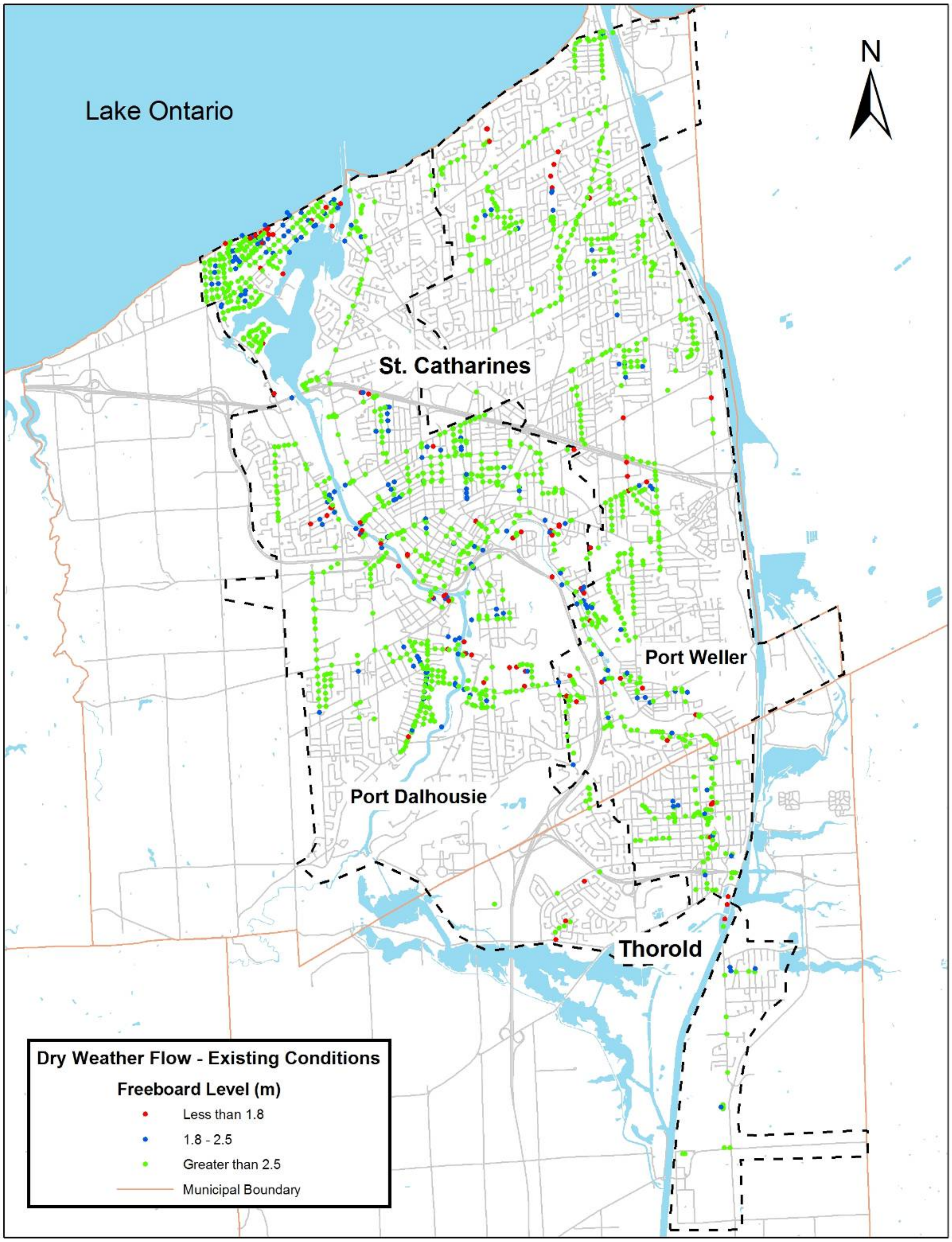


FIGURE 4-8
Hydraulic Capacity – Average Year Storm (Existing Conditions)

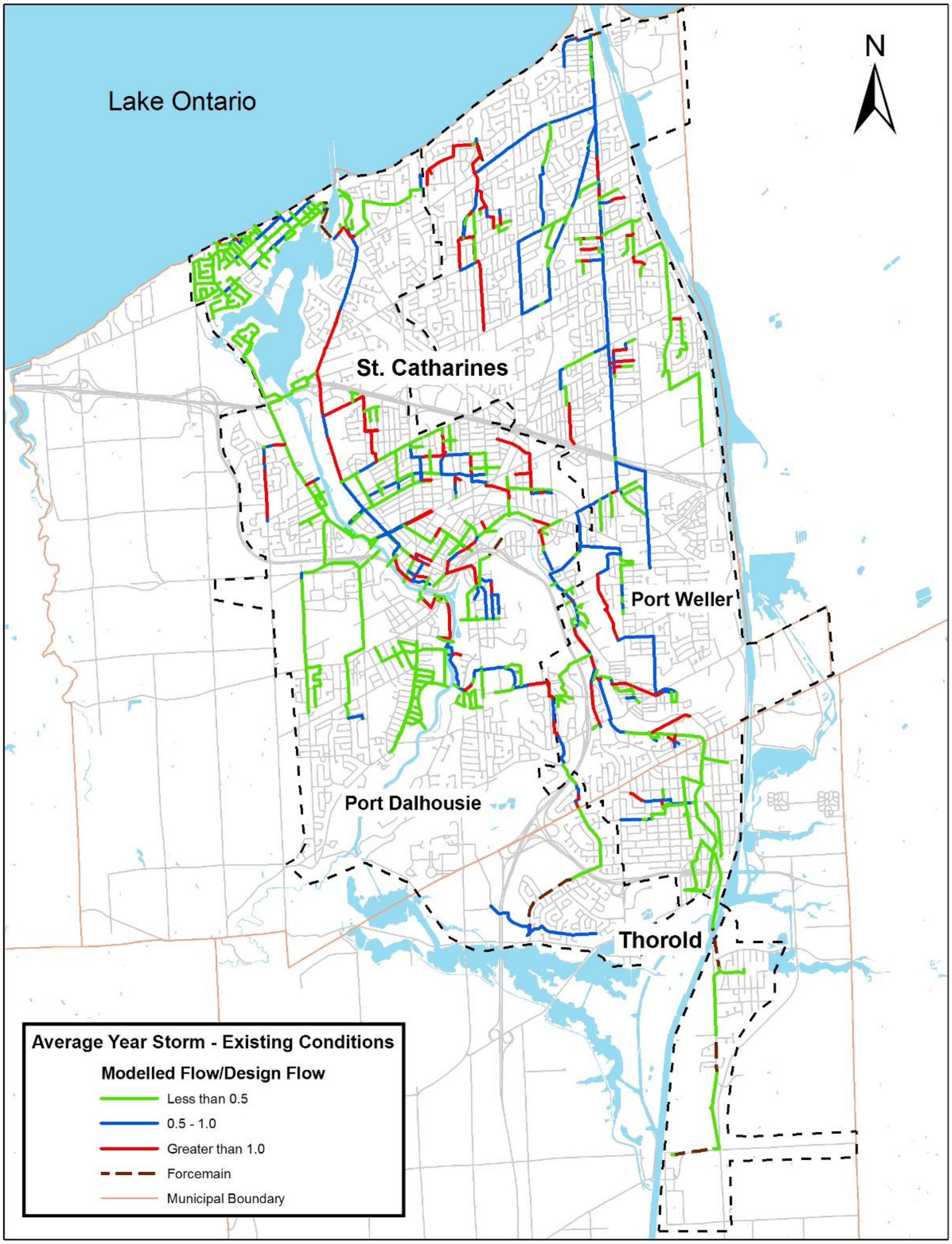
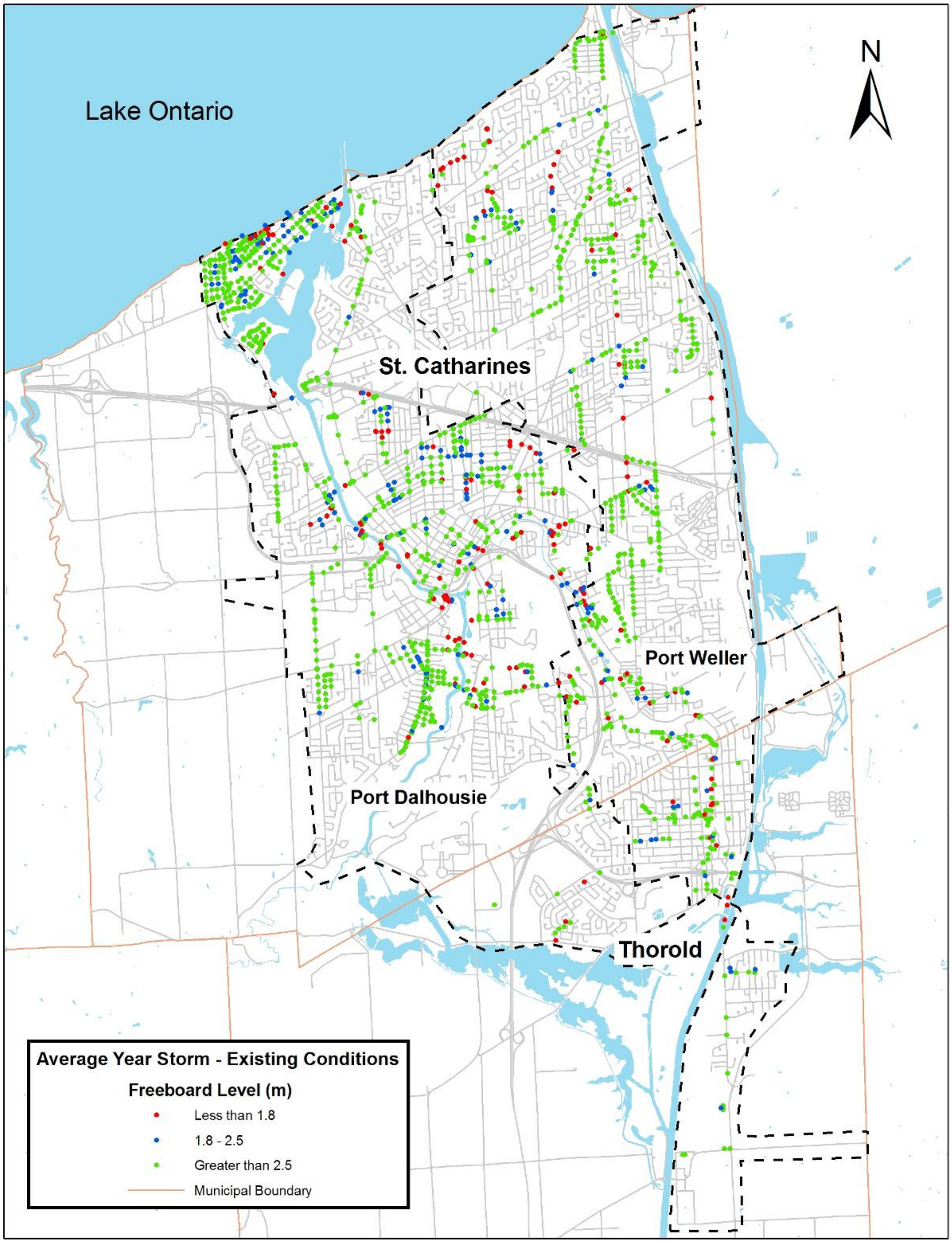


FIGURE 4-9
Freeboard – Average Year Storm (Existing Conditions)



Capacity Improvements

During the average year storm, several pipes within both the Port Dalhousie sewershed and the Port Weller sewershed run at full capacity, as illustrated in Figure 4-8. These areas were investigated for risk of basement flooding using Figure 4-9 as reference.

St. Catharines. The following areas were identified as potentially having basement flooding concerns during the average year storm:

- Manning and Fitzgerald Street (Port Dalhousie sewershed)
- Shoreline Drive (Port Weller sewershed)

City of St. Catharines staff cross referenced the above locations with basement flooding records and FLAP participation. The areas noted did not appear to undergo flooding during recent wet weather events. It is recommended that flooding concerns within the City continue to be addressed as part of the FLAP program. Areas with multiple FLAP applications or complaints should be examined for targeting a reduction of wet weather in the system.

The remaining areas that display capacity constraints during the average year storm do not appear to pose an increased risk of basement flooding.

Thorold. The limitations of the model for the area of Thorold have been noted. Based on the current information available it was not possible to determine, through the model, potential areas with capacity constraints. Through discussions with staff from the City of Thorold, it was indicated that capacity constraints can be found upstream of the Peel Street Pump Station within the Port Weller sewershed. Although recent upgrades were made to this pump station, basement flooding still occurs upstream of the station during wet weather periods, indicating impact from wet weather influence. The City of Thorold has been conducting an investigation program of the upstream area enforcing the disconnection of illegally connected sumps from the sanitary system.

It was also noted that constraints exist downstream of the Peel St. Pump Station, restricting conveyance of additional flows downstream. It was indicated that infrastructure contributing to this constraint are a forcemain under the Welland Canal and the Regional trunk main.

Results from the two-year and five-year design storms are presented in Figures 4-10 to 4-13. It must be remembered when viewing these figures, however, that the model results indicated in the figures are not complete for Thorold and that these results were not used to address capacity constraints and are included only for reference.

FIGURE 4-10
Hydraulic Capacity – Two-Year Storm (Existing Conditions)

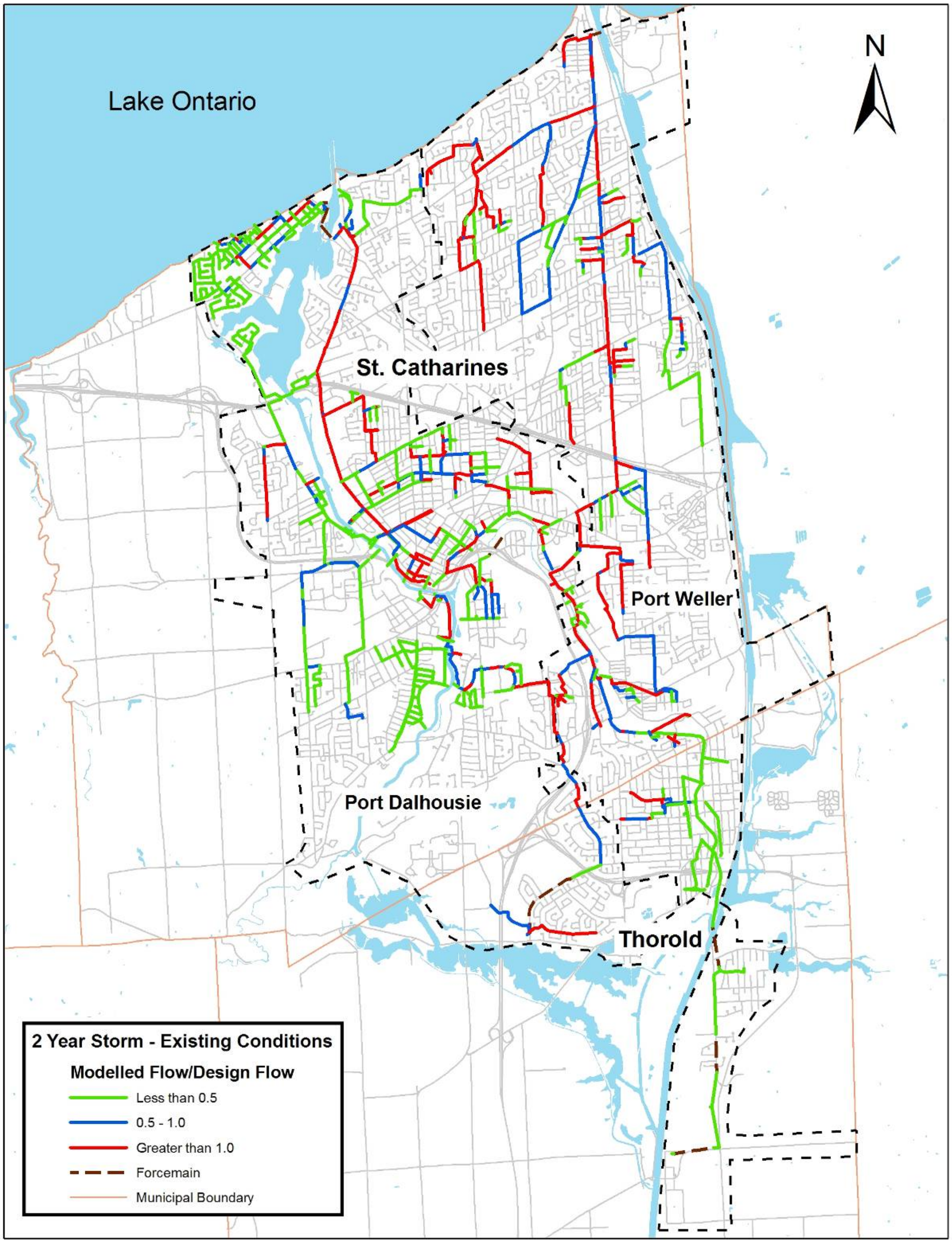


FIGURE 4-11
Freeboard – Two-Year Storm (Existing Conditions)

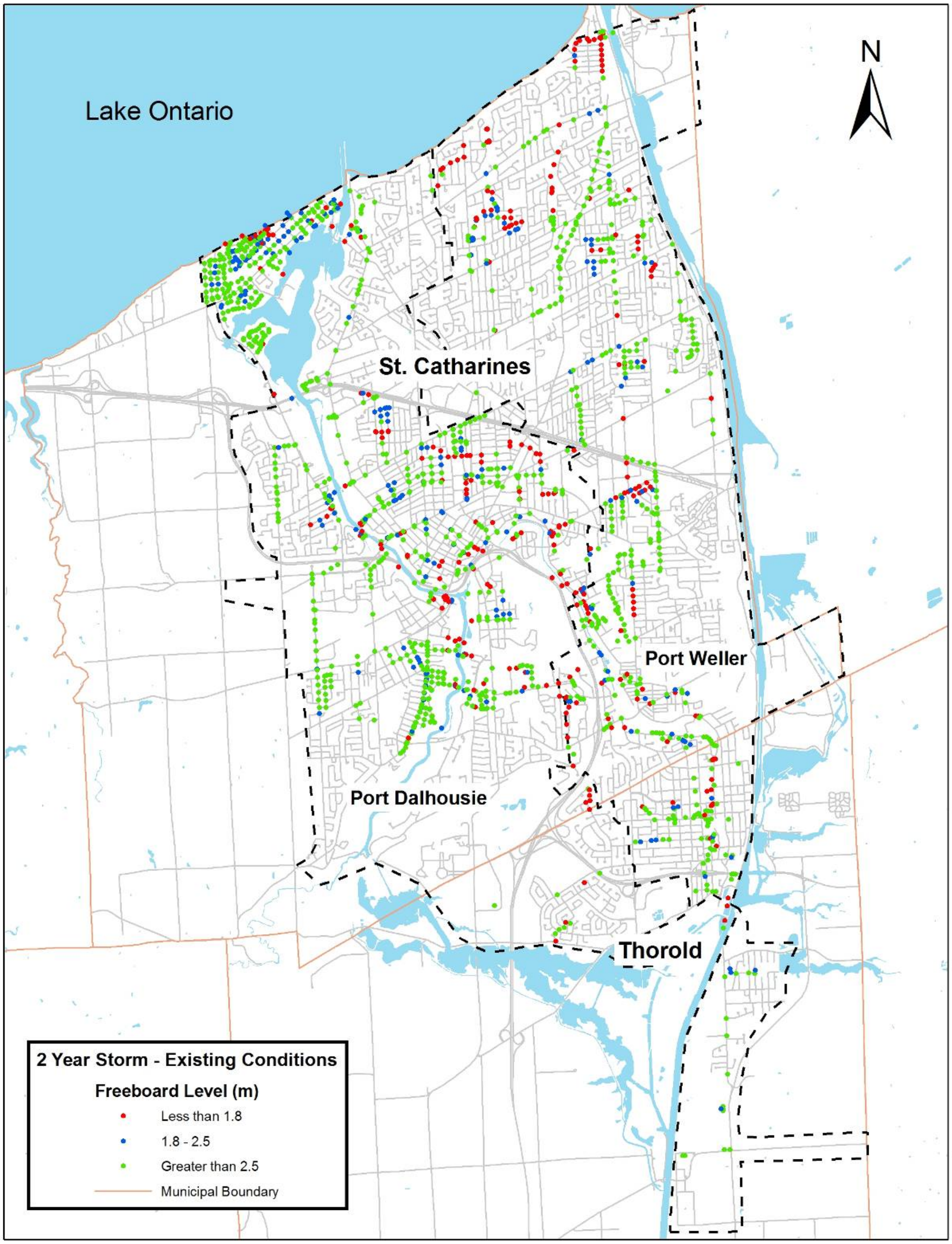


FIGURE 4-12
Hydraulic Capacity – Five-Year Storm (Existing Conditions)

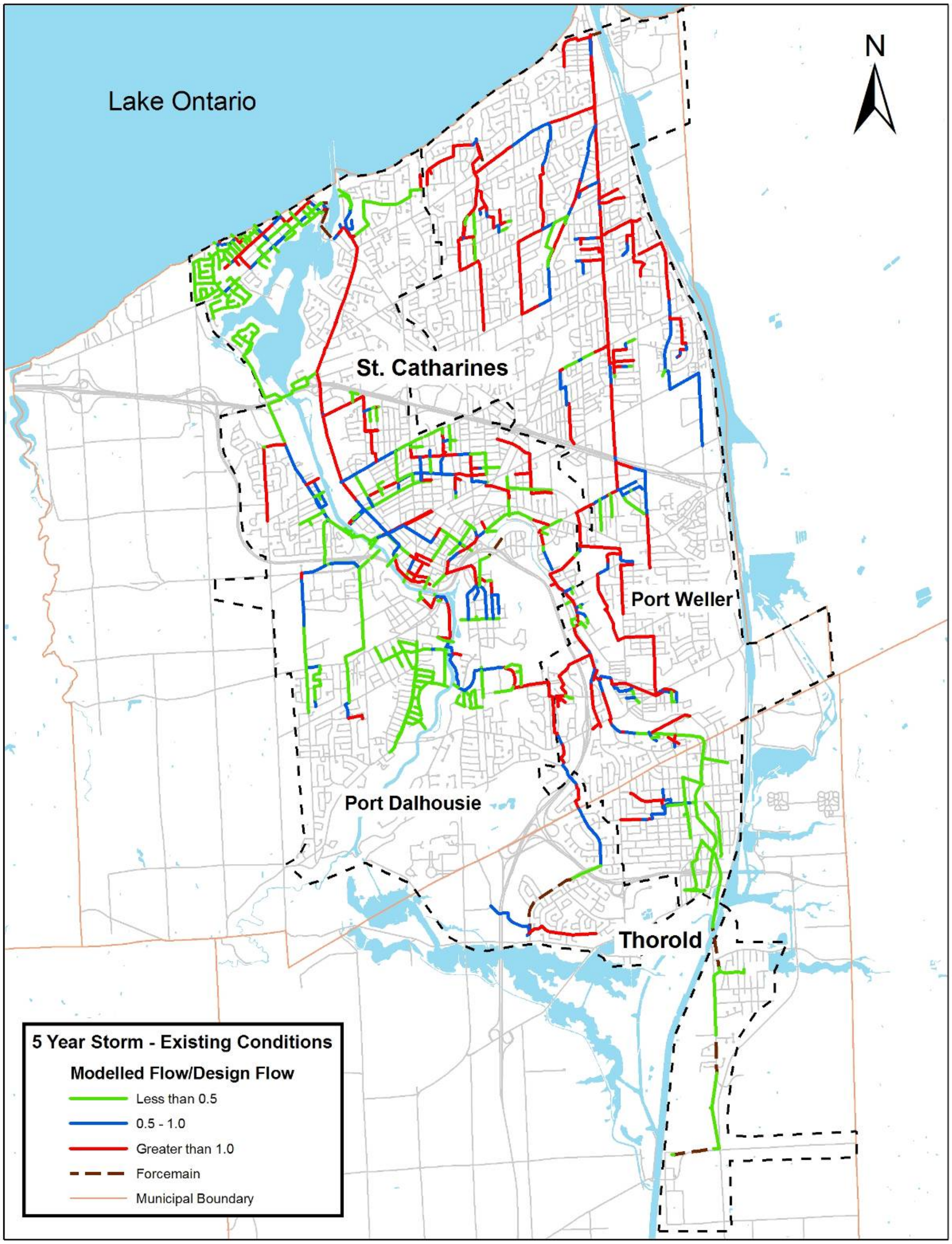
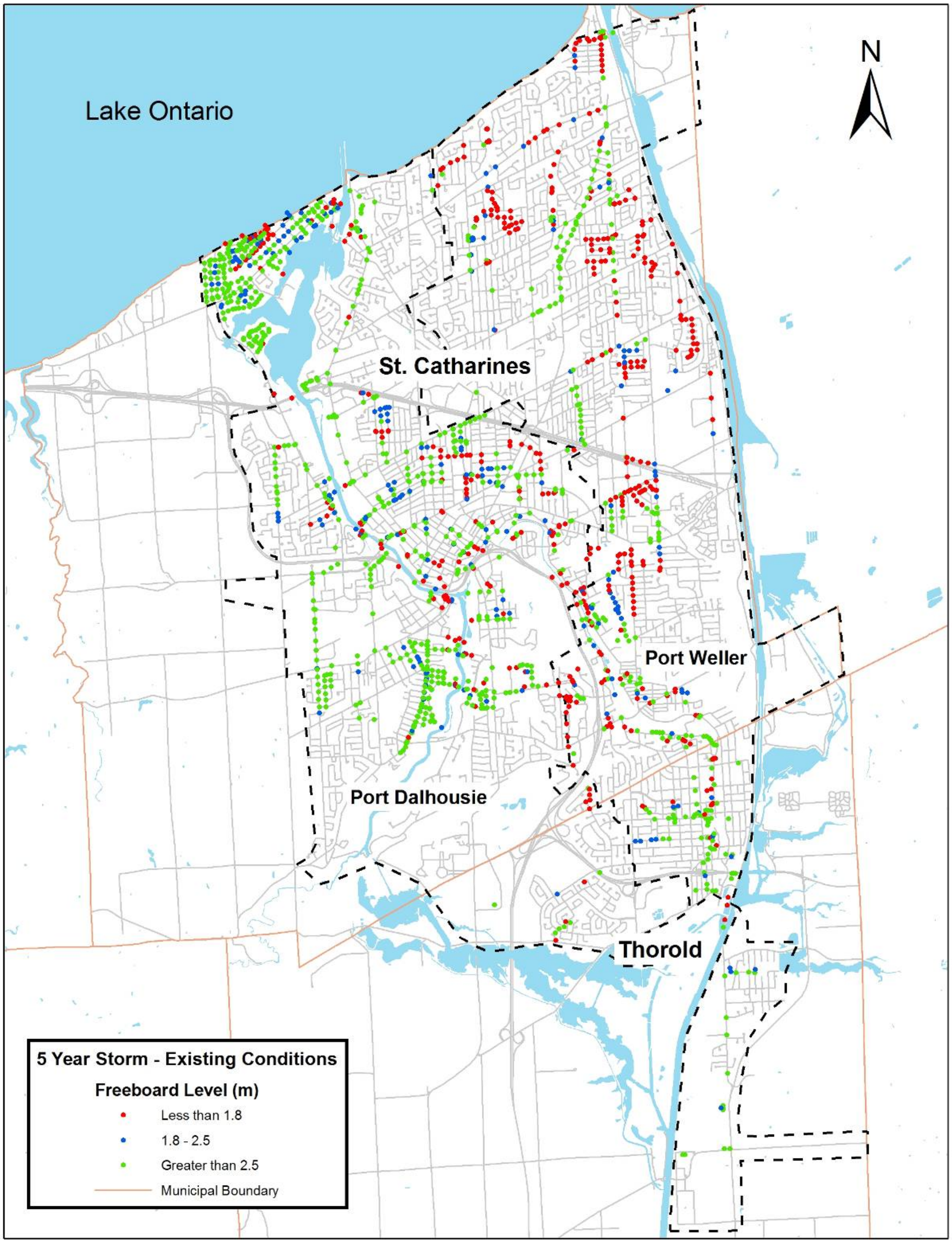


FIGURE 4-13
Freeboard – Five-Year Storm (Existing Conditions)



4.3.2 Future Conditions

Population projections were used to evaluate future dry weather flows for 2012, 2017, and 2032. The dry weather flow was increased uniformly across the system based on future flow projections for the Port Dalhousie WWTP and Port Weller WWTP generated in the 2003 Master Plan.

The results were similar for each of the future dry weather flow scenarios. Figure 4-14 displays the hydraulic capacity for the Port Dalhousie and Port Weller sewersheds under the 2032 condition. As shown, both sewersheds have adequate capacity for future flow related to general growth during dry weather flow.

The manhole freeboard for the both sewersheds is shown for the 2032 condition in Figure 4-15. Similar to the existing conditions, areas with limited freeboard are a result of topographical challenges and do represent an increased risk of basement flooding.

The dry weather flow at the Port Dalhousie WWTP under the 2032 conditions had an average flow of 54.9 MLD and a peak flow of 959 L/s. The Port Weller WWTP had an average flow of 64.5 MLD and a peak flow of 1,118 L/s under the 2032 conditions

The Regional North East Wastewater Servicing Study, which examined current and future wastewater servicing for the North East area of the Region, was being undertaken at the same time as the PCP. Different potential future flow scenarios for the St. Catharines and Thorold area were being examined. These future flow projections were also simulated in the model to determine their effect on the capacity constraints and freeboard. The results were similar and did not change the areas of concern within the system, with the exception of the total flows at the Port Dalhousie WWTP and Port Weller WWTP. Further details on the different rationales for predicting future flows are included in Appendix H.

FIGURE 4-14
Hydraulic Capacity – Dry Weather Flow (2032 Conditions)

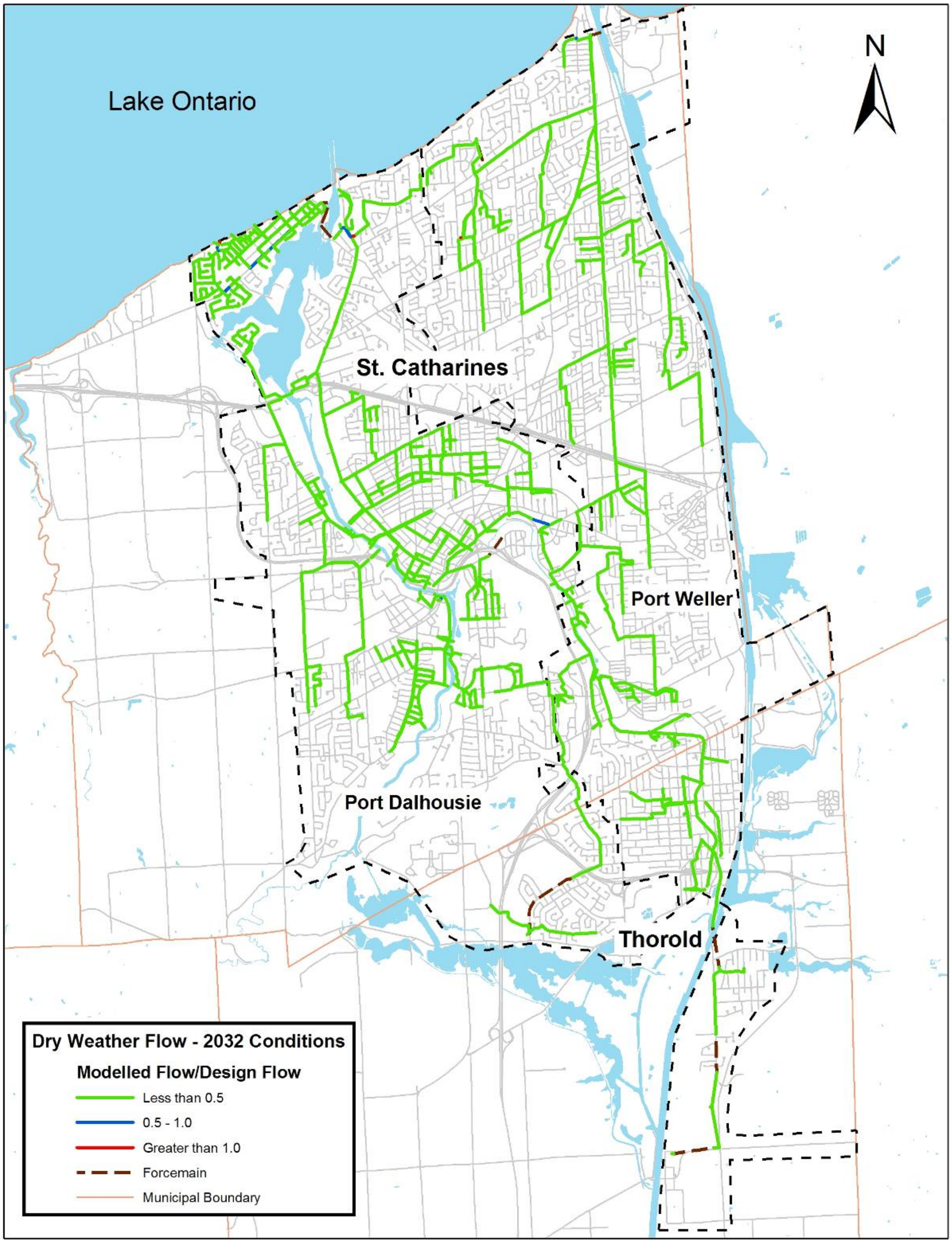
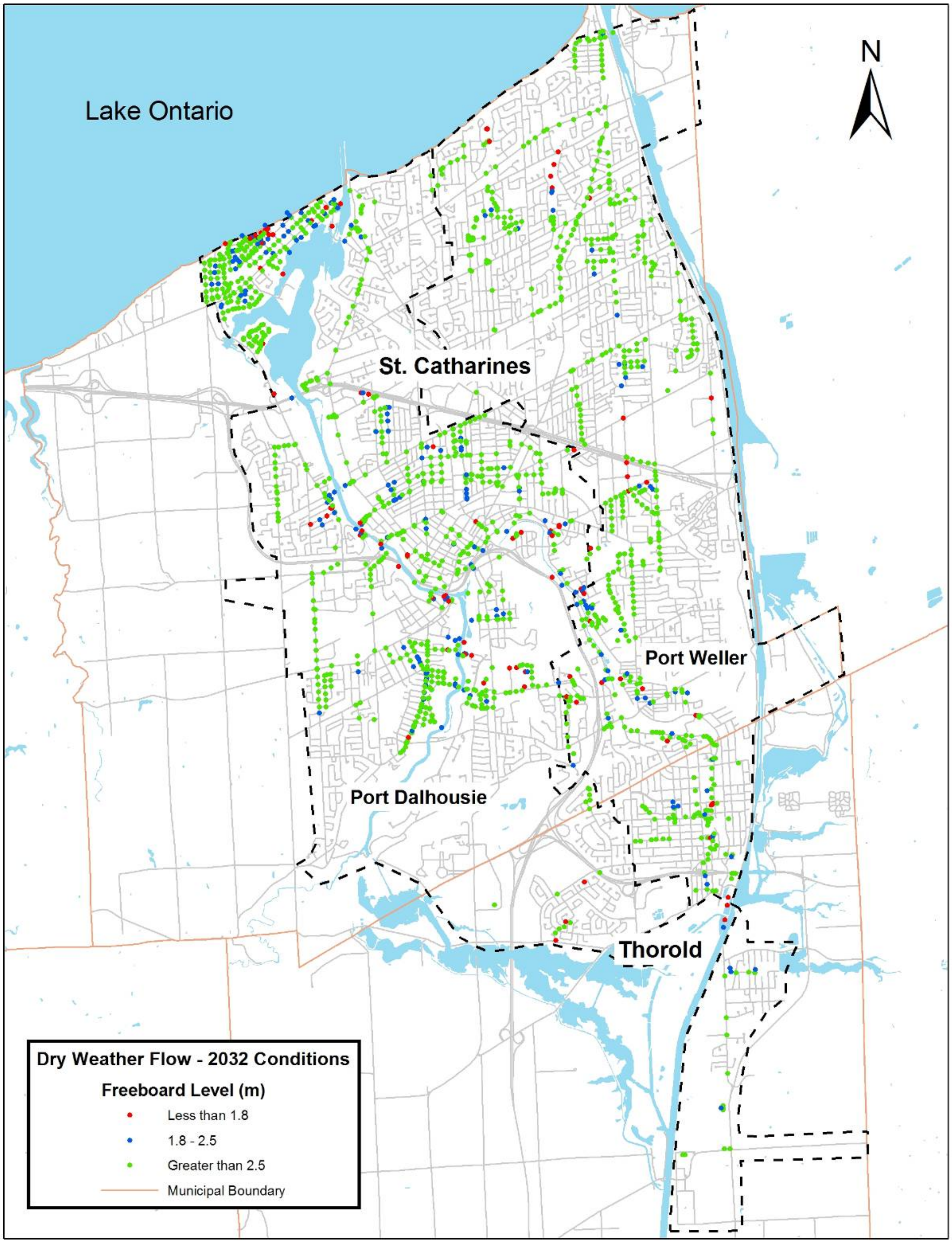


FIGURE 4-15
Freeboard – Dry Weather Flow (2032 Conditions)



5. Inventory of Contaminant Discharges

5.1 CSOs

The combined sewer overflow volumes were computed using the calibrated XP SWMM model and the typical year rainfall event (1989) for the time period from April to October to generate the wet weather flows. The volumes presented within this report represent the volume at the CSO outfall and could be the result of multiple contributing regulators, as described in Section 3.2.4 of this report. The overflow node identification (ID) column in Tables 5.1 and 5.2 indicates how many regulators contribute to each outfall location.

5.1.1 Model Results

The results of the typical year analysis for existing conditions are displayed graphically in Figure 5-1. The size of the circle is based on the yearly volume of the overflow. Overflow locations that have recent capital works either constructed or approved for CSO abatement are highlighted in orange. It is to be noted that projects approved in the capital works budget may not proceed to implementation as planned based on non-monetary constraints and status should be reviewed at subsequent updates of the Pollution Control Plan.

The frequency of overflow and total overflow volume for all CSO locations under existing conditions are summarized in Tables 5.1 and 5.2 for the Port Dalhousie sewershed and Port Weller sewershed. CSOs that do not achieve 90% capture (MOE PCPP requirement) are highlighted in grey.

The individual overflow volumes were compared to those generated for the 2006 Port Dalhousie CSO Study Report and the 1999 Port Weller Sanitary Trunk Sewer Analysis. There was a general decrease in overflow volume and frequency from calibration of the model. However, there was an increase in volume for the overflows upstream of the Page Street flow monitor in the Port Dalhousie sewershed, due to an increase in both DWF and WWF.

Both the Port Dalhousie sewershed and the Port Weller sewershed have 20 overflow locations that do not overflow during the typical year storm. These CSOs will not be considered further during the evaluation process.

The Port Dalhousie sewershed has nine overflows and the Port Weller sewershed has 12 overflows that do not individually meet 90% wet weather flow capture. As illustrated, five of these overflows have capital projects already associated with them. These projects will be discussed in further detail in Section 5.2.

FIGURE 5-1
Typical Year – CSO Overflow Volumes

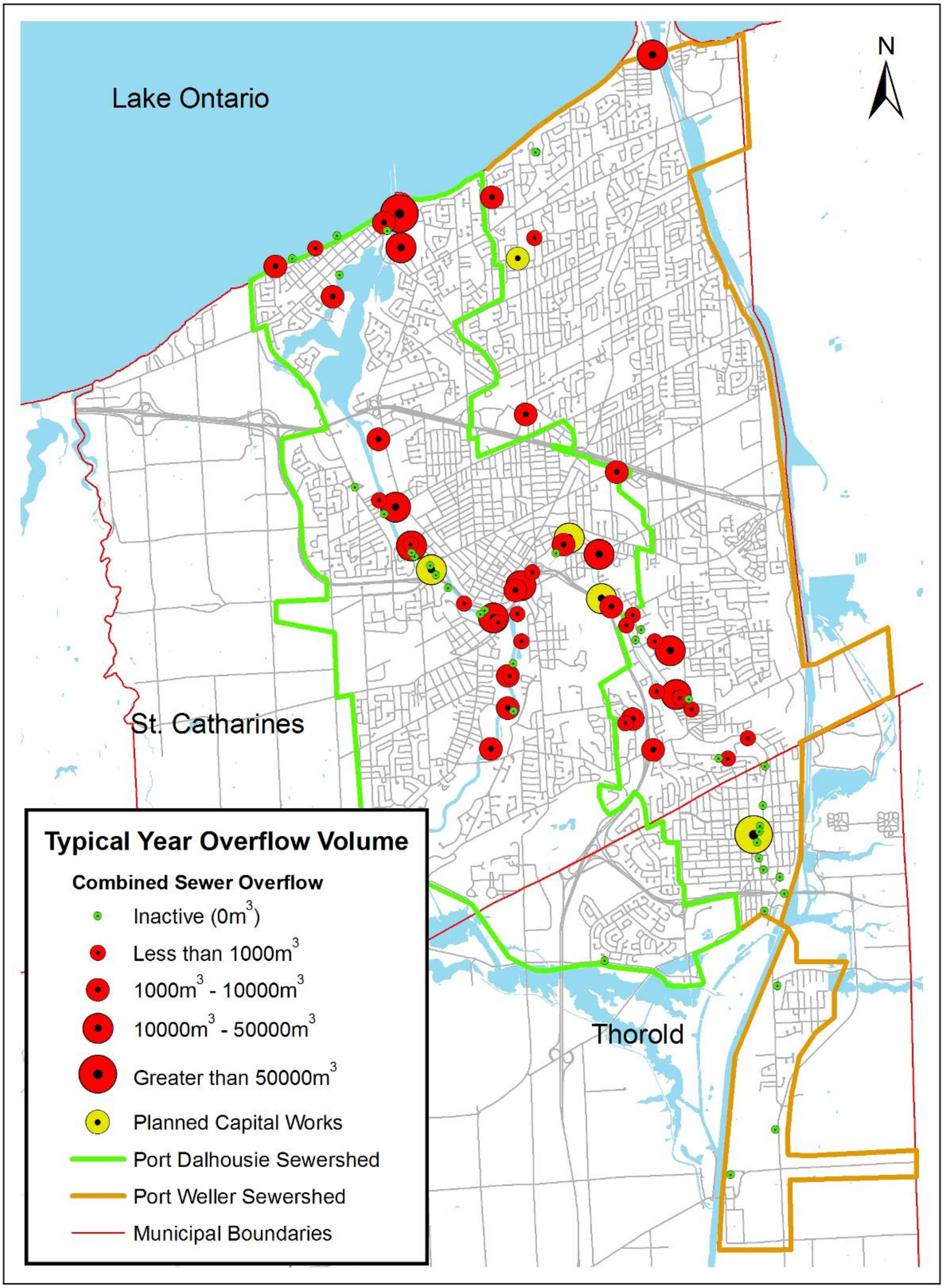


TABLE 5.1
Port Dalhousie Sewershed(Existing Conditions) – Typical Year (1989) CSO Summary

Receiving Body	CSO Location	Overflow Node ID	Existing Conditions, Typical Year		% Capture
			Frequency	Volume (m^3)	
Dalhousie Harbour	Michigan Avenue	102	26	12392	83.3
Lake Ontario	Lakeside PS	135		0	100.0
Martindale Pond	Main & Christie	113		0	100.0
Lake Ontario	Bayview & Ann	115		0	100.0
Lake Ontario	Christie Street	117		0	100.0
Lake Ontario	Colton & Shelley	128		0	100.0
Martindale Pond	Corbett and Bayview	130, 131, 132, 133	4	2803	89.0
Port Dalhousie Harbour	Lock Street	107		0	100.0
Lake Ontario	Cole Farm PS	125	11	1117	96.1
Twelve Mile Creek	Scott & Ontario	1301	4	4280	95.5
Twelve Mile Creek	Carlton & Ontario	1601	4	32282	92.1
Old Welland Canal	Page South of Welland, Ida Street, Berryman & Richmond	1614, 1615, 1633	34	31709	82.2
Martindale Pond	Grote & Carlton	1606, 1622, 1624	4	1300	95.7
Twelve Mile Creek	Thomas Street, Henry & Beech, George & Beech	1607, 1620, 1621	5	12129	95.7
Twelve Mile Creek	Kensington and Woodruff	1702	4	478	96.0
Twelve Mile Creek	Welland & Ontario, Welland & Montebello, Welland & Wellington, Welland & Lake, Welland & Clark	1803, 1805, 1806, 1807, 1808	16	24786	82.5
Twelve Mile Creek	Adam Street	2001		0	100.0
Twelve Mile Creek	Lake-Ontario, Salina-Ontario, Yates-Salina, Norris-Yates	1812, 1813, 2101, 2103		0	100.0
Twelve Mile Creek	Yates and Trafalgar	2102		0	100.0
Twelve Mile Creek	Henrietta Street	2203		0	100.0
Twelve Mile Creek	Renown Rd PS	2200	5	17193	95.7
Twelve Mile Creek	St. Paul Crescent	2301	4	214	94.1
Twelve Mile Creek	End of Monck Street	2401		0	100.0
Twelve Mile Creek	Rivercrest	2501a	2	144	98.3
Twelve Mile Creek	Riverview Drive	2596		0	100.0
Lake Gibson	Confederation Heights PS	3251		0	100.0
Twelve Mile Creek	Violet Street	4301	4	571	82.5
To storm on Martindale	Bridge and Martindale, Barton Street	4302		0	100.0
Martindale Pond	Grapeview & Martindale	4401		0	100.0
Twelve Mile Creek	Wellandvale PS	4502		0	100.0
Twelve Mile Creek	Wellandvale Road	4504		0	100.0
Twelve Mile Creek	Martindale Road	4503		0	100.0
Twelve Mile Creek	Crestcombe and Springbank	4600		0	100.0
Twelve Mile Creek	Dittrick Street	5008	4	550	94.4
Twelve Mile Creek	Hillcrest-Rockcliffe, Glenridge-Rockcliffe, South-Rockcliffe, Highland-Rockcliffe, Glenwood-Ridgewood	5009, 5010,5012, 5015, 5016	4	161	99.5
Twelve Mile Creek	Westchester & O.W. Canal	5001	26	20085	75.3
Twelve Mile Creek	Argyle PS	5006a	21	3396	77.3
Twelve Mile Creek	Parkway & O.W. Canal	5100	4	5236	95.2
Twelve Mile Creek	Carlisle-Church, James-King, King Street, Carlisle-St.Paul, James-St.Paul, Court-St.Paul	1810, 1815, 1816, 5202, 5204, 5402,	2	60	99.7
Old Welland Canal	Riordan & Gale	5500		0	100.0
Old Welland Canal	Eastchester PS	5800a	38	12937	69.8
Twelve Mile Creek	Capner & Oakdale	6000	42	14063	43.4
Twelve Mile Creek	Hamilton Street	7001	4	3838	95.5
Twelve Mile Creek	Kent Street	7100	6	3912	94.7
Twelve Mile Creek	Kinsey Street	7105	4	1813	93.9
Lake Ontario	Port Dalhousie WWTP Overflow	100	6	48229	96.7
	Total CSO Volume			**255679**	84.6

LEGEND
Grey – Overflows do not meet 90% capture criteria
Orange – Overflows have approved capital works for CSO abatement

TABLE 5.2
Port Weller Sewershed (Existing Conditions) – Typical Year (1989) CSO Summary

Receiving Body	CSO Location	Overflow Node ID	Existing Conditions, Typical Year		% Capture
			Frequency	Volume (m^3)	
Lake Ontario	Port Weller WWTP By-pass	100	4	35381	94.8
Twelve Mile Creek	Elmwood Ave & QEW	2303	29	6883	57.3
Lake Ontario	Beachview & Lake Ontario	428	4	2138	70.1
Old Welland Canal	Hartzel & CNR line	3405	4	14637	67.9
Old Welland Canal	Oakdale & Marren	3498	3	2119	98.2
Old Welland Canal	Lincoln & Oakdale at corner	3501	3	131	64.2
Old Welland Canal	Turner Cres. & Oakdale	3601	3	65	94.4
Old Welland Canal	Phelps St. & Old Welland Canal	3701	0	0	100.0
Old Welland Canal	Haight St. & Disher	3803	4	70	89.7
Old Welland Canal	131 Moffat	3997	0	0	100.0
Spring Garden Creek (to Lake Ontario)	Spring Garden PS Old Coach Rd.	413	0	0	100.0
Old Welland Canal	Chestnut & Briarsdale Dr. (node 4102 & 4103)	4102, 4103	4	918	73.0
Dicks Creek (to Old Welland Canal)	Aerial Sewer Briarsdale	4153	4	1042	58.0
Old Welland Canal	Brookdale & Glengarry	4201	4	355	94.8
Old Welland Canal	Burleigh Hill & Glendale	4202	4	1716	80.0
Spring Garden Creek (to Lake Ontario)	Old Coach Rd. & Spring Garden Creek	424	0	0	100.0
Old Welland Canal	Wedsworth & Hastings	4302	33	12052	57.9
Old Welland Canal	Chestnut & Merritt	4304	0	0	100.0
Old Welland Canal	Almond & Merritt	4306	1	2	99.9
Old Welland Canal	Walnut & Merritt	4309	4	221	98.2
Spring Garden Creek (to Lake Ontario)	Forster St. & Linwell (node 422 & 423)	422, 423	2	242	98.9
Spring Garden Creek (to Lake Ontario)	Guy Road (nodes 421, 462, 420 & 419)	421,462,420,419	3	4609	72.7
Old Welland Canal	Bradley & Dundas Cres.	4650	0	0	100.0
Ball Avenue West Creek	Ball & Merritt	4702	4	584	93.8
Old Welland Canal	Ursula & Rountree	M75155004	4	905	89.0
Old Welland Canal	Upstream of Parshal Flume	4998	0	0	100.0
Old Welland Canal	Regent & Front St.	5301	0	0	100.0
Old Welland Canal	Portland Ave	5351	0	0	100.0
Old Welland Canal	Pine Plaza	5400	0	0	100.0
Old Welland Canal	Whyte & Ann St.	5412	0	0	100.0
Old Welland Canal	Front St. & St. David's	5454	0	0	100.0
Old Welland Canal	Pine Plaza (node 5414 & 5401)	5401,5414	33	56193	32.5
Old Welland Canal	Front St. & Regent	5650	0	0	100.0
Welland Canal	Garden St.	5801	0	0	100.0
Old Welland Canal	Pine St. & Richmond St.	5853	0	0	100.0
Welland Canal	Sullivan & CNR	5996	0	0	100.0
Beaverdams Creek (to Lake Gibson)	Peel Street PS	6550	0	0	100.0
Davis Creek (to Lake Gibson)	Centre St. PS	6552	0	0	100.0
Davis Creek (to Lake Gibson)	Blackhorse PS	6553	0	0	100.0
	Total CSO Volume			**140263**	82.1

LEGEND
Grey – Overflows do not meet 90% capture criteria
Orange – Overflows have approved capital works for CSO abatement

5.1.2 Conformance with MOE Guidelines

System Wide

The Port Dalhousie and Port Weller models were analyzed under existing conditions for conformance with the MOE's Procedure F-5-5 for 90% capture rate on a system-wide basis which does not include the bypasses from the WWTPs. Plant by-pass may occur as a result of hydraulic constraints or may be performed manually by plant operations due to operational limitations at the WWTP. The system model does not, therefore, accurately predict WWTP overflows. The Port Dalhousie WWTP and Port Weller WWTP by-pass assessments have, however, been included in the North East Servicing Study carried out by the Region concurrent with this PCP study. Also, the MOE system wide conformance with F-5-5 is considered for the collection system separate from the WWTP bypass. The current system F-5-5 conformance has, therefore, for the purposes of CSO mitigation alternatives, been considered in this PCP report on a collection system basis without the plant by-pass included. The comparison of % capture with and without WWTP bypass (calculated from Tables 5.1 and 5.2) included is, however, shown in Table 5.3 to illustrate the impact of the bypass on the overall capture rate.

TABLE 5.3
Existing Conditions – With and Without Plant Bypass

System	With Plant Bypass			Without Plant Bypass		
	Total WWF (m^3)	Total CSO (m^3)	% Capture	Total WWF (m^3)	Total CSO (m^3)	% Capture
Port Dalhousie	1664727	255679	84.6	1664727	207450	87.5
Port Weller	783098	140263	82.1	783098	104882	86.6

Since the previous updates completed for the Port Dalhousie and Port Weller sewersheds (reports described in Section 3) an analysis of the predicted volume of overflows shows that the total volume of overflows has decreased by approximately 56,320 m^3 and 3,250 m^3 for each sewershed, respectively. This translates to a reduction in overflow volumes of 18% and 2.3% for the Port Dalhousie and Port Weller sewersheds, respectively. These improvements have resulted, at least in part, from the completion of CSO abatement projects undertaken by the Cities.

MOE Procedure F-5-5 requires that a municipality: during a seven-month period commencing within 15 days of April 1, capture and treat for an average year all of the dry weather flow plus 90% of the volume resulting from wet weather flow that is above the dry weather flow. From Tables 5.5, 5.2, and 5.3, it can be seen that with the WWTP bypass included and when considering only the collection system as required through F-5-5, both the Port Dalhousie and Port Weller systems fall below the 90% target stipulated in the MOE guideline. Several CSOs already have capital works in progress for CSO abatement that are anticipated to significantly improve the % capture rate currently experienced in the systems. These CSOs are described in the next section.

5.2 Completed and Approved Capital Works Projects

The City of St. Catharines and City of Thorold have undertaken, or are undertaking, several projects related to CSO abatement. A detailed description of these projects can be found in

Section 3.3. A brief description of the projects currently in the design or construction phase is presented in Table 5.4.

TABLE 5.4
Completed and Approved Capital Works Projects[1]

Sewershed	Project	Description	Status as of March 2008
Port Dalhousie	Welland/ Ontario	7,080 m^3 storage	Under Construction
	Page St.	920 m^3 storage	In Design
	Capner / Oakdale	1,030 m^3 storage	Under Construction
Port Weller	Guy Road	1,400 m^3 added storage	Under Construction
	Lockview Park[2]	2500 m^3 storage	Under Construction
	Thorold – North End		Under Construction
	CSO Storage Facilities	400 m^3 Storage 400 m^3 Storage 600 m^3 Storage	

[1] Projects approved in Capital Works budget may not proceed to implementation based on non-monetary constraints and status should be reviewed at subsequent updates of the Pollution Control Plan

[2] Lockview park storage intended to alleviate basement flooding, not CSOs

These projects were not included in the updates to the current system model and analysis of current system performance due to the stages of implementation. However, the reduction in CSO volume was estimated for each respective outfall using the typical year (1989) rainfall data. The volume and frequency were estimated using design storage volumes for the projects. The actual constructed volume and subsequent performance for each CSO may vary from the design values. The estimated reduction in CSO volume and percent capture for each CSO targeted by each of the capital projects is presented in Table 5.5.

TABLE 5.5
CSO Volume Reduction for Approved Capital Works

Sewershed	CSO Location	Existing Conditions Typical Year Analysis			Approved Capital Works Typical Year Analysis		
		Frequency	Volume	% Capture	Frequency	Volume	% Capture
Port Dalhousie	Welland / Ontario	16	24786	82.5	1	590	99.6
	Page St.	34	31709	82.2	6	20090	88.7
	Capner / Oakdale	42	14063	43.4	4	2260	90.9
Port Weller	Guy Road	3	4609	72.7	1	1170	93.1
	Pine Plaza (Thorold)	33	56193	32.5	N/A	8320[1]	90

[1] Based on 90% design capture

The Pine Plaza overflow in Thorold has been converted to a storm sewer overflow, and has been replaced by six temporary overflows connected to the new partially separated sanitary system. The storage tanks included in these upgrades were designed for 90% capture of wet weather flow. This capture rate was used to estimate the remaining overflow volume. However, the actual amount of CSO volume will likely be considerably less due to the combined sewer separation project that has reduced the amount of wet weather inflow in the system.

The planned and constructed capital works result in an estimated reduction of 47,600 m^3 of CSO volume per year for the Port Dalhousie sewershed and 60,299 m^3 for the Port Weller sewershed. This has a significant impact on the overall system's performance using the F-5-5 criteria. A summary of the CSO volumes and predicted system performance in regard to F-5-5 % capture rates with the approved capital works is presented in Tables 5.6, 5.7, and 5.8 for the Port Dalhousie sewershed and Port Weller sewershed, respectively.

TABLE 5.6
Port Dalhousie Sewershed (Approved Capital Works) – Typical Year (1989) CSO Summary

Receiving Body	CSO Location	Approved Works, Typical Year		% Capture
		Frequency	Volume (m^3)	
Dalhousie Harbour	Michigan Avenue	26	12392	83.3
Martindale Pond	Corbett and Bayview	4	2803	89.0
Lake Ontario	Cole Farm PS	11	1117	96.1
Twelve Mile Creek	Scott & Ontario	4	4280	95.5
Twelve Mile Creek	Carlton & Ontario	4	32282	92.1
Old Welland Canal	Page South of Welland, Ida Street, Berryman & Richmond	6	20090	88.7
Martindale Pond	Grote & Carlton	4	1300	95.7
Twelve Mile Creek	Thomas Street, Henry & Beech, George & Beech	5	12129	95.7
Old Welland Canal	Kensington and Woodruff	4	478	96.0
Twelve Mile Creek	Welland & Ontario, Welland & Montebello, Welland & Wellington, Welland & Lake, Welland & Clark	1	590	99.6
Twelve Mile Creek	Renown Rd PS	5	17193	95.7
Twelve Mile Creek	St. Paul Crescent	4	214	94.1
Twelve Mile Creek	Rivercrest	2	144	98.3
Twelve Mile Creek	Violet Street	4	571	82.5
Twelve Mile Creek	Dittrick Street	4	550	94.4
Twelve Mile Creek	Hillcrest-Rockcliffe, Glenridge-Rockcliffe, South-Rockcliffe, Highland-Rockcliffe, Glenwood-Ridgewood	4	161	99.5
Twelve Mile Creek	Westchester & O.W. Canal	26	20085	75.3
Twelve Mile Creek	Argyle PS	21	3396	77.3
Twelve Mile Creek	Parkway & O.W. Canal	4	5236	95.2
Twelve Mile Creek	Carlisle-Church, James-King, King Street, Carlisle-St.Paul, James-St.Paul, Court-St.Paul	2	60	99.7
Old Welland Canal	Eastchester PS	38	12937	69.8
Twelve Mile Creek	Capner & Oakdale	4	2260	90.9
Twelve Mile Creek	Hamilton Street	4	3838	95.5
Twelve Mile Creek	Kent Street	6	3912	94.7
Twelve Mile Creek	Kinsey Street	4	1813	93.9
Lake Ontario	Port Dalhousie WWTP bypass	6	48229	96.7
	Total CSO Volume (without plant bypass)		**159831**	90.4
	Total CSO Volume (with plant bypass)		**208060**	87.5

LEGEND
Grey – Overflows do not meet 90% capture criteria
Orange – Updated volume estimates based on approved capital works

TABLE 5.7
Port Weller Sewershed (Approved Capital Works) – Typical Year (1989) CSO Summary

Receiving Body	CSO Location	Existing Conditions, Typical Year		% Capture
		Frequency	Volume (m^3)	
Lake Ontario	Elmwood Ave & QEW	29	6883	57.3
Lake Ontario	Beachview & Lake Ontario	4	2138	70.1
Old Welland Canal	Hartzel & CNR line	4	14637	67.9
Old Welland Canal	Oakdale & Marren	3	2119	98.2
Old Welland Canal	Lincoln & Oakdale at corner	3	131	64.2
Old Welland Canal	Turner Cres. & Oakdale	3	65	94.4
Old Welland Canal	Haight St. & Disher	4	70	89.7
Old Welland Canal	Chestnut & Briarsdale Dr. (node 4102 & 4103)	4	918	73.0
Dicks Creek (to Old Welland Canal)	Aerial Sewer Briarsdale	4	1042	58.0
Old Welland Canal	Brookdale & Glengarry	4	355	94.8
Old Welland Canal	Burleigh Hill & Glendale	4	1716	80.0
Old Welland Canal	Wedsworth & Hastings	33	12052	57.9
Old Welland Canal	Almond & Merritt	1	2	99.9
Old Welland Canal	Walnut & Merritt	4	221	98.2
Spring Garden Creek (to Lake Ontario)	Forster St. & Linwell (node 422 & 423)	2	242	98.9
Spring Garden Creek (to Lake Ontario)	Guy Road (nodes 421, 462, 420 & 419)	1	1170	93.1
Ball Avenue West Creek	Ball & Merritt	4	584	93.8
Old Welland Canal	Ursula & Rountree	4	905	89.0
Old Welland Canal	Pine Plaza (node 5414 & 5401)	-	8320	90
Lake Ontario	Port Weller WWTP bypass	4	35381	94.8
Total CSO Volume (without plant bypass)			**53570**	93.2
Total CSO Volume (with plant bypass)			**88951**	88.6

LEGEND
Grey overflows do not meet 90% capture criteria
Orange updated volume estimates based on approved capital works

TABLE 5.8
System Wide F5-5 Conformance with Approved Capital Works

System	Typical Year Total WWF including WWTP Bypass (m^3)	Typical Year CSO Volume (m^3)	% Capture
Port Dalhousie	1664727	**159831**	90.4
Port Weller	783098	**53570**	93.2

The approved capital works upgrades allow both systems to achieve the 90% criteria when the plant bypass is not considered. The improvement underlines the impact that the capital works programs have had on the amount of CSO discharged to the environment. The CSOs associated with the approved capital works will not be carried forward in the evaluation process since they have previously undergone a process that resulted in their selection for

implementation. In order to properly assess the impact of remaining CSOs listed in Tables 5.6 and 5.7 on the environment and their priority for implementation, an analysis of the potential impacts on the receiving streams was performed.

5.2.1 Pollutant and Load Contributions

As part of the CSO High Rate Treatment (HRT) Feasibility Study (Hydromantis, 2005), the City of St. Catharines published sample results for typical contaminant concentrations for combined sewage in the study area. These values are summarized in Table 5.9.

TABLE 5.9
Mean Concentrations of Typical CSO Contaminants

Parameter	Mean Concentration (mg/L)
Total Suspended Solids (TSS)	278
Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)	68
Total Phosphorus (TP)	1.9
Total Kjeldahl Nitrogen (TKN)	11.3
Ammonia (NH_3-N)	6.6

Source: City of St. Catharines CSO HRT Feasibility Study (Hydromantis/CH2M HILL, 2005)

The impact that CSOs might have on a receiving water body environment is dependant on, among other factors, the contributing loading. Loading for a typical year of rainfall is determined by multiplying the volume of each CSO (outlined in Tables 5.1 and 5.2) by the mean concentrations in Table 5.9. For comparison of loadings, three indicator pollutants were selected: TSS, BOD, and TP. The loadings for each overflow in the Port Dalhousie sewershed and Port Weller sewershed are shown in Tables 5.10 and 5.11, respectively. Only CSOs which were found to overflow during a typical rainfall year are shown in these tables.

TABLE 5.10
Pollutant Loadings – Port Dalhousie Sewershed (Typical year overflows)

Receiving Body	CSO Location	Volume (m^3)	Loading (kg)		
			TSS	BOD	TP
Lake Ontario	Cole Farm PS	1117	311	76	21222
	Michigan Avenue	12392	3445	843	24
Martindale Pond	Corbett & Bayview	2803	779	191	5
	Grote & Carlton	1300	361	88	2
Twelve Mile Creek	Scott & Ontario	4280	1190	291	8
	Carlton & Ontario	32282	8974	2195	61
	Thomas Street, Henry & Beech, George & Beech	12129	3372	825	23
	Renown Rd PS	17193	4780	1169	33
	St. Paul Crescent	214	59	15	0
	Rivercrest	144	40	10	0
	Violet Street	571	159	39	1
	Dittrick Street	550	153	37	1

TABLE 5.10
Pollutant Loadings – Port Dalhousie Sewershed (Typical year overflows)

Receiving Body	CSO Location	Volume (m^3)	Loading (kg)		
			TSS	BOD	TP
	Hillcrest-Rockcliffe, Glenridge-Rockcliffe, South-Rockcliffe, Highland-Rockcliffe, Glenwood-Ridgewood	161	45	11	0
	Westchester & O.W. Canal	20085	5584	1366	38
	Argyle PS	3396	944	231	6
	Parkway & O.W. Canal	5236	1456	356	10
	Carlisle-Church, James-King, King Street, Carlisle-St. Paul, James-St. Paul, Court-St. Paul	60	17	4	0
	Hamilton Street	3838	1067	261	7
	Kent Street	3912	1088	266	7
	Kinsey Street	1813	504	123	3
Old Welland Canal	Kensington & Woodruff	478	133	33	1
	Eastchester PS	12937	3596	880	25

TABLE 5.11
Pollutant Loadings – Port Weller Sewershed (Typical year overflows)

Receiving Body	CSO Location	Volume (m^3)	Loading (kg)		
			TSS	BOD	TP
Lake Ontario	Elmwood Ave & QEW	6883	1913	468	13
	Beachview & Lake Ontario	2138	594	145	4
Spring Garden Creek	Forster St. & Linwell (node 422 & 423)	242	67	16	0
Old Welland Canal	Oakdale & Marren	2119	589	144	4
	Lincoln & Oakdale at corner	131	36	9	0
	Turner Cres. & Oakdale	65	18	4	0
	Haight St. & Disher	70	19	5	0
	Chestnut & Briarsdale Dr. (node 4102 & 4103)	918	255	62	2
	Brookdale & Glengarry	355	99	24	1
	Wedsworth & Hastings	12052	3350	820	23
	Almond & Merritt	2	1	0	0
	Walnut & Merritt	221	61	15	0
	Ball & Merritt	584	162	40	1
	Ursula & Rountree	905	252	62	2
	Hartzel and CNR Line	14637	4069	995	27.8
Dicks Creek	Aerial Sewer Briarsdale	1042	290	71	2
Old Welland Canal	Burleigh Hill & Glendale	1716	477	117	3

5.3 Potential Impacts on Receiving Streams

In considering the impacts of a CSO, it is important to examine the state of the receiver where the overflow ultimately discharges. The sensitivity of a receiving stream is based on a number of factors including the assimilative capacity. The assimilative capacity of a receiving water body is dependant on the baseline water quality in the water body as well as the volume of stream flow. Another factor influencing the sensitivity of a receiving stream is the proximity to sensitive water users, such as recreational beaches or water treatment plant intakes. A description of the existing conditions within each of the receiving streams is included in Section 3.4 of this report. The follow section will discuss the relative potential impacts to these receiving streams based on the existing conditions reflected in the selected water quality parameters.

In order to examine potential impacts, three factors that could influence the ability of the receiving water body to assimilate potential contaminants will be discussed as they relate to the local water bodies. These factors are:

- Use by local water users
- Water quality
- Water quantity

5.3.1 Impact on Local Water Users

Potential water users within the study area can be divided into two basics categories; recreational water users and drinking water users.

Recreational Water Users

Local water courses, in particular Martindale Pond, are used for local water sports especially rowing. These water uses can be impacted by CSOs through recreational contact. Local water courses are also used for sport fishing. A number of the water ways support walking activities with trails adjacent to the water bodies.

As shown in Figure 3-9, there are three municipal beaches located within the study area including Lakeside Beach, Municipal Beach, and Jones Beach. Based on the previous PCP efforts and the assessments carried out in this current PCP it is not anticipated that existing CSOs have any direct impact on the three municipal beach areas. There are, however, multiple factors that do contribute to impaired water quality at these locations including storm water runoff, agricultural runoff, industrial effluent, marinas and water fowl. Since the completion of the original PCP in 1989, the City of St. Catharines has worked to decrease the number of beach postings at each location through efforts to reduce storm water impacts. The results of this work can be seen in Figures 5-2, 5-3, and 5-4. St. Catharines continues to investigate causes to the water quality impairment and prioritizing improvements based on potential impacts.

FIGURE 5-2
Lakeside Beach – Percentage of Beach Season Without a Swimming Advisory

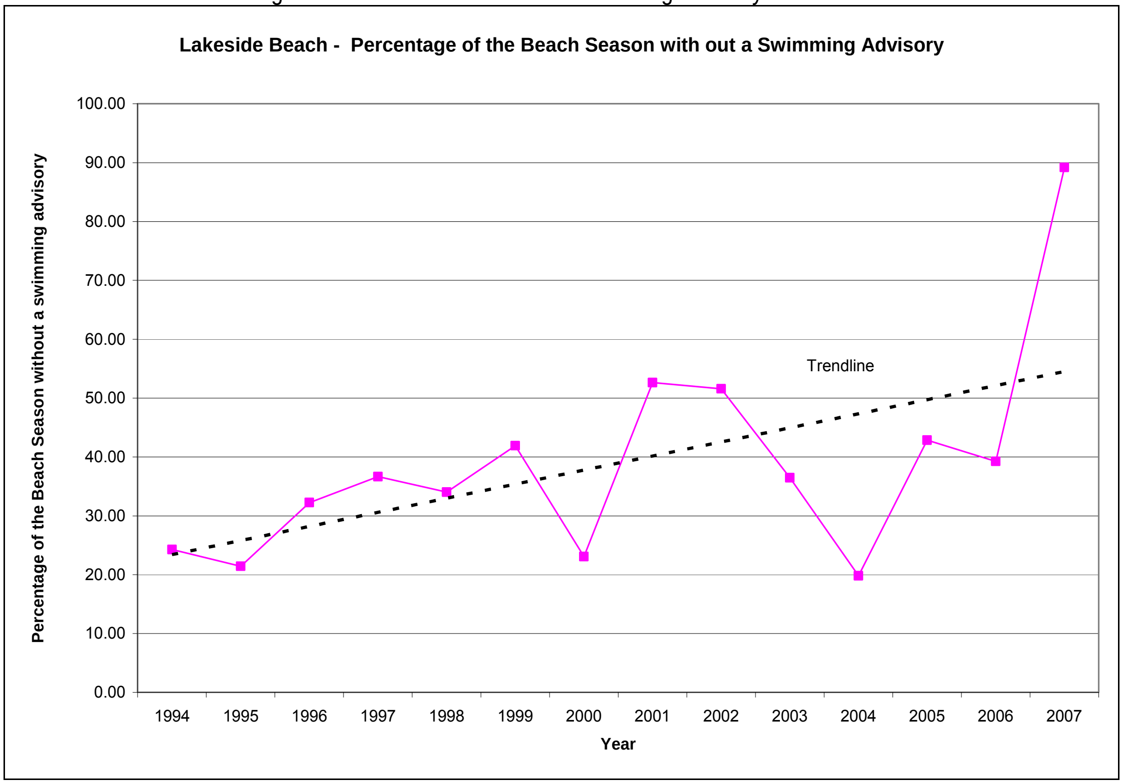


FIGURE 5-3
Municipal Beach – Percentage of Beach Season Without a Swimming Advisory

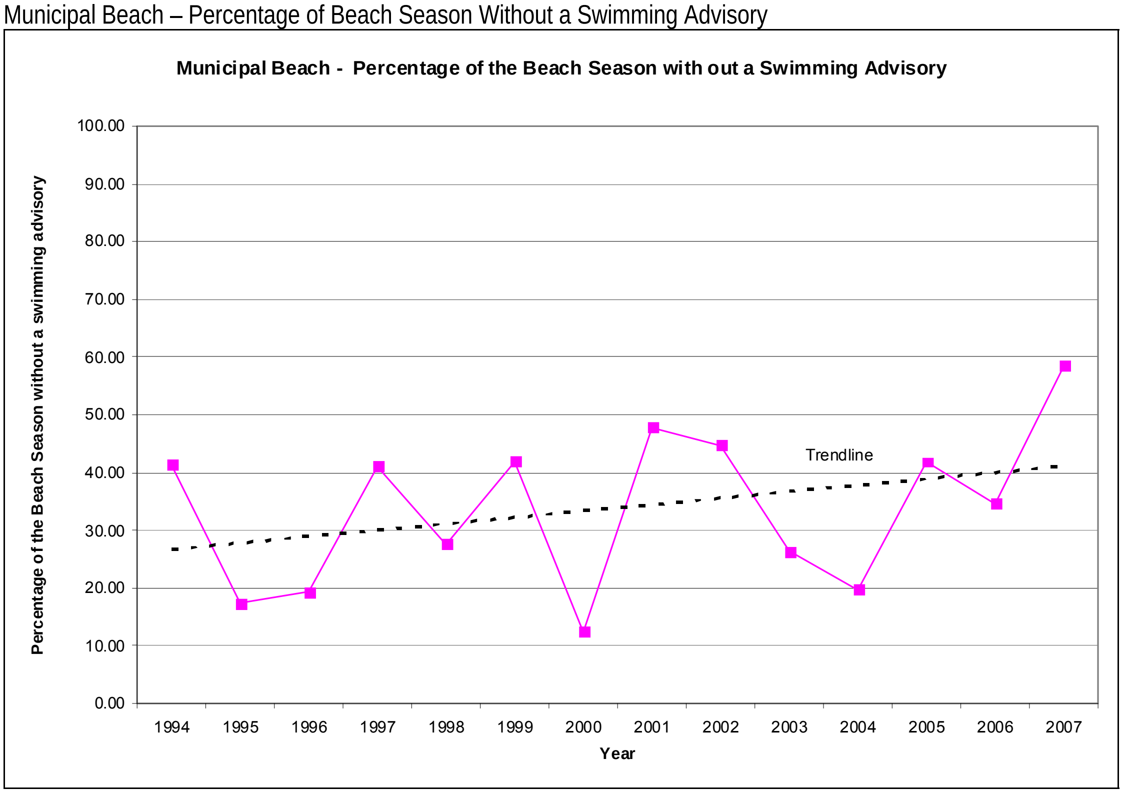
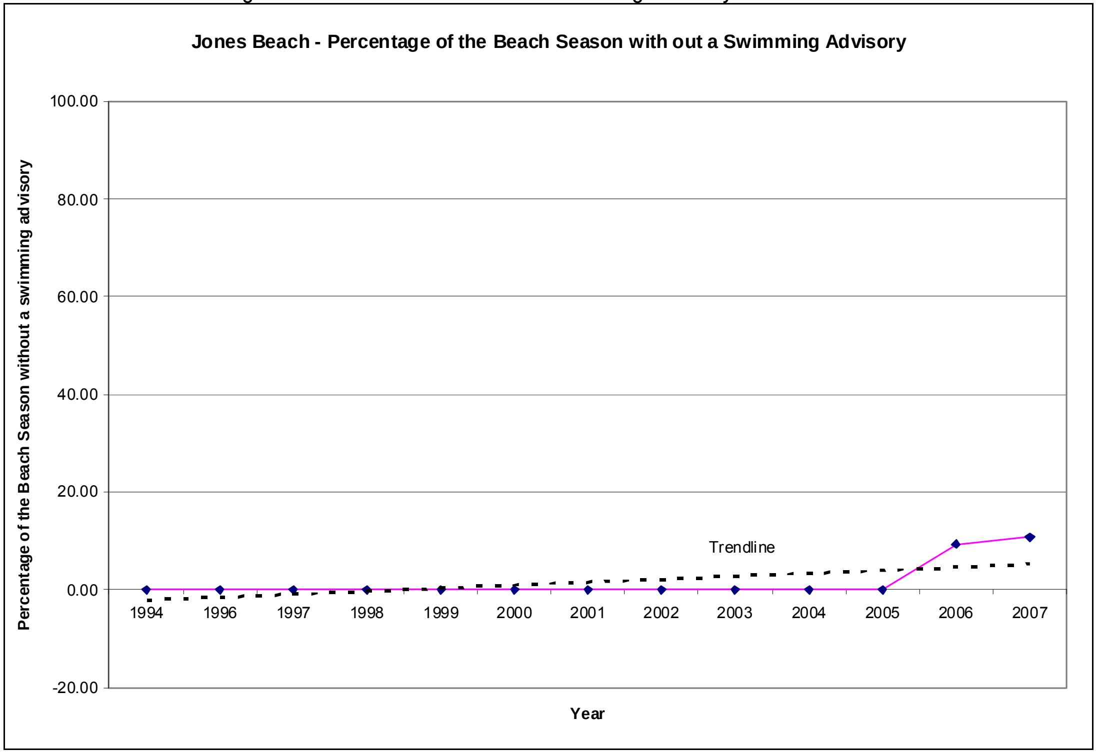


FIGURE 5-4
Jones Beach – Percentage of Beach Season Without a Swimming Advisory



Drinking Water Use

The Decew Water Treatment Plant (WTP) withdraws raw water from Lake Erie via the Welland Canal to be treated for distribution as drinking water to St. Catharines, Thorold, Niagara-on-the-Lake, and Jordan. As part of the provincial Source Protection Planning initiative, an Intake Protection Zone (IPZ) is being developed for this WTP. The IPZ identifies areas that have higher potential to impact the raw water source from contaminant sources. As indicated previously, initial findings from the IPZ study have shown that all of Lake Gibson is included within the IPZ areas. However, there are no CSOs which currently discharge to Lake Gibson during the typical year scenario.

5.3.2 Existing Water Quality

The existing water quality within a water body affects the water body's ability to accept and assimilate additional loads. Objectives for concentrations of various parameters in Ontario water bodies are outlined by the MOE through Provincial Water Quality Objectives (PWQOs). As summarized in Table 3.4, there are a number of stream systems where multiple parameters are above the PWQOs. Studies by the NPCA have shown that the elevated iron levels are suspected to be as a result of natural sources. In addition to CSOs and natural sources, other factors such as industrial discharges as well as urban and rural runoff may have impacts on water quality.

5.3.3 Relative Water Quantity

As indicated previously, there was limited information on flows for the local water courses within the study area. As flows have an impact on the water course's ability to assimilate potential contaminants, the receiving streams were grouped on a relative basis based on

water quantity. The water bodies assimilative capacities based on flow were grouped into high, medium and low categories based on water quantity. For example, the smaller local creeks were classified as low; whereas Lake Ontario would be classified as high.

5.4 Ranking of CSOs

A process was developed to determine which CSOs should be addressed in further detail and given priority for implementation. Previous studies have used the system-wide F-5-5 capture criteria to develop and rank alternatives. With the addition of the approved capital works, and not including WWTP bypass, both sewersheds achieve the system-wide F-5-5 conformance. Therefore, the selection of CSOs and subsequent priority ranking for this study was based on a two-stage process.

The selection stage ranked each CSO based on the potential environmental impact. This potential impact was developed by examining the total overflow volume and the sensitivity of the receiving water body. Total overflow volume was used as an evaluation criteria instead of frequency as most of the overflows with high frequency, also had larger relative volumes of overflow. There were also a few overflows with lower frequency of overflows that had larger volumes of overflow. Based on these two factors it was decided that overflow volume as a criteria would better represent the potential impact on the environment than frequency.

The purpose of this ranking was to identify the top 10 critical CSO locations that should be addressed in the short term (0–10 years) based on their impact on receiving stream environments.

The second stage of ranking determined the implementation priority for these 10 CSOs. These CSOs were evaluated in greater detail for preferred alternatives, cost, and implementation scheduling. A breakdown of the criteria for the first stage of ranking is described below.

Overflow Volume (50% weighting)

The total overflow volume produced during the typical year analysis was used to identify which CSOs discharge the most to the local receiving streams. The CSOs were given a score out of 5 based on their total volume relative to the largest discharger in either system. To determine the overflow volume score the largest overflow volume for both sewersheds was given a score of 5. Then the other CSOs overflow volume scores were calculated based on the overflow volume divided by the largest overflow volume then multiplied by the highest score of five. This method then provided an overflow volume score based on the relative size of each CSO. The CSO with the largest typical year volume for both sewersheds was Carlton and Ontario in the Port Dalhousie sewershed and was therefore given a score of 5. The scores of each CSO are provided later in Table 5.13.

Impact on Receiving Stream Environment (50% weighting)

This receiving stream environment score was based on the receiving stream sensitivity. Stream sensitivity was judged on four factors; potential drinking water impact, recreational impact, the existing water quality and the relative water quantity. Within each category the receiving stream was given a score of 5, 3, or 1, which represented high potential for impact, moderate potential for impact, and low potential for impact. An average score out of 5 was

then determined for each receiving body. A summary of the receiving stream environment scores is presented in Table 5.12. The basis for these assignments is described in Section 5.3 of this report.

TABLE 5.12
Receiving Stream Impact Summary

Receiving Body	Drinking Water Impact	Recreational Impact	Existing Water Quality	Relative Water Quantity	Total Score (Max 5)
Lake Ontario	1	5	1	1	**2**
Martindale Pond	1	3	3	3	**2.5**
Twelve Mile Creek	1	3	3	3	**2.5**
Old Welland Canal	1	3	5	3	**3**
Spring Garden Creek	1	3	5	5	**3.5**
Dicks Creek	1	3	3	5	**3**
Welland Canal	1	1	1	3	**1.5**

1 – Low potential for impact
3 – Medium potential for Impact
5 – High potential for Impact

CSO Ranking Summary

The total score for each CSO was determined by summing the overflow volume score and receiving stream impact score. Overflow locations that did not overflow during the typical year analysis were not included in the ranking. The plant by-pass and CSOs with approved capital works were also not included in the ranking. A summary of the results for each sewershed is presented in Tables 5.13 and 5.14. Three locations had a tied score for the 10th ranking; therefore, 12 sites were carried forward. The top 12 ranking CSOs for the Port Dalhousie and Port Weller sewersheds combined are highlighted in green. These CSOs will be addressed through the priority ranking exercise in further detail and evaluated in the subsequent section of this report.

TABLE 5.13
Port Dalhousie Sewershed – Receiving Stream Impact Summary

Receiving Body	CSO Location	Typical Year CSO Volume	Overflow Volume Score	Receiving Stream Impact Score	Total Score (Max 10)	Overall Rank
Lake Ontario	Cole Farm PS	1117	0.2	2	2.2	39
	Michigan Avenue	12392	1.9		3.9	8
Martindale Pond	Corbett & Bayview	2803	0.4	2.5	2.9	29
	Grote & Carlton	1300	0.2		2.7	31
Twelve Mile Creek	Scott & Ontario	4280	0.7	2.5	3.2	13
	Carlton & Ontario	32282	5.0		7.5	1
	Thomas Street, Henry & Beech, George & Beech	12129	1.9		4.4	7
	Renown Rd PS	17193	2.7		5.2	4
	St. Paul Crescent	214	0.0		2.5	34
	Rivercrest	144	0.0		2.5	34
	Violet Street	571	0.1		2.6	32
	Dittrick Street	550	0.1		2.6	32
	Hillcrest-Rockcliffe, Glenridge-	161	0.0		2.5	34

TABLE 5.13
Port Dalhousie Sewershed – Receiving Stream Impact Summary

Receiving Body	CSO Location	Typical Year CSO Volume	Overflow Volume Score	Receiving Stream Impact Score	Total Score (Max 10)	Overall Rank
	Rockcliffe, South-Rockcliffe, Highland-Rockcliffe, Glenwood-Ridgewood					
	Westchester & O.W. Canal	20085	3.1		5.6	2
	Argyle PS	3396	0.5		3.0	23
	Parkway & O.W. Canal	5236	0.8		3.3	10
	Carlisle-Church, James-King, King Street, Carlisle-St. Paul, James-St. Paul, Court-St. Paul	60	0.0		2.5	34
	Hamilton Street	3838	0.6		3.1	15
	Kent Street	3912	0.6		3.1	15
	Kinsey Street	1813	0.3		2.8	30
Old Welland Canal	Kensington & Woodruff	478	0.1	3	3.1	15
	Eastchester PS	12937	2.0		5	5

TABLE 5.14
Port Weller Sewershed – Receiving Stream Impact Summary

Receiving Body	CSO Location	Typical Year CSO Volume	Overflow Volume Score	Receiving Stream Impact Score	Total Score (Max 10)	Overall Rank
Lake Ontario	Elmwood Ave & QEW	6883	1.1	2	3.1	15
	Beachview & Lake Ontario	2138	0.3		2.3	38
Spring Garden Creek	Forster St. & Linwell (node 422 & 423)	242	0.0	3.5	3.5	9
Old Welland Canal	Oakdale & Marren	2119	0.3	3	3.3	10
	Lincoln & Oakdale at corner	131	0.0		3.0	23
	Turner Cres. & Oakdale	65	0.0		3.0	23
	Haight St. & Disher	70	0.0		3.0	23
	Chestnut & Briarsdale Dr. (node 4102 & 4103)	918	0.1		3.1	15
	Brookdale & Glengarry	355	0.1		3.1	15
	Wedsworth & Hastings	12052	1.9		4.9	6
	Almond & Merritt	2	0.0		3.0	23
	Walnut & Merritt	221	0.0		3.0	23
	Ball & Merritt	584	0.1		3.1	15
	Ursula & Rountree	905	0.1		3.1	15
	Burleigh Hill & Glendale	1716	0.3		3.3	10
	Hartzel & CNR Line	14637	2.3		5.3	3
Dicks Creek	Aerial Sewer Briarsdale	1042	0.2	3	3.2	13

6. Identification and Assessment of Pollution Control Planning Alternatives

6.1 Categories of Control Alternatives

In order to address the top 12 overflows selected within the previous section, it is necessary to examine the various control alternatives that are available to mitigate the occurrence of these CSOs. These alternatives can be grouped into three main categories:

- **Source Controls** – Water use methods such as water conservation or lot level methods that remove, capture or slow the flow of stormwater that may be directed to the storm or sanitary sewer system. Source control alternatives may be applied at a lot level or system wide through municipal programs and policies.
- **Conveyance Controls** – Methods of storing, slowing and/or staggering the flow of excessive amounts of stormwater that has been directed to the sewer system during wet weather events. Conveyance controls can address site specific issues or can be included in system wide maintenance programs.
- **End-of-Pipe Controls** – These controls occur at the end of a flow conveyance system or outfall. They often include some form of water treatment or physical separation.

6.2 Evaluation Methodology

Two approaches were used to evaluate the overall Pollution Control Plan alternatives.

6.2.1 System Wide Policies and Programs Review Approach

System wide policies and programs address various source control and conveyance alternatives. These policies and programs were reviewed in conjunction with Cities of St. Catharines and Thorold operations staff to determine which were currently being undertaken by each City; how these policies and programs could be enhanced and any additional policies or programs which could be added to improve the operation and maintenance of the collection system and, ultimately, improve performance and reduce pollutant discharges.

6.2.2 Site-Specific Infrastructure Upgrades Evaluation Approach

In order to address the site-specific overflows outlined in Section 5.1, an evaluation of conveyance and end-of pipe control technologies was completed. The evaluation included an examination of benefits and impacts of each technology. Each of the control technologies were then modeled for the site-specific CSOs. The benefits and impacts of each control technology, in conjunction with the modeling results were used to determine the most feasible and appropriate technology.

6.3 System Wide Policies and Programs Review

One method of decreasing the volume, frequency and impact of overflows is to control the volume and quality of extraneous flows entering the system at its source. Source control can be achieved through various program and policy initiatives.

6.3.1 St. Catharines

Under the original Pollution Control Plan, St. Catharines initiated a number of pollution control programs and policies in the early 1990s, as described in Section 3.4 of this report. These programs are implemented by City Staff. A review of the existing programs was carried out to determine which programs were working successfully and what, if any, changes were required. In addition, the review attempted to identify any gaps where new programs could be recommended for implementation. The following section includes implementation considerations for these programs to address the objectives of the current PCP.

Downspout Disconnection Program

The City updated its Sewer Use By-Law in 1991. The by-law prohibits the connection and discharge of roof water into the municipal sanitary or combined sewer system. The City has already achieved significant compliance with their downspout (roof leader) disconnection program. Under this by-law over 17,000 properties have been inspected and are compliant. However, continued enforcement is required to ensure that properties remain compliant and it is recommended that this program be continued with a focus on public education and enforced on an as needed basis.

Pet Litter Control Program

The Pet Litter Control Program is an educational program which encourages pet owners to properly dispose of pet wastes. The aim is to decrease the amount of pet waste carried to local water ways via surface run off. As a part of this program, 34 stoop and scoop dispensers have been installed and maintained in City Parks. It is recommended that this program be continued.

Environmental Education Program

The City of St. Catharines carries out an ongoing environmental education and public outreach program with a focus on water conservation and water pollution. This program has included newspaper advertisements, displays at local shopping malls and public events, website information and school presentations. In 2007, in-school presentations were delivered to approximately 2,500 elementary and secondary school students.

In 2007, the City of St. Catharines endorsed a resolution from the Great Lakes and St. Lawrence Cities Initiative and pledged a 15% reduction in City-wide water use by 2015 (based on the amount of water used in 2000). As of 2006, St. Catharines had reduced its water use by 13.5% compared to 2000.

The City of St. Catharines also delivers a public education program targeted at reducing the amount of fats, oils, and grease (FOG) that enter the sanitary sewers. This program specifically targets sewersheds known to have these issues. This program focuses both on residential and commercial users, specifically restaurants.

It is recommended that the Environmental Education Program be continued.

Dry Weather Seepage Abatement

The Dry Weather Seepage Abatement program surveys storm sewer outfalls for flow during dry weather periods. Based on the results of the bacterial testing, homes are investigated for potential cross connections and improperly functioning septic tanks. Remedial measures are recommended and implemented as required. It is recommended that this program be continued.

Citizen’s Reports

Citizens may report to the City, concerns with potential environmental implication. The City documents and responds to these concerns which include spills, illegal dumping, drainage issues, and foul odours. Quick responses often eliminate problems and minimize environmental damage. It is recommended that this program be continued.

Water Quality Monitoring Surveys

City of St. Catharines staff collects and analyze samples from all watercourses and storm sewers within the City boundaries, as well as Lake Ontario. These monitoring programs are necessary to measure improvements over time and to evaluate the water quality of receiving bodies.

One of the requirements of a Pollution Control Plan is the determination of pollutant concentrations and mass loading entering the receiving bodies. In order to measure these factors and monitor their changes over time it is important to have an adequate characterization of the wastewater flows in the combined sewer system. This would include monitoring the conveyance systems both during dry and wet weather periods.

It is recommended that the Water Quality Monitoring Program be continued. In addition it is recommended that this program be expanded to adequately characterize the wastewater flows in the combined sewer system. The program could also be expanded to examine the impact of CSOs on natural environment components and habitat areas.

Beach Water Quality Program

In conjunction with the Niagara Region’s Public Health Department, City of St. Catharines staff collect daily samples at the City’s three recreational beaches during the swimming season (June to September). When the original Pollution Control Plan was developed all of the City’s beaches had permanent swimming advisories by the Public Health Department due to the poor water quality. One of the original goals of the Pollution Control Plan was to post the beaches safe for swimming. In 1994, both Lakeside Beach and Municipal Beach had the permanent swimming advisories lifted and the beaches instead were posted safe or unsafe depending upon the daily sampling results. The number of days both of these beaches have had the swimming advisories has seen steady improvement. In 2007, Lakeside Beach had swimming advisories for 12 days and Municipal Beach had swimming advisories for 46 days. In 2006, Jones Beach had the permanent swimming advisory lifted. In 2007, Jones Beach had swimming advisories for 99 days.

It is recommended that this program be continued and work should continue towards reducing the number of swimming advisories as much as possible. This would include developing an integrated Beach Management Plan including efforts specifically focused on reducing non-point source pollution.

Weeping Tile/Foundation Drain Disconnection

Disconnecting weeping tiles from the sanitary sewer reduces inflow to the sewer that may cause capacity issues. The City of St. Catharines does not currently have a foundation drain disconnection by-law that would address existing systems. Further studies and infrastructure modeling assessments are required to determine the ultimate cost effectiveness of a weeping tile disconnection program in compassion with other conveyance alternatives. Estimating the reduction in wet weather flow due to a disconnection program is extremely difficult, as there is limited data and limited case studies from other communities with similar characteristics. The Regional Municipality of Niagara does have an extraneous flow elimination by-law but this by-law does not address retroactive disconnection.

The City's FLAP program does offer a grant of up to $3,000 for approved works in residential properties that have experienced basement flooding. In the case where the weeping tiles are connected into the sanitary sewer, their disconnection and re-direction to the ground surface (via a sump pump) is required and is an eligible FLAP cost.

Foundation drains are typically only disconnected when the local sewer and service connections are being replaced. The cost to benefit ratio is very high and therefore not an option frequently considered. Drainage area disconnection of foundation drains may not be feasible in low-lying areas where the water table is high. The City should investigate the opportunity and feasibility of establishing a voluntary weeping tile disconnection program partially funded by the municipality and examine the need for a retroactive by-law to address all connections. The initial evaluation should be focused on areas already known to have capacity issues and suspected to have significant foundation drain inflows.

Floatables Control Program

Preventing floatables from reaching local receiving water bodies can be achieved through controlling floatables at source or at site specific discharge locations. As described above, the City has introduced an anti-litter by-law, which helps to decrease the amount of debris which enters the sewer system. To control floatables at overflow locations where control regulators have not been constructed, trash rakes, screens or other mechanical means of separation may be installed.

The City should investigate the feasibility of installing screens or trash rakes on non-controlled CSOs. Where screens or other mechanical devices are installed, it is important that there is a regular maintenance program associated with them. The maintenance program would include regular inspection of the screens with debris removal as necessary. Screens should only be installed where regular inspection and maintenance is feasible. Debris build-up that is not removed could have implications on upstream capacity and could cause sewer back up.

CSO Regulator Inspections and Maintenance

The City of St. Catharines performs regular inspections, cleaning and maintenance on sewer and storage tanks with overflow gates, weirs, bar screens, throttling valves and sluice gates. The regular inspection and maintenance of all CSO regulators should be continued.

Closed Circuit Television (CCTV) Inspections

The City of St. Catharines performs annual closed circuit television (CCTV) inspections at various locations within their sewer system. The goal is to find structural as well as operational defects. Remediation is recommended based on NAAPI coding. CCTV inspections should continue based on specific needs identified within the system.

Catchbasin Cleaning

The City of St. Catharines currently has a regular catchbasin cleaning program. It has been found in the previous PCP studies in St. Catharines that a further enhanced catchbasin cleaning program would not significantly reduce the discharge of pollutants from storm sewers. The current catchbasin cleaning program should be continued.

Street Sweeping Program

The City of St. Catharines currently has an annual street sweeping program. Past studies have determined that further enhancement to the street sweeping program would not significantly reduce the levels of contaminants in storm water and is, therefore, not recommended. The current annual street sweeping program should be continued.

Combined Sewer Separation

The City of St. Catharines has an ongoing sewer separation program aimed at separating areas of the City with combined sewer systems. The annual program includes the removal of storm inflow to the combined system. The diverted storm water must be managed either through an existing storm sewer system or through a new storm system that would be constructed. New storm outfalls require water quality treatment prior to discharge to the natural environment. The sewer separation program should be continued to implement separation in areas that would receive recognized benefit from the program.

Manhole Rehabilitation with Recommended Program Upgrades

The City has undertaken manhole inspection programs in some areas of the City. Manhole rehabilitation and or catchbasin inlet controls is conducted as part of the City's operation and maintenance practices. Manholes are evaluated through the CCTV survey as well. Rehabilitation is recommended based on the survey results. Typically rehab is done as part of road, sewer or water works projects.

Specific attention should be given to manholes located in valleylands and floodplains. During significant wet weather events the water level of the local creeks can rise considerably. In a number of instances sanitary and combined sewers are located within the adjacent valleylands or floodplains. A significant amount of wet weather flow may enter the sanitary and combined sewer system through manholes in these locations. Identifying and providing these manholes with a watertight seal will help keep wet weather flows the

sanitary and combined sewers. It is recommended that the City of St. Catharines continue their inspections and further explore the potential for effective manhole rehabilitation.

Sewer Rehabilitation with Recommended Program Upgrades

The City conducts a sewer rehabilitation program to improve and maintain the capacity of the sewer system. Sewer rehabilitation involves repairing or replacing sewers that have reached their service life or are failing. The City should try to improve on this maintenance program by integrating it with a regularly scheduled sewer inspection program that identifies problem areas before they cause problems to residents or the environment. The City’s rehabilitation program should continue with program enhancements and efficiencies realized through an improved inspection program.

Sewer Flushing/Reaming with Recommended Program Upgrades

As part of a regular maintenance program, sewer flushing is an effective means of preventing sewer and manhole blockages. Sewer lines are flushed using high pressure water. Sewer flushing may also be used to respond to emergency blockages. In the current program the entire sewer system is done on a five-year cycle. Sewer flushing should be performed in conjunction with vacuuming to ensure that debris is not moved downstream causing additional problems. This program also includes a reaming budget of $75,000 per year to address defects related to tree roots and grease issues.

It is recommended that the current sewer flushing program be reviewed. This program should address regular flushing for preventative maintenance as well as approaches for emergencies.

CSO Storage Facility Review

As mentioned within this report, the City of St. Catharines has installed and is in the process of installing new storage facilities within their collection system. The facilities are designed to capture a particular volume of overflow thus reducing the flows that reach the natural environment. Monitoring instrumentation installed in these facilities can provide water level information that can be used to confirm that they are operating to design objectives. This can be achieved through assessment of the monitoring data collected that provides the levels captured and subsequently discharged from the tanks. This information can be used to determine the volume of combined sewage stored as well as how much overflows beyond the capacity of the storage facility. It is recommended that monitoring and assessment of the monitoring data be carried out to provide an annual assessment of CSO storage facility performance. The results of the assessment would indicate the incidents, if any, of over capacity overflow and make recommendations on a process to ensure that these facilities are operating within design parameters.

6.3.2 Thorold

Similar to St. Catharines, the City of Thorold has a number of pollution control programs and policies as part of their municipal programming. These programs are implemented by City Staff. A detailed review of the existing programs was carried out to determine which programs were working successfully and what if any changes were required. In addition,

the review attempted to identify any gaps where new programs could be recommended for implementation.

The following section includes implementation considerations for these programs to address the objectives of the current PCP.

Downspout Disconnection Program

Similar to St. Catharines, the City of Thorold has a downspout disconnect by-law with an associated disconnect program. The City has had success with their downspout (roof leader) disconnection program, specifically in the area of Thorold South. Improvements have been observed since many properties have been inspected and are compliant. However, continued enforcement is required to ensure that properties remain compliant and it is recommended that this program be continued with a focus on public education and enforced on an as needed basis.

Water Conservation Program with Recommended Program Upgrades

The City currently has a Water-use By-Law which allows for water restrictions to be enacted from June 1 to September 1 for watering of lawns or gardens, if required.

The City of Thorold anticipates working with the Niagara Region in the near future to provide ongoing environmental education and public outreach programs with a focus on water conservation and water pollution. This anticipated program should be implemented and updated annually as required.

Weeping Tile/Foundation Drain Disconnection with Recommended Program Upgrades

Disconnecting weeping tiles from the sanitary sewer reduces inflow to the sewer that may cause capacity issues. The City of Thorold does not currently have a foundation drain disconnection by-law that would address existing systems. Further studies and infrastructure modeling assessments are required to determine the ultimate cost effectiveness of a weeping tile disconnection program in comparison with other conveyance alternatives. Estimating the reduction in wet weather flow due to a disconnection program is extremely difficult, as there is limited data and limited case studies from other communities with similar characteristics. The Regional Municipality of Niagara does have an extraneous flow elimination by-law but this by-law does not address retroactive disconnection.

Foundation drains are typically only disconnected when the local sewer and service connections are being replaced. The cost to benefit ratio is very high and therefore not an option frequently considered. Drainage area disconnection of foundation drains may not be feasible in low-lying areas where the water table is high. The City should investigate the opportunity and feasibility of establishing a voluntary weeping tile disconnection program partially funded by the municipality and examine the need for a retroactive by-law to address all connections. The initial evaluation should be focused on areas already known to have capacity issues and suspected to have significant foundation drain inflows.

Citizens' Reports

Citizens may report to the City, concerns with potential environmental implication. The City documents and responds to these concerns which may include spills, illegal dumping,

drainage issues and foul odours and directs them to the appropriate authorities if required. Quick responses often eliminate problems and minimize environmental damage. It is recommended that this program be continued.

Catchbasin and Street Cleaning

Thorold performs routine catchbasin and street cleaning similar to the program in St. Catharines. Past studies in St. Catharines have determined that enhanced street sweeping and enhanced catchbasin cleaning would not significantly reduce the levels of contaminants in storm water. Enhancements of the City's existing program are, therefore, not recommended.

Operations and Maintenance Program

The City of Thorold performs annual closed circuit television inspections at various locations within their sanitary sewer system. Prior to the video inspection, the sanitary sewer is flushed and cleaned. Sewer flushing is an effective means of preventing sewer and manhole blockages. Sewer lines are flushed using high pressure water. Sewer flushing may also be used to respond to emergency blockages. On average, approximately 20 percent of the sanitary sewer collection system is video inspected and flushed each year. The findings from these inspections are placed on a maintenance list and addressed according to their priority and as the sanitary maintenance budget allows**.** In addition, there is also an annual maintenance program for clearing sanitary laterals to address defects related to tree roots and grease issues. It is recommended that these programs be continued.

Manhole Rehabilitation with Recommended Program Upgrades

The City has undertaken manhole inspection programs in some areas of the City. Manhole rehabilitation and or catchbasin inlet controls is conducted as part of the City's operation and maintenance practices. Manholes are evaluated through the video inspection program as well. Rehabilitation is recommended based on the survey results. Typically rehabilitation is done as part of road, sewer or water works projects.

Specific attention should be given to manholes located in valleylands and floodplains. During significant wet weather events the water level of the local creeks can rise considerably. In a number of instances sanitary and combined sewers are located within the adjacent valleylands or floodplains. A significant amount of wet weather flow may enter the sanitary and combined sewer system through manholes in these locations. Identifying and providing these manholes with a watertight seal will help keep wet weather flows the sanitary and combined sewers. It is recommended that the City of Thorold continue their inspections and further explore the potential for effective manhole rehabilitation.

Sewer Rehabilitation with Recommended Program Upgrades

The City conducts a sewer rehabilitation program to improve and maintain the capacity of the sewer system. Sewer rehabilitation involves repairing or replacing sewers that have reached their service life or are failing. The City should try to improve on this maintenance program be integrating it with a regularly scheduled sewer inspection program that identifies problem areas before they cause problems to residents or the environment. The City's rehabilitation program should continue with program enhancements and efficiencies realized through an improved inspection program.

6.3.3 Region of Niagara

Household Hazardous Waste Collection

This source control program focuses on the collection of deleterious chemicals that sometimes are disposed of in a manner that threatens stormwater or sanitary sewage quality. The Region of Niagara currently has a hazardous waste collection program. It is recommended that this program be continued.

6.4 Site-Specific Infrastructure Upgrades Evaluation

Conveyance and end-of-pipe control technologies that address site-specific CSOs were compiled for evaluation. A description of each of these controls is presented below:

- **Weir/overflow adjustment** – adjustment of weir or overflow level to reduce the amount of CSO by conveying more flow through the system. Will cause increased flow to downstream sewers and potential for increasing the hydraulic gradeline upstream.
- **Sewer separation** – separation of combined sewers into separate sanitary and storm systems, applies only to areas that are still combined.
- **Inline storage** – is storage within the existing pipe system that could be taken advantage of through modification to existing control structures (i.e. weirs) or the construction of new control structures. Used only in areas where existing system has excess capacity for storing wet weather flows. This alternative often uses real time controls for weir adjustment.
- **Offline storage** – combines a number of storage alternatives including offline storage (pipes or tanks), sewer replacement or twinning for additional storage capacity or end of pipe tank or tunnel. Specific storage alternative to be used will need to be confirmed using site specific information at a future design stage.
- **Pump capacity upgrades** – includes increasing the pumping capacity at existing stations and applies only where increasing the pumping capacity does not have a negative impact on the downstream system to alleviate the overflow.
- **High Rate Treatment (HRT) and Continuous Deflective Separation (CDS)** – HRT can include a number of technologies from vortex separation technology to high rate screening/filtration, high rate sedimentation and retention treatment basins to remove solids from the wastewater. Some HRT technologies are often applied in conjunction with clarification technologies to achieve an even higher level of solids removal. CDS is an emerging technology that uses vortex principles and screening to treat smaller peak flows than HRT technologies, with a significantly smaller footprint.

HRT and CDS are relatively new technologies with limited applications at this time. These technologies also require additional operation and maintenance support as compared to the other alternatives. For this current update of the PCP, these technologies will not be carried forward in the evaluation process. These options may be re-examined with subsequent updates of the PCP as the technology becomes more proven.

6.4.1 Evaluation Considerations

The benefits and impacts of each control technology on technical, economic, social, and environmental criteria were considered. The purpose of this exercise was to summarize the advantages and disadvantages of each control technology for consideration during the evaluation process. A summary of the results is presented in Table 6.1.

TABLE 6.1
Evaluation Considerations Summary

	Weir/Overflow Adjustment	Sewer Separation	Inline Storage	Offline Storage	Pump Capacity Upgrades
Technical Impacts	• Technically easy to implement • Can only be applied in areas with additional capacity • Can cause increased risk of basement flooding • Places increased strain on pollution control plant during wet weather	• Can be technically challenging due to state of existing infrastructure • Reduces wet weather inflow by removing roadway stormwater from sanitary collection system • Sources from roof leaders and weeping tiles may still contribute to sanitary system	• Can only be implemented in areas with additional system capacity • Can be effective means of reducing basement flooding and CSOs	• Typically most cost effective means of controlling basement flooding related to wet weather flow • Moderate difficulty to implement depending on land availability and site conditions	• Only available at pump station • Will increase flows to downstream system and treatment facility • Large variance between dry weather and wet weather pumping capacity may make alternative infeasible
Economic Impacts	• Low capital costs compared to other alternatives • Low O&M costs	• Typically carried out in conjunction with road and watermain upgrades • High capital costs associated with entire construction	• Cost can vary based on method to utilize in system storage • Installing a weir would have moderate costs while installing new pipes to convey flow to other areas can have high costs	• High capital costs • High O&M costs	• Moderate capital costs due to cost of mechanical equipment • O&M costs similar to normal operation
Social Impacts	• Adjustments would cause limited disruptions to public • Increased risk of basement flooding may concern residents	• Major disruptions to public including road closures • Will decrease risk of basement flooding in affected area	• Installation of a weir structure would cause minimal impact to public • New sewers could involve road closures	• Construction may significantly disrupt surrounding neighbourhood • If available open space is used, impact on private property would be minimized	• Implemented using existing infrastructure, impact on residents should be minimal • Increased risk of basement flooding downstream of pump station

TABLE 6.1
Evaluation Considerations Summary

	Weir/Overflow Adjustment	Sewer Separation	Inline Storage	Offline Storage	Pump Capacity Upgrades
Environmental Impacts	• Will reduce the amount of CSOs discharged to the environment • Implementation would have little or no impact on surrounding site environment	• Road sewer separation removes stormwater from the sanitary system and decreases the frequency of CSOs • Larger quantity of stormwater will discharge to environment through stormwater collection system	• Will reduce CSOs by directing more flow to treatment facility • Implementation could have little to moderate impact on surrounding environment	• This alternative would prevent a large quantity of CSO from discharging to the environment • Impact during construction would be confined to surrounding area	• Will help alleviate CSOs • Construction should have limited impact on surrounding area

6.4.2 Level of Protection

In order to choose the most appropriate control technology alternative(s) for a specific overflow location the feasibility of each of the alternatives and the level of protection provided by the alternatives on a site-specific basis was assessed. The future system-wide conformance will be estimated once the preferred alternatives are selected.

The City of St. Catharines has historically used a two-year design storm to size CSO alternatives.

6.4.3 Site Selection Summary

CSOs that already have capital works in the design or construction phase will not, as discussed previously, be included in the evaluation process. These projects and their expected performance were outlined in Section 5.2. The estimated cost and scheduling for these projects will be considered when developing the implementation plan.

As a result of the volumetric and environmental ranking in Section 5.4, 12 sites were selected for evaluation. The sites are presented in Table 6.2 along with results for the typical year and two-year design storm analysis.

TABLE 6.2
Locations Included for Site-Specific CSO Evaluation

CSO Location	Rank	Sewer -shed	Typical Year (1989) Analysis			2-Year Design Storm	
			Freq.	Overflow Volume (m^3)	% Capture	Peak Flow (L/s)	Overflow Volume (m^3)
Carlton & Ontario	1	PD	4	32282	92.1	2680	8680
Westchester & O.W. Canal	2	PD	26	20085	75.3	760	2870
Hartzel & CNR Line	3	PW	3	5650	87.6	1610	4110
Renown Road PS	4	PD	5	17193	95.7	500	4300
Eastchester PS	5	PD	38	12937	69.8	320	1340
Wedsworth & Hastings	6	PW	33	12052	57.9	770	1790
Thomas Street, Henry & Beech, George & Beech	7	PD	5	12129	95.7	2360	4470
Michigan Avenue	8	PD	26	12392	83.3	810	1620
Forster & Linwell	9	PW	2	242	98.9	40	90
Parkway & O.W. Canal	10	PD	4	5236	95.2	1550	1890
Oakdale & Marren	10	PW	3	2119	98.2	160	640
Burleigh Hill & Glendale	10	PW	4	1716	80.0	60	380

6.4.4 Site-Specific CSO Evaluation

Using the evaluation considerations presented earlier, a modeling exercise was undertaken for the 12 selected CSOs to determine which alternatives are feasible at each location. Conveyance controls, such as adjusting the overflow weir or sewer separation, were evaluated first, since conveyance controls typically use existing infrastructure and are easier to implement. End-of-pipe or offline storage was considered second, since they would require construction of new facilities and have high associative costs.

A description of the methods used to determine the feasibility of each alternative in the model is presented below. In addition, reasons for non-feasibility of alternatives were common at a number of locations. These reasons are described below for each technology.

Weir/Overflow Adjustment

Weir and overflow adjustments were evaluated in the model by raising the elevation at which a CSO begins to discharge. The overflow volume and downstream flow conditions were monitored to determine the effectiveness of the control. Common reasons that weir and overflow adjustments were found not to be feasible included minimal impact on the CSO volume or frequency, and/or increased risk of basement flooding in the area based on the surcharged water level or hydraulic gradeline levels. Weir adjustments in the model were examined at the outfall location. Where multiple upstream regulators contribute to one outfall, examination of these regulators would need to be examined at a more site-specific level.

Sewer Separation

Sewer separation was evaluated by examining the City of St. Catharines sewer mapping. These maps indicated sewers that were separated, partially separated or combined. Sewer separation was not feasible in sewer catchments where separated sewer systems currently

predominate. For these areas, partial connections (i.e. weeping tiles and roof leaders) should be confirmed and options for disconnection brought forward.

Inline Storage

Inline storage was evaluated by examining the area upstream of each CSO and identifying sewers that have available capacity during the typical year simulation. The absence of excess system capacity during wet weather flow events was a common reason for the inline storage control not being feasible.

Offline Storage

For the majority of CSOs offline storage is a feasible alternative. The model results for the typical year simulation were used to determine the size of storage required. At this stage, method of offline storage has not been confirmed and could include an end of pipe tank, an offline tank within the system or increasing the size of or twinning of an existing sewer.

Pump Capacity Upgrades

Increased pumping capacities were evaluated in the model to determine their effectiveness. The control was found to be not feasible if the flow increase would cause downstream surcharging or if the increased pumping rates were impractical when compared to typical dry weather flow capacity.

The results of the evaluation are summarized in Table 6.3. Within the table, ✘ denotes alternatives which are not feasible at this location, ✓shows alternatives which are feasible. Further details on each of the options, on a site-specific basis, are provided later in Section 7.2.

TABLE 6.3
Site-Specific CSO Alternative Evaluation Results

CSO Location	Weir/Overflow Adjustment	Pump Capacity Upgrades	Sewer Separation	Inline Storage	Offline Storage
Carlton & Ontario	✘	✘	✓	✘	✓
Westchester & O.W. Canal	✘	✘	✓	✘	✓
Hartzel & CNR Line	✘	✘	✓	✘	✓
Eastchester PS	✘	✘	✓	✘	✓
Renown Road PS	✘	✘	✘	✘	✓
Wedsworth & Hastings	✘	✘	✓	✘	✓
Thomas Street, Henry & Beech, George & Beech	✘	✘	✓	✘	✓
Michigan Avenue	✓	✘	✘	✘	✘
Forester & Linwell	✓	✘	✓	✘	✓
Parkway & O.W. Canal	✘	✘	✓	✘	✓
Oakdale & Marren	✘	✘	✘	✘	✓
Burleigh Hill & Glendale	✘	✘	✓	✘	✓

7. Description of the CSO Preferred Solutions

The previous section of this report evaluated various CSO control options to determine which alternatives were feasible at each of the overflow locations. This section will describe considerations for each of the overflow locations in further detail. Based on the evaluation, the consideration of options at each location includes storage as a primary control alternative. There are, however, at various locations, other feasible alternatives that may be determined, through subsequent detailed EA assessments to provide benefit to the final control alternative(s) implemented. In some cases, for instance, there are locations that may be appropriate for sewer separation that would, ultimately, reduce the volume and cost of the recommended storage option. The implementation approach for each of the 12 locations includes, therefore, discussion of additional options which may provide benefit to the primary storage control option.

7.1 Approved Projects

The following projects related to CSO abatement are either in the design or construction phase:

- Welland/Ontario (7,000 m^3 storage tank) – Under Construction
- Page Street (920 m^3 storage) – In Design
- Capner/Oakdale (1,030 m^3 storage) – Under Construction
- Guy Road (1,400 m^3 additional storage) – Under Construction
- City of Thorold – North end – 3 storage tanks (400 m^3, 400 m^3, and 600 m^3) – Under Construction

A detailed description of these projects can be found in Section 3.3 and their estimated improvement on CSO discharge is described in Section 5.2.

7.1.1 Cost Estimates of Approved Projects

The estimated cost for approved capital works is shown in Table 7.1. These cost estimates were taken from existing studies and reports for each individual project.

TABLE 7.1
Approved Capital Projects – Cost Estimates

Sewershed	Location	Recommendation	Estimated Costs
Port Dalhousie	Welland/Ontario	7,000 m^3 storage	$7,000,000
	Page Street	920 m^3 storage	$1,500,000
	Capner/Oakdale	1,030 m^3 storage	$1,200,000
Port Weller	Guy Road	1,400 m^3 storage	$1,610,000
	Lockview Park[1]	2,500 m^3 storage	Not Available
	Thorold Storage	Total – 1,400 m^3 storage (includes 3 tanks)	$4,500,000

[1]Lockview park storage intended to alleviate basement flooding, not CSOs. Also alleviates WWTP overflows.

7.2 Recommended Projects

The following section describes recommended approaches for each of the 12 sites identified as critical locations for CSO abatement. The location of each of these projects is shown in Figure 7-1. A description and detailed map is also presented for each outfall location. These maps show graphically some of the considerations for the feasibility of the CSO alternatives.

7.2.1 Description of Recommended CSO Control Projects

Carlton & Ontario

The drainage area for the Carlton & Ontario outfall is very large and consists mainly of combined sewers. These combined sewers contain numerous CSO regulators that control flow to the Carlton & Ontario outfall. The Carlton & Ontario outfall discharges to Twelve Mile Creek and is located on General Motors property. Figure 7-2 shows the drainage area for the Carlton and Ontario outfall and its associated points of interest.

There are numerous regulators that are within the Carlton & Ontario drainage area and which overflow to relief sewers that ultimately discharge to other outfalls. Raising these weirs will create an increased risk of basement flooding and may only divert wet weather flow to other outfalls. Weir adjustment is therefore not a feasible solution to alleviate CSOs in this area.

The large amount of combined sewers within the Carlton & Ontario drainage area presents an opportunity for sewer separation. There is a large amount of wet weather inflow to the system during storm events that contribute to the overflow volume.

The Carlton & Ontario outfall discharges a high volume of CSO to Twelve Mile Creek. Approximately 8,700 m^3 of conventional storage would be required to capture the overflow from a two-year design storm.

Thomas Street, Henry & Beech, and George & Beech

The Thomas Street, Henry & Beech, and George & Beech CSOs discharge to Twelve Mile Creek near Kensington Place & Ontario Street via a relief sewer. The drainage area for these overflows is located within the same dry weather catchment as the Carlton & Ontario outfall, as illustrated in Figure 7-2.

Raising the weirs at these regulators will increase the flow to the Carlton & Ontario outfall during wet weather events. Weir adjustment is therefore not a feasible alternative.

Similar to Carlton & Ontario, there is opportunity for upstream sewer separation due to the large number of combined sewers.

Conventional storage would require 4,470 m^3 of storage based on the two-year design storm. The overflow manhole is located within a recreational park. Land availability will need further investigation before designing the chosen alternative.

FIGURE 7-1
Recommended Projects

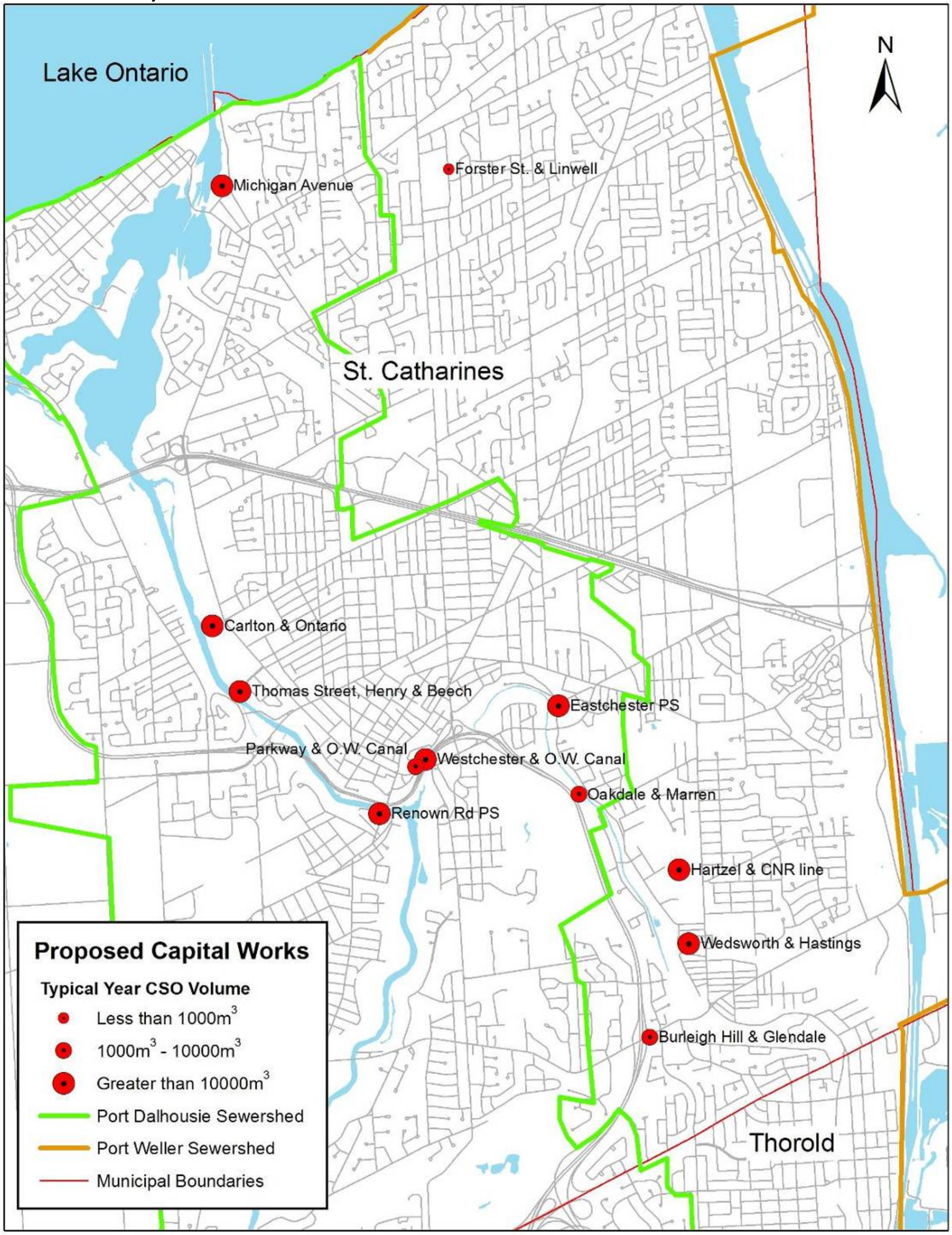


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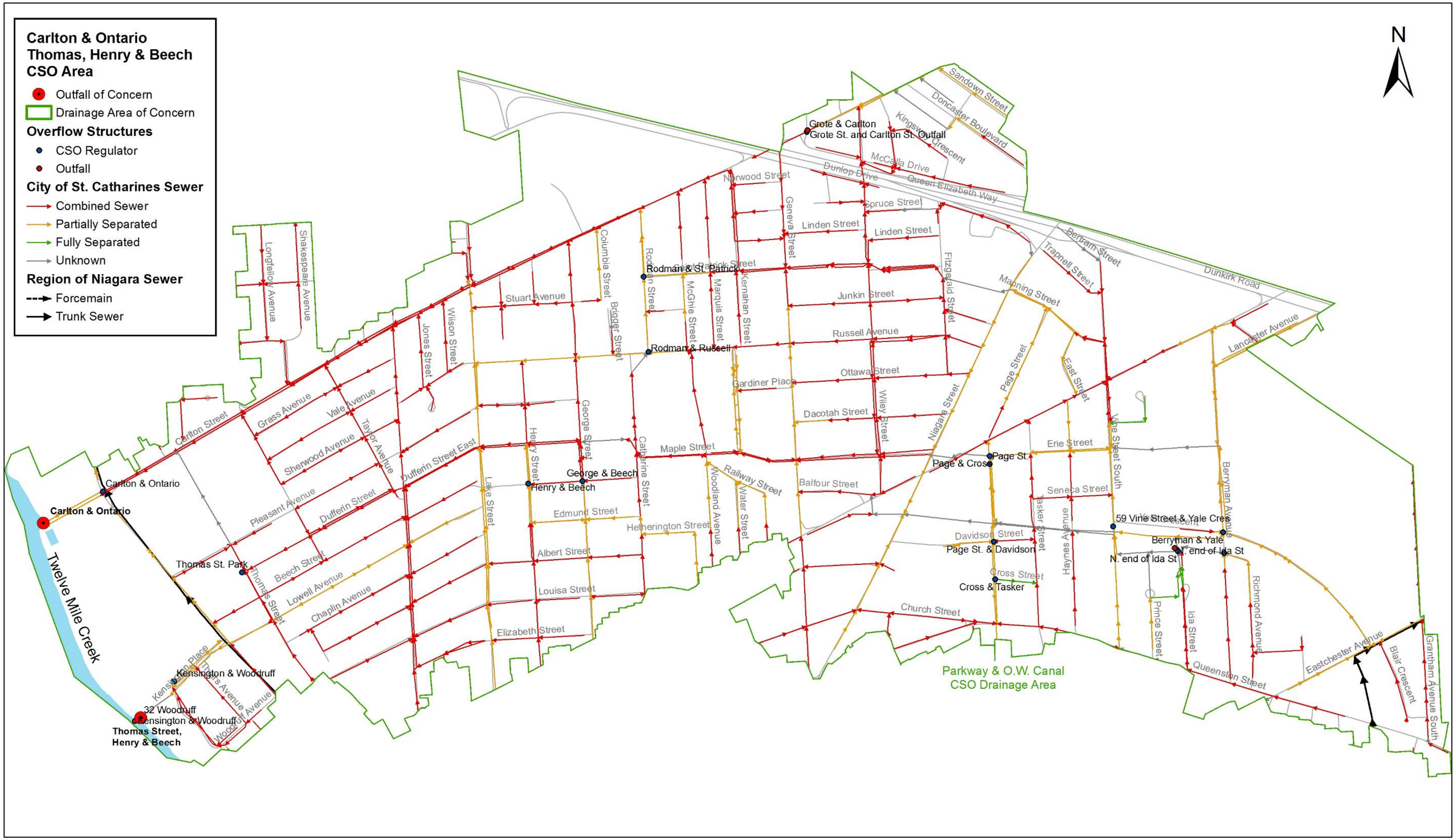
FIGURE 7-2
Carlton & Ontario



The proximity of the Thomas, Henry, and Beech Street outfall to the Carlton and Ontario outfall makes a combined facility a possibility. The Thomas outfall is approximately 500 m south of the Carlton & Ontario outfall. Increasing the capacity of the trunk sewer between the two sites and installing a larger facility at the Carlton & Ontario CSO should be investigated. Since the drainage areas for both outfalls are inter-connected, there is also opportunity for combined source control initiatives.

Westchester & Old Welland (O.W.) Canal

The drainage area for the Westchester and O.W. Canal outfall consists of mainly combined sewers. The outfall discharges to Twelve Mile Creek. Several regulators upstream of the Westchester & O.W. Canal outfall also discharge wet weather flow to Twelve Mile Creek via relief sewers. Argyle PS, the St. Catharines Golf & Country Club, and Burgoyne Woods Park also fall within the drainage area for the Westchester & O.W. Canal outfall. The drainage area is bordered on the north by the Parkway & O.W. Canal CSO drainage area, and on the east by the Eastchester PS CSO drainage area. Figure 7-3 illustrates the drainage area and points of interest for the Westchester & O.W. Canal outfall.

A site-specific Class Environmental Assessment for this CSO location was completed in 2003. The recommendation from this investigation was the construction of an end of pipe 3,000 m^3 storage tank to be located in the area of the lower level parking lot. Following the recommendation a detailed design, including a geotechnical investigation, was completed. Based on the design and selected location a construction cost of $5,307,905 was estimated to complete the recommended undertaking. Based on this estimate, the City has decided to further investigate additional alternatives which may potentially reduce the size of storage element required. Sewer separation may be a feasible alternative to reduce upstream wet weather flow due to the large amount of combined sewers upstream of the Westchester & O.W. Canal outfall. It should be noted that sewer separation in older built out areas can be challenging due to the lack of existing stormwater management facilities and/or the space requirements for new management facilities for the stormwater once it has been separated.

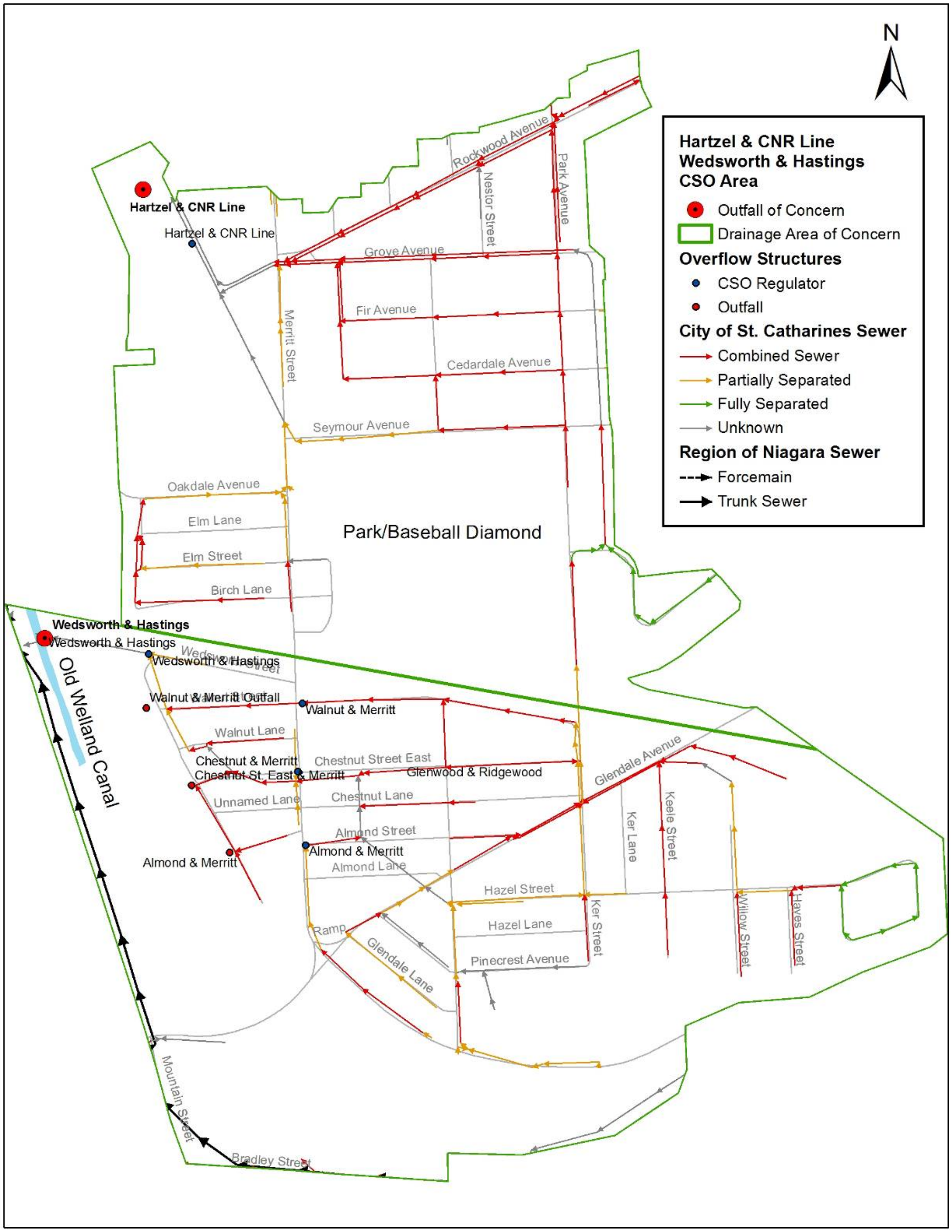
Hartzel & CNR Line

The drainage area for the Hartzel and CNR Line outfall is located in the Port Weller sewershed and consists of both combined and partially separated sewers. The outfall discharges to Old Welland Canal. The drainage area is bordered to the south by the Wedsworth & Hastings CSO drainage area. These two drainage areas are inter-connected by the sewers in the Ker Street & Glendale Avenue area. The drainage area and points of interest for the Hartzel & CNR Line outfall and Wedsworth & Hastings outfalls are shown in Figure 7-4.

As part of previous studies, a recommendation of a 2,360 m^3 storage facility was made for the Hartzel & CNR Line location. The capital cost estimate for this undertaking was $3,100,000, not including the cost of land acquisition. Following this recommendation, potential locations for the proposed storage were investigated. Results of this investigation found that land availability was limited in proximity to the Hartzel & CNR overflow. The City decided that further study was necessary to examine alternate measures that could be implemented such as source control and upstream regulator adjustment, that could decrease the size of storage required.

FIGURE 7-3
Westchester & O.W. Canal

FIGURE 7-4
Hartzel & CNR Line, Wedsworth & Hastings



Based on current modelling results, a 4,110 m^3 storage facility would be required to capture a two-year design storm.

As indicated there is opportunity for upstream sewer separation for the areas that are still combined. Where the sewers have been partially separated, the remaining wet weather influence should be examined to determine whether or not source control, such as weeping tile disconnection, would have an impact in overall volume reaching the Hartzel & CNR overflow. These measures should be investigated in further detail to determine if the storage volume required can be reduced.

Wedsworth & Hastings

The drainage area for the Wedsworth & Hastings outfall is located south of the Hartzel & CNR Line outfall drainage area and also consists of combined and partially separated sewers.

Based on the two-year design storm, a 1,790 m^3 storage facility would be required if conventional storage was chosen.

Three small overflows are in the vicinity of the Wedsworth & Hastings CSO along Merritt Street. If storage is chosen as the selected alternative, an investigation into diverting additional flow to the Wedsworth & Hastings site should be considered during the design of storage for this location.

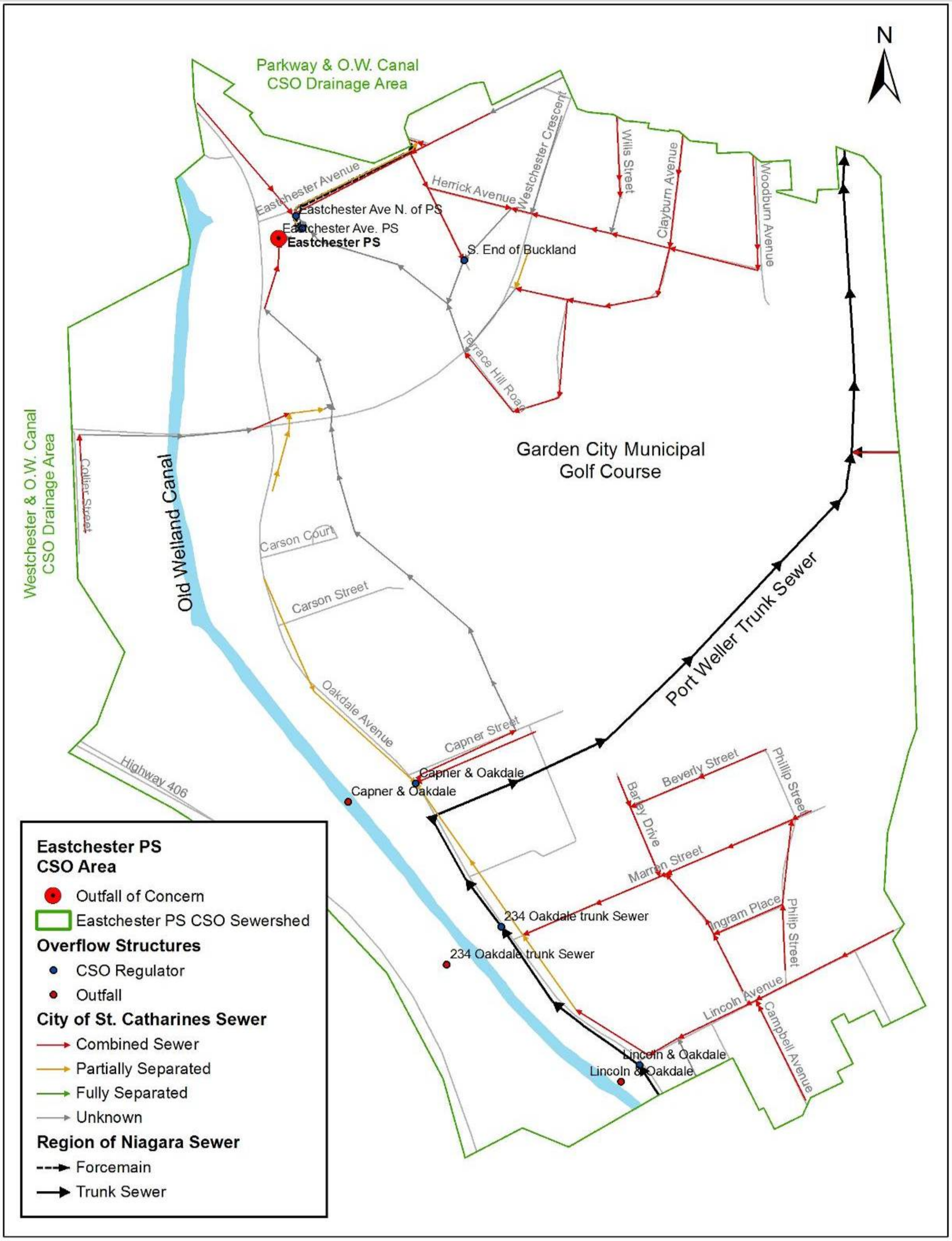
The proximity and inter-connection of the Hartzel & CNR Line outfall and Wedsworth & Hastings outfall drainage areas make them a good candidate for a joint study examining abatement alternatives.

Eastchester PS

The Eastchester PS drainage area is located in the Port Dalhousie sewershed and consists of combined and partially separated sewers. The pump station CSO outfall discharges to Old Welland Canal. The drainage area is bordered on the north by the Parkway & O.W. Canal CSO drainage area, and on the west by the Westchester & O.W. Canal CSO drainage area. Figure 7-5 illustrates the drainage area and points of interest for the Eastchester PS outfall.

A large increase in pump station capacity would be required to alleviate the overflow and is not feasible As there is also limited capacity for additional wet weather flow in the downstream sewer network, making an increase in pump station output undesirable. There is opportunity for sewer separation in the Eastchester PS drainage area since it is a primarily combined area. A storage facility at the Eastchester PS is also feasible. Approximately 1,350 m^3 of storage would be required to capture a two-year storm under existing conditions.

FIGURE 7-5
Eastchester PS



The Eastchester PS overflow is downstream of the Capner & Oakdale CSO, which currently has capital improvements in the design stage. This includes a combination of sewer separation and CSO storage. The Capner & Oakdale storage will pump out to the Port Weller Trunk Sewer, reducing the wet weather flow to the Eastchester PS. The Eastchester PS flows will be significantly affected by these capital works. It is recommended that the flows to Eastchester PS be monitored after the Capner and Oakdale works are completed to determine their effect.

No capital works are currently recommended to the Eastchester PS. Flows to the pump station should be monitored once the upgrades at the Capner & Oakdale CSO are completed. Following the commissioning of these works, further modeling and calculations will be required before determining appropriate alternatives for the Eastchester PS.

Renown Road PS

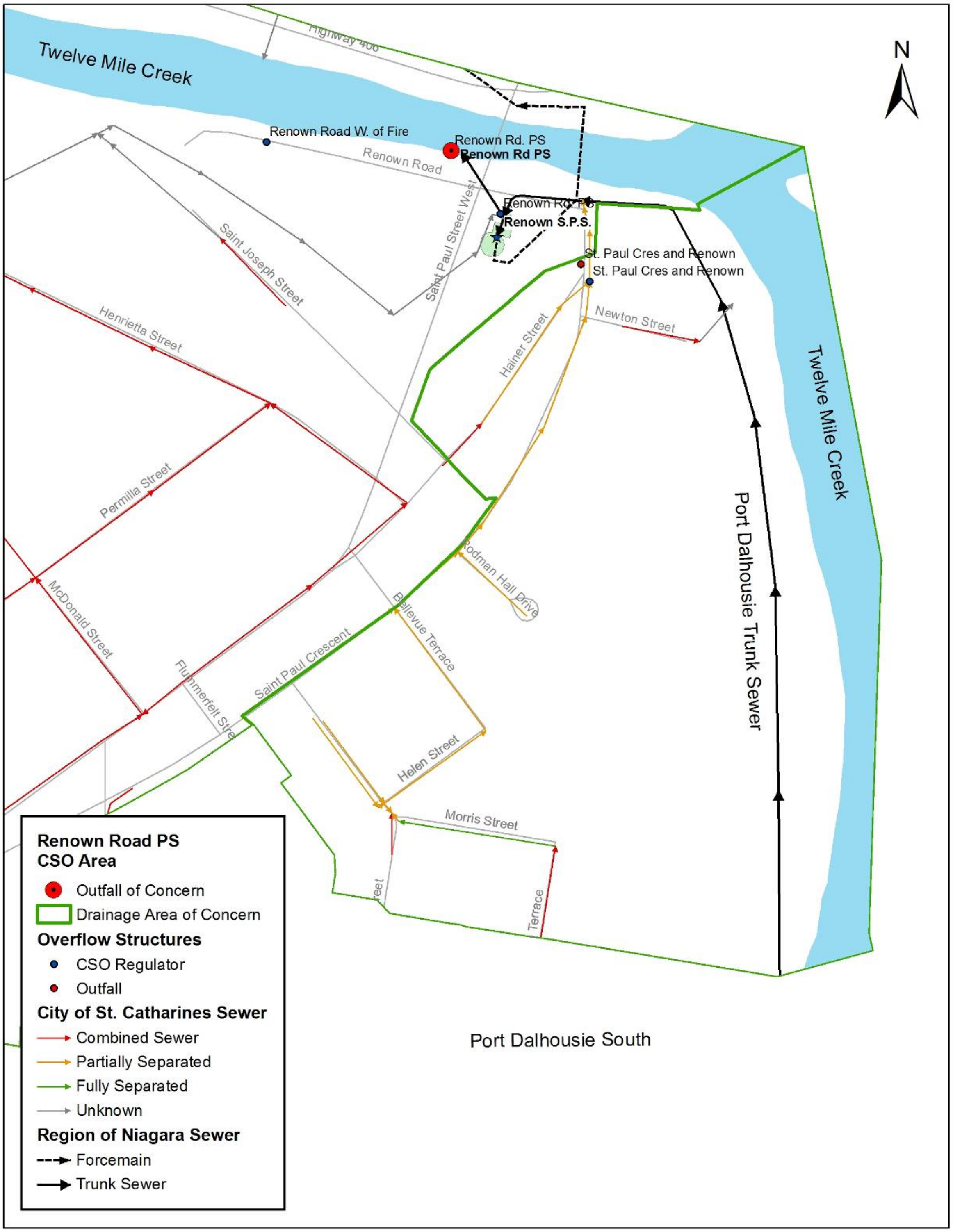
The Renown Road PS drainage area is located in the Port Dalhousie sewershed. It is located on the Port Dalhousie Regional Trunk Sewer and collects from a large portion of southwest Port Dalhousie. The drainage area includes combined, partially separated, and separated sewers. The CSO outfall discharges to Twelve Mile Creek. Figure 7-6 illustrates the points of interest in the vicinity of Renown Road PS.

The Renown Road PS already has significant pump station capacity due to the large drainage area that it collects from. Increasing the pump capacity to address the wet weather flows would require significant reconfiguration of the wet. In addition, the pump station forcemain flows to the Regional Trunk sewer, which has limited additional capacity to accept an increase in wet weather flow.

A 4,300 m^3 conventional storage facility would be required to capture a two-year design storm. Source control alternatives should be examined at the site specific level to determine if upstream wet weather flows can be reduced, decreasing the size and cost of the storage requirements. Land may be available for capital works within the existing boundaries of the pump station property. Land availability should be confirmed as part of the subsequent Class EA.

The Renown Road PS is approximately 60 m downstream of the St. Paul Crescent CSO. Any alternative for the PS should consider potential integration of the flows from St. Paul Crescent, reducing or eliminating this CSO.

FIGURE 7-6
Renown Road PS



Michigan Avenue

The Michigan Avenue CSO is approximately 100 m upstream of the Port Dalhousie WWTP. The drainage area collects from the Lakeside PS drainage area and a small portion of combined gravity sewer. The overflow occurs due to a reduction in pipe diameter from 525 mm to 350 mm at the Michigan Avenue CSO. The CSO outfall discharges to the Port Dalhousie Harbour in Lake Ontario. Figure 7-7 illustrates the points of interest in the vicinity of the Michigan Avenue CSO.

The storage that would be required to capture a two-year design storm at the Michigan Avenue CSO is 1,620 m^3.

The Lakeside PS acts as a control point upstream of the Michigan Avenue CSO and is not the main cause of the overflow. The combined area to the southwest of the Michigan Avenue CSO contributes a large amount of wet weather inflow to the system. Sewer separation in this area would help alleviate wet weather overflow at the Michigan Avenue CSO.

Due to the proximity to the treatment plant, it is recommended that no capital works be constructed at the Michigan Avenue CSO. The Michigan Avenue CSO overflows at a higher frequency than the treatment plant. During the typical year simulation the Michigan Avenue CSO overflows 26 times versus six times during the typical year at the WWTP. Therefore, increasing the flow through capacity to the plant will allow more CSO to be treated during moderate events.

The 2008 North East Servicing Study, completed by the Region, recommends the construction of a Wet Weather Flow Facility (WWFF) at the Port Dalhousie WWTP. A copy of the draft Executive Summary from this report has been included in Appendix I. Consideration should be given to sizing the WWFF to accept the additional flows diverted from the Michigan Avenue CSO. The pipe capacity to the plant should be increased from the current 350 mm pipe to 525 mm pipe allowing flow to be conveyed to the new facility. Further investigation on the impact of increased wet weather flow to the WWFF will need to be conducted as part of the preliminary design of the facility.

FIGURE 7-7
Michigan Avenue

Forster & Linwell

The Forster & Linwell CSO is located in the Port Weller sewershed, near Guy Road Park. The CSO discharges to Spring Garden Creek, which received the highest score from the Receiving Stream Impact Summary (Table 5.12). The drainage area for the Forster & Linwell CSO contains both combined and partially separated sewers, and is illustrated in Figure 7-8.

The storage volume required to capture a two-year storm at the Forster & Linwell CSO outfall is 90 m^3. It would not be cost-effective to construct a stand alone storage facility for this outfall. The approved capital works at Guy Road Park will add an additional 1,400 m^3 of storage to the system. The overflow at Scott & Forster & Forster and Linwell may be able to be re-directed to this facility. Further flow monitoring and modeling upgrades are recommended once these upgrades are completed to ensure the additional storage is being utilized to the fullest.

There is opportunity for sewer separation upstream of the Forster & Linwell CSO to help alleviate wet weather flow. This should be looked at to compliment the Guy Road storage upgrades.

Parkway & Old Welland (O.W.) Canal

The drainage area for the Parkway & O.W. Canal outfall consists of combined and partially separated sewers. The outfall discharges to Twelve Mile Creek. Several regulators upstream of the Westchester & O.W. Canal outfall also discharge wet weather flow to the Old Welland Canal via relief sewers. The Eastchester PS forcemain discharges to the Parkway & O.W. Canal drainage area. The drainage area is bordered on the south by the Westchester and O.W. Canal CSO drainage area, and on the east by the Eastchester PS CSO drainage area. Figure 7-9 illustrates the drainage area and points of interest for the Parkway & O.W. Canal outfall.

There is opportunity for sewer separation upstream of the Parkway & O.W. Canal CSO.

A storage volume of 1,890 m^3 would be required to capture a two-year event. The outfall for the Parkway & O.W. Canal CSO is located near the Westchester & O.W. Canal outfall. The opportunity for upstream source control as well as a combined storage facility to capture both overflows should be investigated further.

FIGURE 7-8
Forester & Linwell

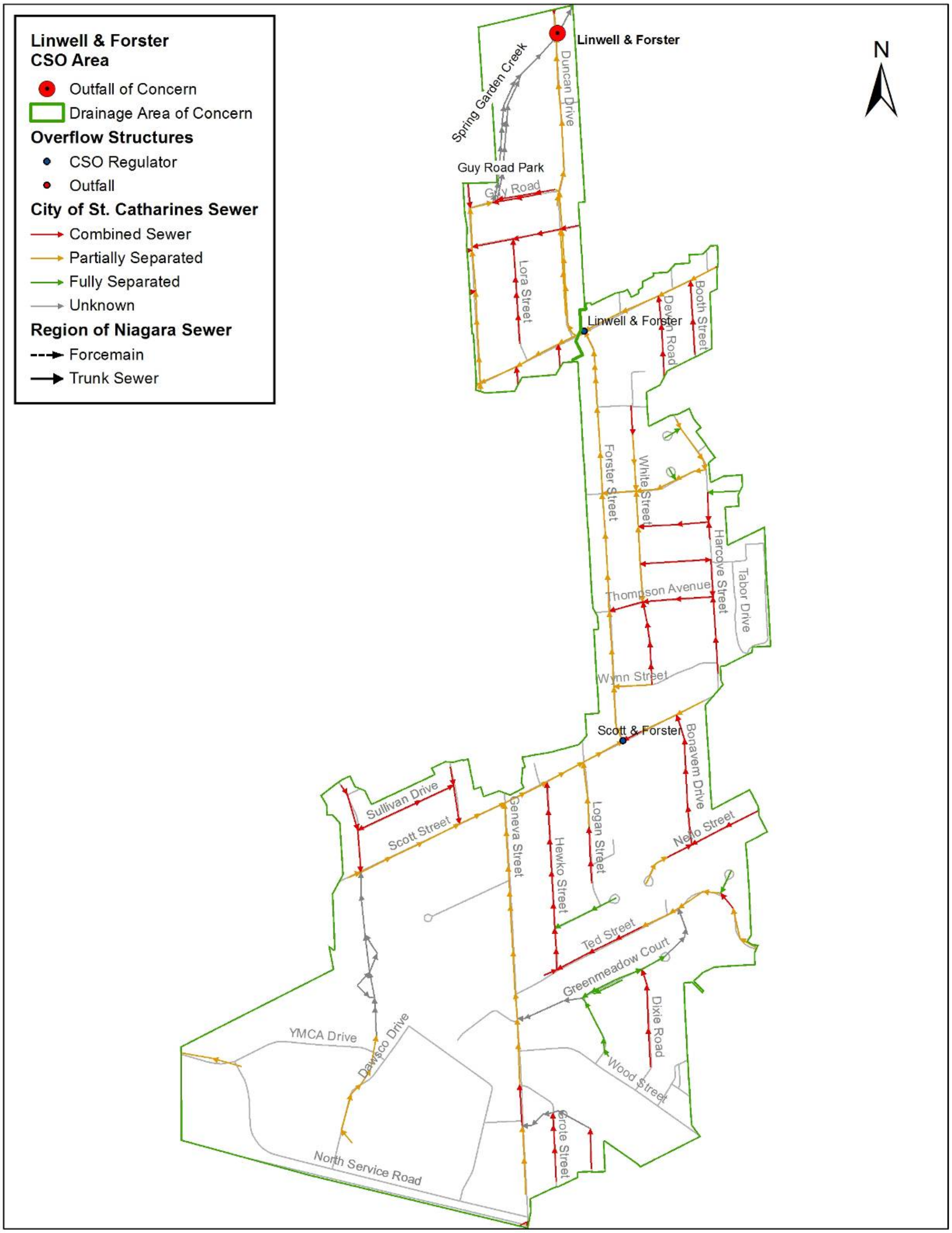
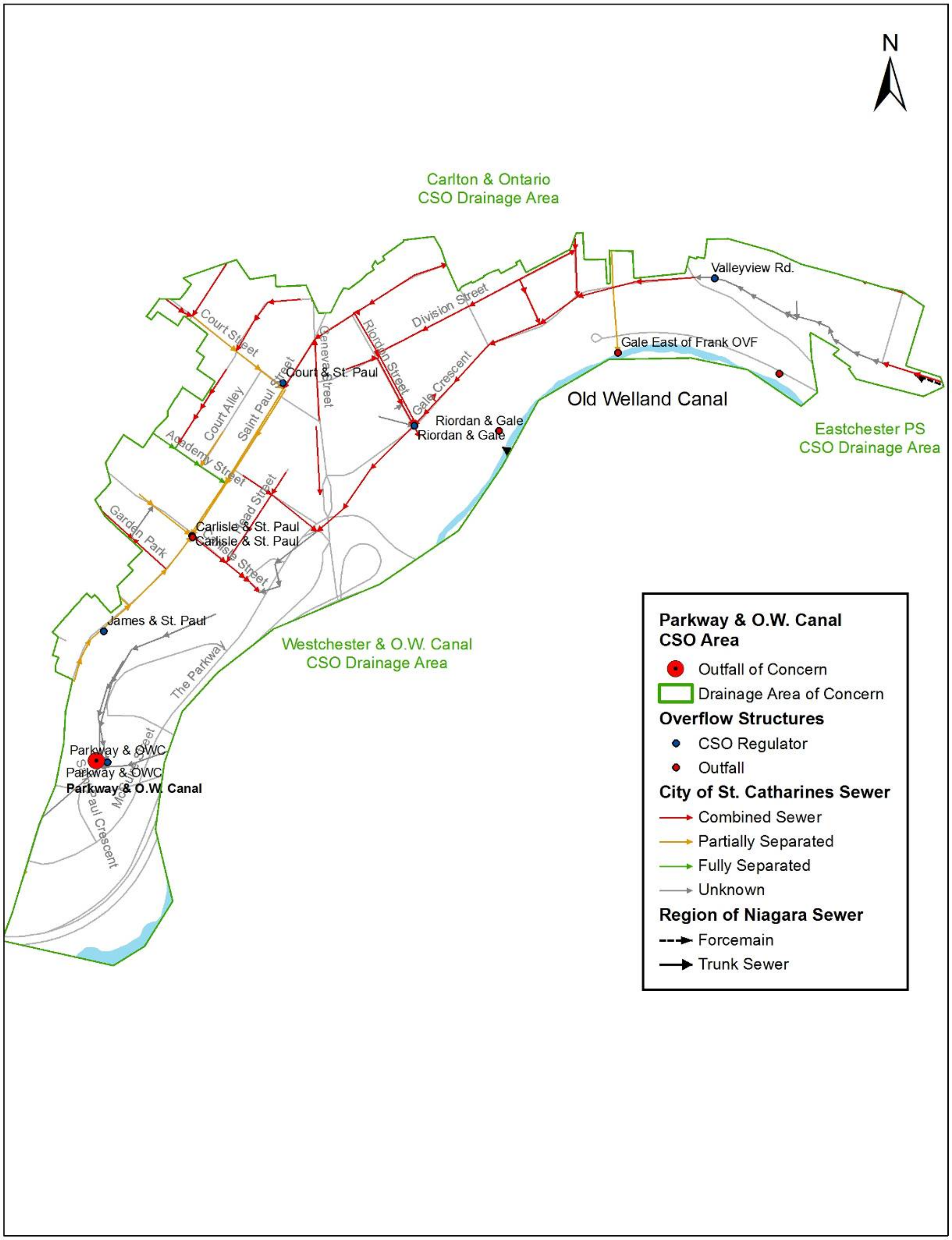


FIGURE 7-9
Parkway & O.W. Canal



Oakdale & Marren

The Oakdale & Marren CSO is located along the Port Weller Trunk Sewer and discharges to the Old Welland Canal. The drainage area for the CSO collects from a large portion of south Port Weller. The Oakdale & Marren CSO and surrounding points of interest are illustrated in Figure 7-10.

Since the Oakdale & Marren CSO is located along the Regional Trunk Sewer, there is limited opportunity for sewer separation that will have a direct impact on the overflow.

A storage volume of 640 m^3 would be required to capture a two-year storm event at the Oakdale & Marren outfall.

Burleigh Hill & Glendale

The Burleigh Hill & Glendale CSO is located in the Port Weller sewershed. The drainage area is small and consists of combined and partially separated sewers. The Burleigh & Glendale outfall discharges to Old Welland Canal. The drainage area for the Burleigh Hill & Glendale CSO is illustrated in Figure 7-11.

Approximately half of the upstream contributing area is combined, so there is some opportunity for sewer separation within the Burleigh Hill & Glendale drainage area. Sewer separation as well as reduction of flow from the partially separated areas should be investigated further in a subsequent EA.

A storage volume of 380 m^3 would be required to capture the overflow from a two-year design storm.

Port Dalhousie and Port Weller Wastewater Treatment Plants

Although not addressed within this report, there are overflows/bypasses which occur at each of the WWTPs during wet weather events. As indicated in Table 5.1 of this report, the Port Dalhousie WWTP, under existing conditions and during the typical year (1989) storm analysis, had an overflow frequency of 6 during the seven wet weather months in the analysis and an overflow volume of 48,229 m^3. Similarly in Table 5.2, the Port Weller WWTP, under existing conditions and during the typical year (1989) storm analysis, had an overflow frequency of 4 during the seven wet weather months in the analysis and an overflow volume of 35,381 m^3. Recommendations for these overflows are being addressed as part of the North East Servicing Study and will be investigated further as part of the Regional Water and Wastewater Master Plan Update anticipated in 2008. Initial recommendations from the North East Servicing Study include the construction of wet weather flow facilities at the Port Dalhousie and Port Weller WWTPs. An additional recommendation from the North East Servicing Study that is relevant to the PCP study area is the provision of an interconnection between the Port Weller and Port Dalhousie regional sewer systems.

FIGURE 7-10
Oakdale & Marren

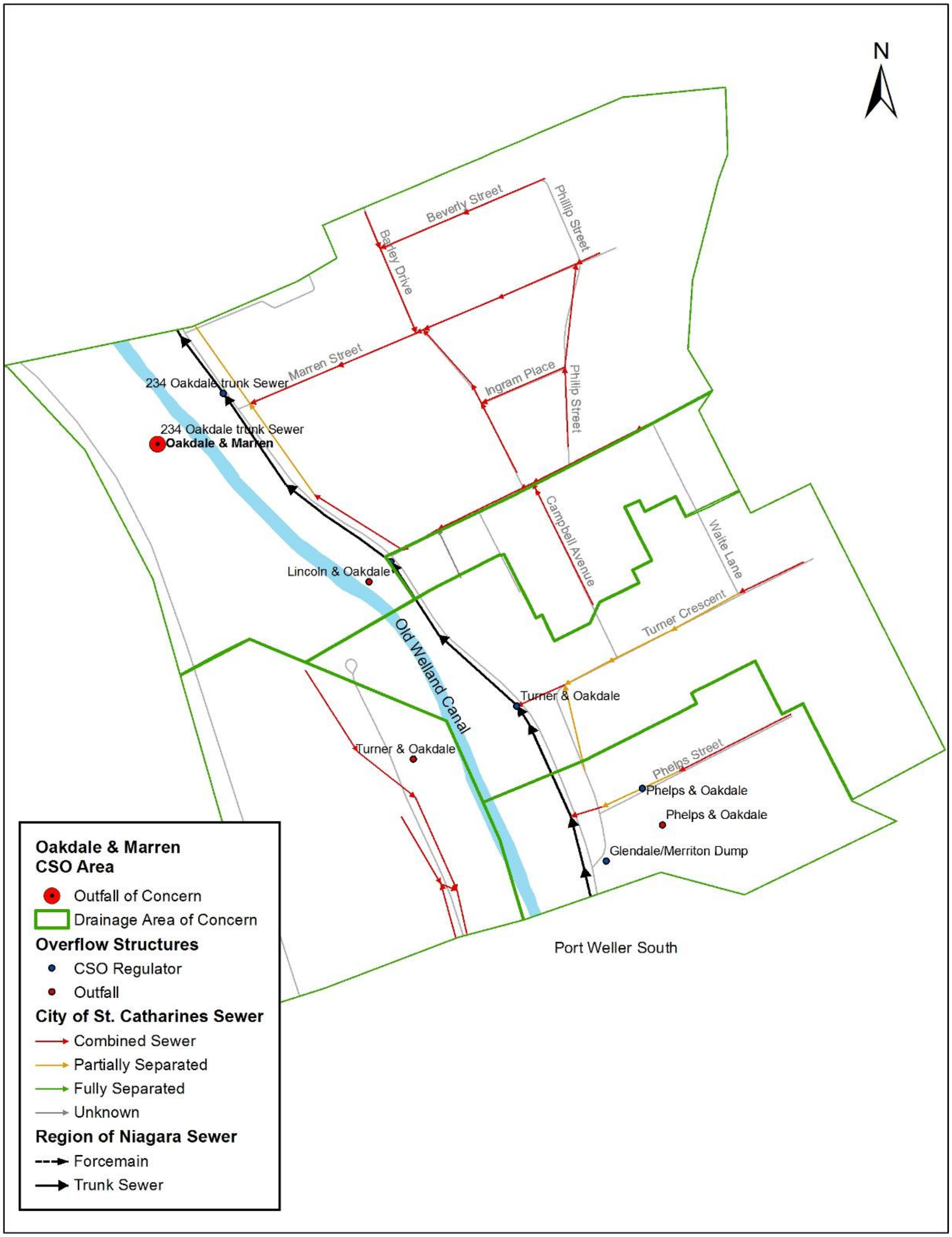
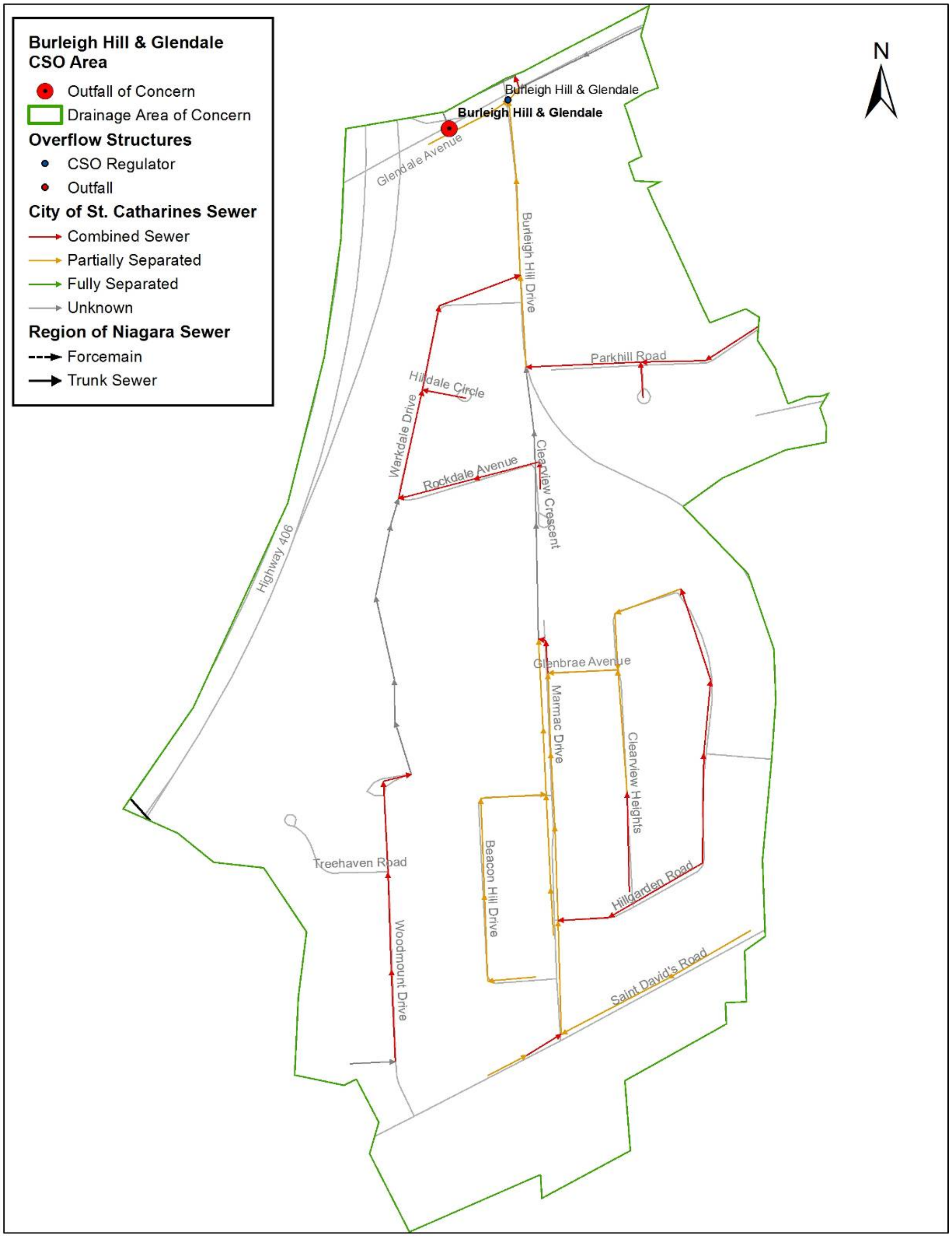


FIGURE 7-11
Burleigh Hill & Glendale



7.2.2 Probable Cost Estimates of Recommended Projects

A probable capital cost estimate was developed for a CSO storage tank at each of the selected sites. The cost estimate was based on past projects of various size CSO tanks, updated to 2008 costs. The costs developed do not include land costs, zoning and planning costs, geotechnical investigations, special foundation construction, and engineering costs. A breakdown of the unit storage costs developed from previous projects is presented in Table 7.2. The CSO storage cost for each site is presented in next section.

TABLE 7.2
CSO Storage Unit Cost Breakdown

Storage Volume (m^3)	2007 Unit Cost ($/$m^3$)
0 – 500	$3,000
500 – 1000	$2,500
1000 – 2000	$2,000
2000 – 4000	$1,500
> 4000	$1,000

These estimates have been prepared with an accuracy level set forth per the Association for the Advancement of Cost Engineering (AACE) standard. Estimate Classifications range from a class 5 to class 1. Estimate class is determined by project scope documents, available site and design information and owners' available project funding. The capital costs included herein are based on current market conditions and material pricing as currently known. The estimate was based on limited scope and unknown site conditions and is thus regarded as Class 5/4. A summary of the AACE Cost Estimate Classification System is present in Appendix J.

7.3 Recommendations for Implementation (Prioritization)

The outfall locations were initially ranked in Section 5.4 based on the potential impact on the environment. This ranking factored in both potential load contributions as well as sensitivity of the receiving water body. The top 12 sites from this ranking were carried forward and examined in further detail. The results of this investigation assisted in the second ranking for implementation priority. Considerations for this second stage of ranking include:

- Initial ranking (based on environmental impacts
- Budgetary constraints (annual capital works budget)
- Proximity of outfalls (outfalls adjacent to each other should be examined within a similar timeframe to determine opportunity for joint approaches)

A summary of the overflow characteristics and their associative ranking is presented in Table 7.3. Based on the recommended projects below the overall percent captures for the Port Dalhousie and Port Weller sewersheds will be 96.5% and 96.8%, respectively. This represents an improvement from the existing percent capture rates of 6.1% and of 3.6% for Port Dalhousie and Port Weller sewersheds, respectively. These improvements include the capital improvements that are in progress.

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TABLE 7.3
Ranking of CSOs for Implementation

CSO Location	Original Overflow Volume (m^3)	2-Year Storm Storage Volume (m^3)	Estimated Overflow Volume[1] (m^3)	Estimated % Capture[1]	CSO Storage Tank Cost[2]	Estimated Annual O&M Costs	Rank	Comments
Carlton & Ontario	32,282	8,680	2,277	99.4%	$11,457,600	$30,000	1	• Potential for upstream sewer separation • Joint approach could be looked at with Thomas St.
Thomas Street, Henry & Beech, George & Beech	12,129	4,470	0	100%	$5,900,400	$30,000	2	• Potential for upstream sewer separation • Joint approach could be looked at with Carlton & Ontario.
Westchester & O.W. Canal	20,085	2,870	1,667	98.0%	$5,682,600	$30,000	3	• High cost associated with storage, due in part to geotechnical conditions • Examine possibility of upstream control to decrease storage volume • Joint approach could be looked at with Parkway & OWC.
Parkway & O.W. Canal	5,236	1,890	1,262	98.8%	$4,989,600	$30,000	4	• Examine possibility of upstream control to decrease storage volume • Joint approach could be looked at with Westchester & OWC
Hartzel & CNR Line	5,650	4,110	1,416	96.9%	$5,425,200	$30,000	5	• Land availability for large storage is an issue in this area • Examine possibility of upstream control to decrease storage volume • Joint approach could be looked at with Wedsworth & Hastings
Wedsworth & Hastings	12,052	1,790	173	99.4%	$4,725,600	$30,000	6	• Examine possibility of upstream control to decrease storage volume • Joint approach could be looked at with Hartzel & CNR line
Renown Road PS	17,193	4,300	3,413	99.1%	$5,676,000	$30,000	7	• Examine possibility of upstream control to decrease storage volume
Eastchester PS	12,937	1340	997	97.7%	$3,537,600	$30,000	8	• No recommendations are being made at this time, site should be re-examined to determine the impact of Capner & Oakdale upgrades • Estimated cost of 2-year storage facility is shown for information purposes
Michigan Avenue	12,392	1620	487	99.3%	$4,276,800	$30,000	9	• Recommendation for downstream pipe upgrade from 350 to 525 mm to convey flows to Port Dalhousie WWTP WWFF • This project should not be commenced prior to the construction of the Port Dalhousie WWFF
Forster & Linwell	242	90	62	99.7	$356,400	$30,000	10	• Feasibility of conveying flows to new Guy Rd. storage facility should be examined
Oakdale & Marren	2,119	640	199	99.8	$2,112,000	$30,000	11	• Limited opportunity for sewer separation as overflow is located on Regional trunk
Burleigh Hill & Glendale	1,716	380	633	92.6	$1,504,800	$30,000	12	• Examine possibility of upstream control to decrease storage volume

[1]Estimated Overflow Volume and % Capture based on 2-Year Storage alternative.
[2]Storage costs based on 2-year Storage alternative. Specific storage type is to be confirmed during subsequent design phases.
Cost/size of storage may vary if source control/sewer separation is determined to be part of the preferred abatement solution during subsequent phases.

8. Implementation Plan

8.1 Data Management and PCP Considerations

8.1.1 PCP Updates

In order to track the status and success of the recommendations from this PCP and to determine the impacts on the existing system, it is recommended that the PCP be updated every five years. The next update for the St. Catharines and Thorold PCP should commence in 2012.

8.1.2 Data Management Considerations

A data management program will help to facilitate future PCP updates and may assist the Cities and Regions with system maintenance and development planning. The following section briefly describes a number of these data management recommendations.

St. Catharines

Updated Combined Sewer Mapping. In order to track the impact of sewer separation on the overall system, it is important to have up to date mapping showing which areas within the collection system have been separated and which areas remain combined. An up to date map showing current combined pipes within the system aids a City in planning their capital programs and helps in calibrating the sewer model and keeping this model up to date. This mapping layer can be integrated into the City's existing GIS infrastructure mapping.

The City of St. Catharines is in the process of updating their infrastructure data management system to produce mapping which shows areas that are combined, separated and partially separated. It is recommended that the City of St. Catharines continue to update this database and maintain it as part of an annual infrastructure update report.

Thorold

Infrastructure Data Update/Electronic Mapping and Modeling. The sanitary and sewer mapping for the City of Thorold is currently maintained in a hard copy format. This format does not facilitate easy upgrades to municipal mapping or integration into the system computer model. It is recommended that the existing mapping be converted into an electronic format. The preferred format for infrastructure is GIS. This is consistent with the Regional data management system and is similar to what other Niagara Municipalities are using. GIS mapping format allows attributes to be linked to the mapping elements of an infrastructure system. This required infrastructure data update would best be accomplished in conjunction with Niagara Region Public Works Department. Once the updated sanitary and storm sewer infrastructure were integrated into a GIS system with all associated asset attributes, then an effective model could be completed. A more comprehensive understanding of the interaction of Thorold's sanitary and storm sewer collection systems with the Regional trunk sewer and storm mains would prove to be invaluable and greatly assist with development of required future capital projects.

Once this has been completed, then the integration of St. Catharines', Thorold's, and the Niagara Region's network of sanitary and storm sewer infrastructure could be integrated and the subsequent comprehensive model completed. The requirement for locations of flow monitors/meters would be developed to calibrate this model. When this fully functional calibrated model is complete with permanent flow metering locations, then the most effective and efficient placement of the storage facilities, capacity improvement or other related improvements could be successfully identified. This would provide a holistic approach to pollution control planning within the study area.

Regional Municipality of Niagara

Pump Station Records/Database. Accurate pump station information is important when examining system capacities. Pump station information is used to calibrate the two sewer system models and is used to look at the feasibility of site specific development.

It is recommended that a database be developed to manage Regional pump station information in a central location. At a minimum, the database should house the following information:

- Upgrade history
- Number of pumps
- Rated pump capacity
- Tested pump capacity
- Pump start/stop levels
- Wet well dimensions
- Overflow information
  - Size
  - Type
  - Invert
  - Overflow discharge location

As previously noted, discrepancies exist between theoretical pump station capacities. Capacities should be verified through drawdown and fill tests using all of the pumps at each station.

Regional Municipality of Niagara/ St. Catharines/Thorold

Integrated Flow Monitoring Program and Data Collection. The two cities and the Region should examine the possibility of an integrated flow monitoring program. This program would ensure that the placement of regional and municipal flow monitors would compliment each other resulting in an effective use of each monitor to gain a better understanding of the sewersheds. Data management protocols should be developed to ensure that the data collected from each of the monitors can be easily integrated for model calibration and analysis of the sewer system.

A list of recommended flow monitor locations is presented in Table 8.1. The locations were developed based on gaps in the current model as well as known problem areas that require additional data for better analysis.

TABLE 8.1
Recommended Flow Monitoring Locations

Site ID	Location	Sewershed	Sewer Ownership	Municipal Location
1	Peel Street PS	Port Weller	Regional	Thorold
2	Pine Plaza	Port Weller	Municipal	Thorold
3	Hartzel Road	Port Weller	Regional	St. Catharines
4	Carlton Street	Port Weller	Regional	St. Catharines
5	Glendale Industrial	Port Weller	Regional	St. Catharines
6	Haulage Road PS	Port Weller	Regional	St. Catharines
7	Guy Road Inflow – West	Port Weller	Municipal	St. Catharines
8	Guy Road Inflow – East	Port Weller	Municipal	St. Catharines
9	Barbican Trail	Port Dalhousie	Regional	St. Catharines
10	Riverview/Oakridge	Port Dalhousie	Regional	St. Catharines
11	Renown Road PS	Port Dalhousie	Regional	St. Catharines
12	Yates Street – East Inflow	Port Dalhousie	Municipal	St. Catharines
13	Ontario/Lowell	Port Dalhousie	Regional	St. Catharines
14	Michigan Avenue	Port Dalhousie	Municipal	St. Catharines

The proposed flow monitoring locations are shown graphically in Figure 8-1.

8.2 Capital Works Implementation Schedule

The implementation schedule for the recommended capital works is shown in Table 8.2. The implementation schedule for the recommended capital works projects takes into consideration the ranking of the projects, the ease of implementation and the capital costs. The schedule may be modified according to the priority placed on the projects within the overall municipal planning perspective and available budgets and funding.

As described there are a number of previously approved projects which are in various stages of the design process from feasibility to tender. These projects have been given priority for scheduling, based on the advancement of these projects. As indicated previously, it is possible that projects approved in the capital works budget may not proceed to implementation as planned based on non-monetary constraints and status should be reviewed at subsequent updates of the Pollution Control Plan.

The schedule also takes into account that the PCP should be updated on a recurring five-year interval.

FIGURE 8-1
Recommended Flow Monitoring Locations

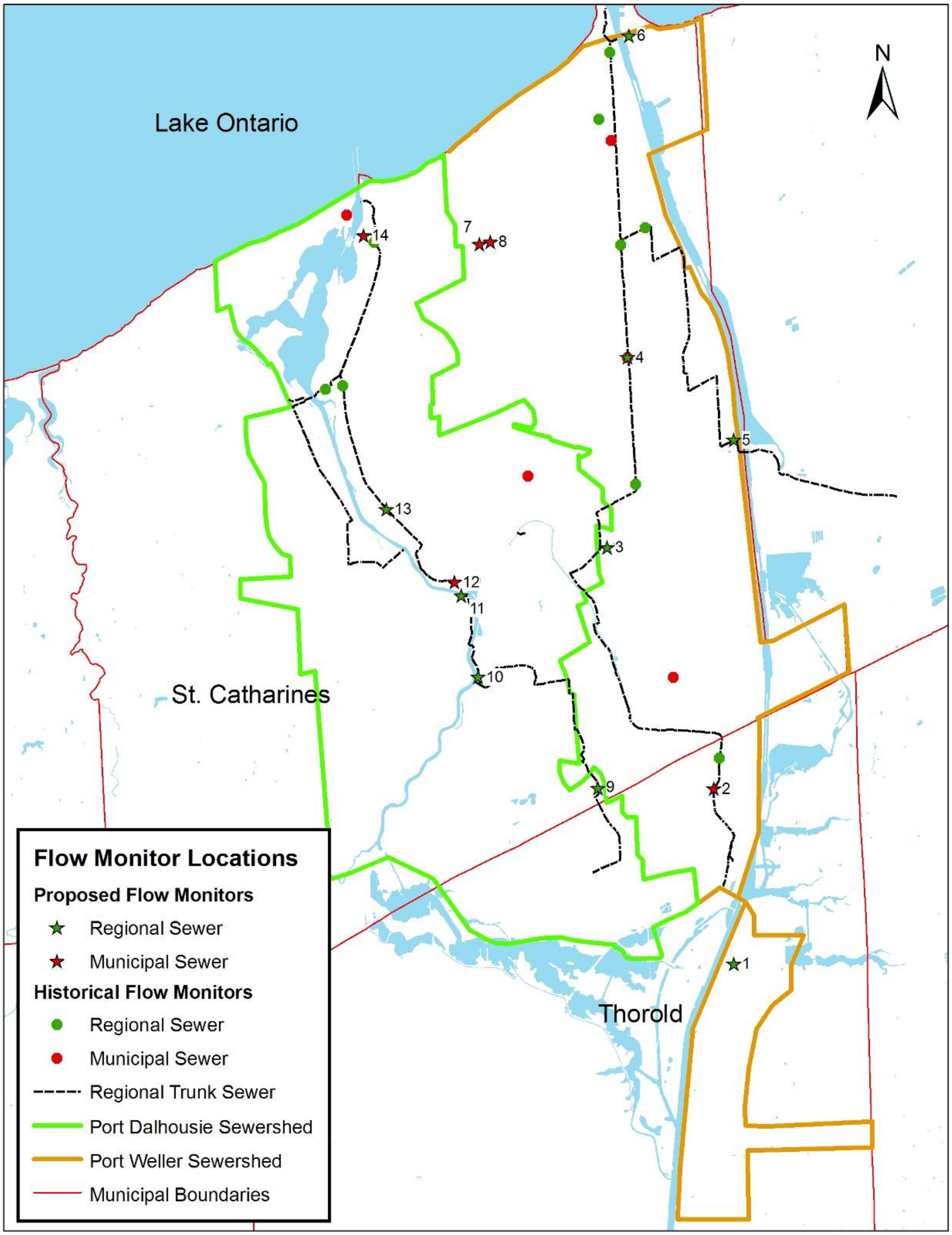

TABLE 8.2
Implementation Schedule

	CSO Location	Recommended Alternative	Estimated Capital Cost	Recommended EA	Recommended Implementation Period
PCP Update					**Complete**
1 to 5 years	Capner & Oakdale	Storage	$1,200,000	Complete	2008
	Westchester/OWC	Storage	$5,683,000	2009	2010
	Parkway & OWC	Storage	$4,990,000		
	Burleigh Hill & Glendale	Storage	$1,505,000	2010	2011
	Hartzel/CNR	Storage	$5,425,000	2011	2012
	Wedsworth & Hastings	Storage	$4,726,000		2013
	Michigan Avenue	Sewer Replacement	$150,000	2012	2013
PCP Update					**2012**
5 to 10 years	Carlton & Ontario	Storage	$11,458,000	2013	2014
	Thomas St., Hennry & Beech, George & Beech	Storage	$5,900,000		2015
	Page Street	Storage	$1,500,000		2016
	Oakdale & Marren	Storage	$2,112,000	2016	2017
	Renown Rd. PS	Storage	$5,676,000	2017	2018
PCP Update					**2017**
	Eastchester	Storage	$3,538,000	2018	2019
	Forester & Linwell	–	–	2019	2020

*Note: This is a draft implementation schedule that may be subject to change

9. Recommendations Summary

9.1 System Wide Policy and Programs

9.1.1 St. Catharines

It is recommended that the City continue to implement the ongoing system wide policies and programs as outlined in Section 6.3 of this report.

9.1.2 Thorold

It is recommended that the City continue to implement the ongoing system wide policies and programs as outlined in Section 6.3 of this report.

9.1.3 Region of Niagara

It is recommended that the Region continue to implement the ongoing system wide policies and programs as outlined in Section 6.3 of this report.

9.2 Capital Works

The recommended capital works described within this section are in addition to those works which are currently in various design and construction phases.

1. **Carlton & Ontario**. Currently, an 8,680 m^3 storage facility is being recommended for Carlton & Ontario at a cost of $8,700,000. The size of this storage tank could be reduced if integration of upstream sewer separation and/or storage is found to be suitable during a more detailed site investigation and Class EA. As noted, the proximity to the Thomas St. outfall could make an integrated abatement approach feasible.

2. **Thomas Street, Henry & Beech, George & Beech**. A 4,470 m^3 storage facility is being recommended for Thomas Street. The size of this storage tank could be reduced if integration of upstream sewer separation and/or storage is found to be suitable during a more detailed site investigation and Class EA. As noted, the proximity to the Carlton & Ontario outfall could make an integrated abatement approach feasible.

3. **Westchester & O.W. Canal**. A 3,000 m^3 storage tank had been previously recommended and designed for this overflow location. The estimated cost for this project was $5,306,000, based on submitted construction tenders. It is being recommended that this location be examined in further detail to determine if there are any upstream opportunities that would reduce the size of the required storage.

4. **Parkway & O.W. Canal**. A 1,890 storage volume would be required for the Parkway outfall location to capture the volume from a two-year storm event. The estimated cost for this storage would be $3,800,000. It is recommended that a joint project be examined for the Westchester and Parkway locations to develop an efficient means of abating overflows at the two locations.

5. **Hartzel & CNR Line.** A 4,110 storage tank would be required for this overflow location, at an estimated cost of $4,100,000. A previous study found that locating land for a storage facility of this size would be challenging in the vicinity of the Hartzel & CNR overflow. It is recommended that the upstream area be examined in further detail to determine if there are opportunities for source control and/or sewer separation. The Wedsworth & Hastings overflow is located near this overflow location and the feasibility of a joint abatement approach should be examined.
6. **Wedsworth & Hastings.** A 1,790 m^3 storage facility is being recommended for this location at an estimated cost of $3,600,000. As indicated this overflow is located near the Hartzel & CNR Line overflow locations. The feasibility of a joint abatement approach as well as opportunity for upstream source control should be examined
7. **Renown Road PS.** A 4,300 m^3 storage facility is being recommended for the Renown Road PS at an estimated cost of $4,300,000. The size of this storage tank could be reduced if integration of upstream sewer separation and/or storage is found to be suitable during a more detailed site investigation and Class EA.
8. **Eastchester PS.** It is recommended that the flows to Eastchester PS be monitored after the Capner & Oakdale works are completed to determine their effect. No capital works are currently recommended to the Eastchester PS. Flows to the pump station should be monitored once the upgrades at the Capner & Oakdale CSO are completed.
9. **Michigan Avenue.** Due to the proximity to the treatment plant, it is recommended that no capital works be constructed at the Michigan Avenue CSO. The Michigan Avenue CSO overflows at a much higher rate than the treatment plant (26 events vs. 6 events during the typical year). Therefore, increasing the flow through capacity to the plant will allow more CSO to be treated during moderate events. The pipe capacity to the plant should be increased from the current 350mm pipe to 525mm pipe. The estimated cost for replacement of the sewer is $150,000.
10. **Forster & Linwell.** The feasibility of conveying flows to the new Guy Road storage facility should be examined on a site-specific level. This Forster & Linwell overflow is located adjacent to Guy Road Park.
11. **Oakdale & Marren.** A 640 m^3 tank is being recommended for this overflow location at an estimated cost of $1,300,000. There is limited opportunity for upstream source control as this overflow is located on the Regional trunk sewer.
12. **Burleigh Hill & Glendale.** A 380 m^3 storage facility is being recommended for this overflow location at an estimated cost of $760,000. The size of this storage tank could be reduced if integration of upstream sewer separation and/or storage is found to be suitable during a more detailed site investigation and Class EA.

9.3 System Upgrades

9.3.1 St. Catharines

It is recommended that flooding concerns within the City continue to be addressed as part of the FLAP program. Areas with multiple FLAP applications or complaints should be examined for targeting a reduction of wet weather in the system.

9.3.2 Thorold

The system constraints upstream and downstream of the Peel St. pump station should be examined. The upstream system should be examined to alleviate basement flooding, in addition to the constraints for conveying flows downstream of the station.

9.4 Data Management

9.4.1 St. Catharines

It is recommended that the following data management components be developed:

1. **Updated Combined Sewer Mapping.** The City of St. Catharines should continue to keep the combined sewer mapping database updated as system improvements are made.

2. **Capital Works Database.** A GIS based database should be developed to show system improvements which address problem areas and alleviate CSOs and basement flooding.

9.4.2 Thorold

1. **Infrastructure Data Update/Electronic Mapping and Modeling.** It is recommended that the existing sanitary and storm sewer mapping be converted into an electronic format. The preferred format for infrastructure is GIS.

9.4.3 Regional Municipality of Niagara

1. **Pump Station Records/Database.** A database should be developed and kept up to date with current pump station information. Pump station capacities should be confirmed through draw fill tests.

9.4.4 St. Catharines/Thorold/Regional Municipality of Niagara

1. **Integrated Flow Monitoring Program.** The two cities and the Region should examine the possibility of an integrated flow monitoring program. This program would ensure that the placement of regional and municipal flow monitors would compliment each other resulting in an effective use of each monitor to gain a better understanding of the sewersheds. Data management protocols should be developed to ensure that the data collected from each of the monitors can be easily integrated for model calibration and analysis of the sewer system.

2. **Annual Report**. It is recommended that an annual report be prepared that provides a comprehensive compilation and summary of the infrastructure management activities

carried out. The annual report should be a compilation of all system upgrades and updates on maintenance and management programs. The annual flow monitoring records should also be compiled in the report. Mapping upgrades for sewer improvements should also be a component of the report. The Cities and the Region should work together to develop this report. The report should determine and report on the success of the upgrades and improvements to programs as recommended in the PCP report as well as make recommendations based on improvements to programs and update the recommendations in the PCP report.

3. **PCP Updates**. It is recommended that the PCP be updated every five years to determine the implementation success of the PCP and the future needs. The next PCP Update should take place in 2012.

10. Public Consultation

Public consultation is an important part of this project. With forecasted growth expected to exacerbate existing issues of combined sewer overflows and basement flooding, it was important that this EA study established ongoing communication with local residents and public review agencies to ensure public concerns were addressed throughout the project.

The public consultation component of this project includes comments received at Public Information Centres and by public agencies, along with responses to these comments. The following sections outline the public consultation component of this phase of the project.

10.1 Notice of Study Commencement

A Notice of Study Commencement was placed in the St. Catharines Standard and Niagara this Week newspapers on February 2, 2007. The Notice was also mailed directly to government review agencies on February 15, 2007. The notice of Study Commencement informed the public and public agencies of the problem statement and the area affected. This Notice has been included in Appendix K.

10.2 Mailing List

At the outset of the project a mailing list of interested review agencies was developed by CH2M HILL and the Cities of St. Catharines and Thorold. A letter and copy of the Notice of Study Commencement were mailed to all parties on the mailing list to confirm the nature and extent of agency interest in this study. The mailing list has been included in Appendix K.

Ten agencies responded to the notice and indicated their interest to continue or discontinue notification of the process.

10.3 Steering Committee

A Project Steering Committee (SC) was formed of agency contacts, Regional and City staff to inform the study process and provide input at each stage of the PCP study. The SC consists of the following individuals:

- Mark Green – City of St. Catharines
- Jason Culp - City of St. Catharines
- Tim Marotta - City of St. Catharines
- Phil Lambert – City of Thorold
- Ryan Creamer – Regional Municipality of Niagara
- Steve Green – Ministry of the Environment

10.4 Public Information Centre

The Public Information Centre (PIC) to learn more about this study took place on June 5, 2008 at Thorold City Hall from 6 to 8 p.m.

Attendees had an opportunity to view displays and speak one-on-one with project staff. An information bulletin and a comment sheet were made available to attendees. 1 person attended the PIC.

10.5 Notice of Completion

The Notice of Completion was published in the St. Catharines Standard and Niagara this Week newspapers and mailed to all agencies and interested parties identified on the mailing list (see Appendix K). The Notice of Completion has been included Appendix K. This Environmental Study Report was made available for 30-day comment period, beginning August 18, 2008.

11. References

CG&S (CH2M HILL). Port Weller Sanitary Trunk Sewer Analysis. Prepared for the City of St. Catharines.

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City of St. Catharines. St. Catharines Area Pollution Control Plan, 1990.

City of St. Catharines. Pollution Control Strategy Annual Reviews (1991 – 1998). A report on the Pollution Control Strategy and Five Year Initiation Plan.

DFO Inc. The Evaluation and Audit of Sanitary Combined Sewer Overflows

Hydromantis, CH2M HILL. City of St. Catharines CSO HRT Feasibility Study. 2005. Prepared for the City of St. Catharines.

MacViro. Combined Sewer Separation Project Remedial Works Schedule “B” Class EA Report, March, 2004. Prepared for the City of Thorold.

Ministry of the Environment (MOE), *Procedure F-5-1*

Ministry of the Environment (MOE), *Procedure F-5-5*

Niagara Peninsula Conservation Authority (NPCA). Twelve Mile Creek Watershed Plan: Phase I, Background Study and Issues Identification. 2005

Niagara Peninsula Conservation Authority (NPCA). Twelve Mile Creek Watershed Plan. 2006.

Appendix A
Pumping Station Information

Theoretical Capacities - Port Dalhousie Pumping Stations

The following table shows the various theoretical pumping station capacities for each of the pumping stations within the Port Dalhousie sewershed.
The source of each of the theoretical capacities is listed in the table. As can be seen, discrepancies exist between the values from the various sources.

Port Dalhousie	Modelled Capacity	Master Service Plan (2003)				C of A						Draw and Fill (DF)/ Flow Data (FD)					
pumping station data (l/s)		firm	Q 1	Q 2	Q 3	Firm	Q1	Q2	Q3	Q4	Year	firm	Q 1	Q 2	Q 3	DF Year	FD Year
Cole Farm	64.7	83.4	55.6	83.4	116.8	83.4	55.5	83.25	116.55		1992						
Lakeside	97	111.8	74.5	111.75	156.5	112.5	75.0	112.5	157.5		1994	109.77	75.71	109.77	158.991	2004	
Renown	1060.8	853.5	569	853.5	1195	1050	500.0	750	1050	1300	1968	585	390	585	819		2007
Confederation Heights	173.7	31.6	31.6	47.4		174	174.0	261			1976						
Wellandvale	30.1	37.1	37.1	55.65		41	27.3	41			1974						
Argyle	34.1	42.6	28.4	42.6	59.64	Not Stated in the C of A											
Eastchester	50.6	31.6	31.6	47.4		Missing											

Notes:
- Flow values shown in the table are cumulative (i.e. Q1 indicates flow with 1 pump running, Q2 is flow with 2 pumps running etc.)
- Firm capacity is generally based on capacity of station with one pump out of service
- The Certificate of Approvals state capacity of 1 pump (Q1), cumulative flows and firm capacity were calculated using multipliers
- Highlighted numbers in Draw/Fill section indicate number of pumps running for test. Where all pumps were not tested, cumulative flows and firm capacity were calculated using multipliers

Theoretical Capacities - Port Weller Pumping Stations

The following table shows the various theoretical pumping station capacities for each of the pumping stations within the Port Weller sewershed.
The source of each of the theoretical capacities is listed in the table. As can be seen, discrepancies exist between the values from the various sources.

Port Weller	Modelled Capacity	Master Service Plan (2003)				C of A					Draw and Fill / Flow Data					
pumping station data (l/s)		firm	Q 1	Q 2	Q 3	Firm	Q1	Q2	Q3	Year	firm	Q 1	Q 2	Q 3	DF Year	FD Year
Centre St.	44	25.5	17	25.5	35.7	40	40	60		2003	44.4	44.4	66.6		2005	
Lombardy	82	34	34.1	51.15		110	75	112.5	157.5	1976						
Black Horse	60	50	50.5	75.75		70	70	105		2003	75.5	75.5	113.25		2005	
Peel	142	142	142.1	213.15		170	140	170	294	2003						2006
Spring Garden	537.4	537				Missing										
Port Weller East	38	38	37.7	56.55		37.8	37.8	56.7		1976						
Carleton	106	106.1	106.1	159.15		150	150	225		1997	150.5	150.5	225.75		1994.0	

Notes:
- Flow values shown in the table are cumulative (i.e. Q1 indicates flow with 1 pump running, Q2 is flow with 2 pumps running etc.)
- Firm capacity is generally based on capacity of station with one pump out of service
- The Certificate of Approvals state capacity of 1 pump (Q1), cumulative flows and firm capacity were calculated using multipliers
- Highlighted numbers in Draw/Fill section indicate number of pumps running for test. Where all pumps were not tested, cumulative flows and firm capacity were calculated using multipliers

Appendix B
Detailed CSO Locations

CSO Locations and Names

The following summary provides names for each of the CSOs in the Port Dalhousie sewershed and the Port Weller sewershed. Figure 1 gives spatial reference to each of the CSOs on the basis of the outfall identifications (IDs). The outfall IDs are from the XP SWMM model for each sewershed.

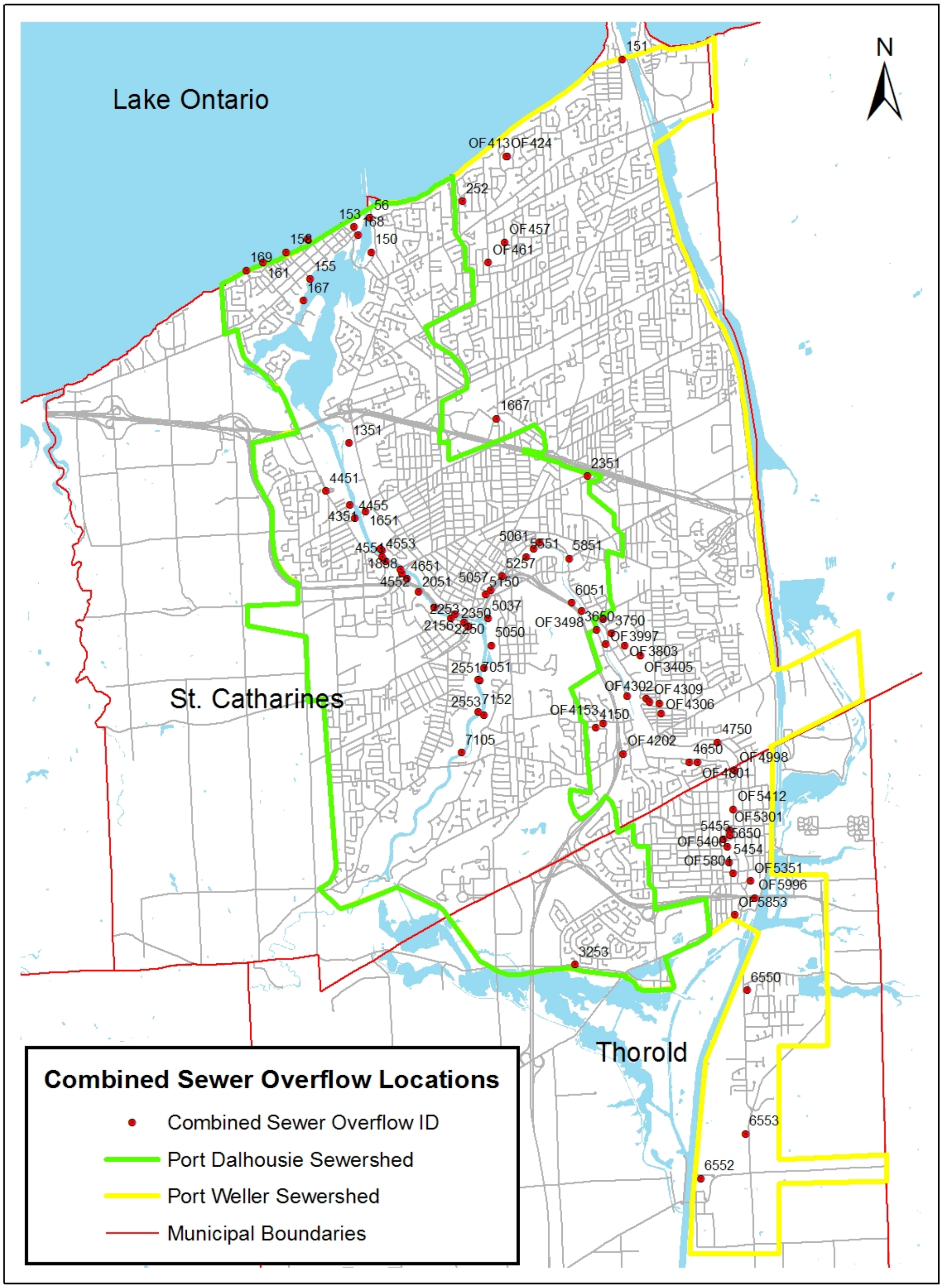

FIGURE 1
CSO Locations and Associated Outfall Identifications

Port Dalhousie Sewershed

The are 46 CSOs outfalls within the Port Dalhousie collection system. These CSOs have the potential to discharge to a number of different local water bodies. In some cases, the CSOs overflow to a storm sewer before ultimately discharging to a surface water body. Table 1 summarizes the location of each CSO and the ultimate receiving water body.

TABLE 1
Port Dalhousie CSO Locations and Receiving Water Bodies

CSO Location	*Outfall ID*	Receiving Water Body
Michigan Avenue	150	*Dalhousie Harbour*
Lakeside PS	153	*Lake Ontario*
Main & Christie	155	*Martindale Pond*
Bayview & Ann	157	*Lake Ontario*
Christie Street	158	*Lake Ontario*
Colton & Shelley	161	*Lake Ontario*
Corbett and Bayview	167	*Martindale Pond*
Lock Street	168	*Port Dalhousie Harbour*
Cole Farm PS	169	*Lake Ontario*
Scott & Ontario	1351	*Twelve Mile Creek*
Carlton & Ontario	1651	*Twelve Mile Creek*
Page South of Welland, Ida Street, Berryman & Richmond	1662	*Old Welland Canal*
Grote & Carlton	1667	*Martindale Pond*
Thomas Street, Henry & Beech, George & Beech	1670	*Twelve Mile Creek*
Kensington and Woodruff	1751	*Old Welland Canal*
Welland & Ontario, Welland & Montebello, Welland & Wellington, Welland & Lake, Welland & Clark	1858	*Twelve Mile Creek*
Adam Street	2051	*Twelve Mile Creek*
Lake-Ontario, Salina-Ontario, Yates-Salina, Norris-Yates	2152	*Twelve Mile Creek*
Yates and Trafalgar	2156	*Twelve Mile Creek*
Henrietta Street	2250	*Twelve Mile Creek*
Renown Rd PS	2253	*Twelve Mile Creek*
St. Paul Crescent	2350	*Twelve Mile Creek*
End of Monck Street	2451	*Twelve Mile Creek*

Rivercrest	2551	*Twelve Mile Creek*
Riverview Drive	2553	*Twelve Mile Creek*
Confederation Heights PS	3253	*Lake Gibson*
Violet Street	4351	*Twelve Mile Creek*
Bridge and Martindale, Barton Street	4451	*To storm on Martindale*
Grapeview & Martindale	4455	*Martindale Pond*
Wellandvale PS	4551	*Twelve Mile Creek*
Wellandvale Road	4552	*Twelve Mile Creek*
Martindale Road	4553	*Twelve Mile Creek*
Crestcombe and Springbank	4651	*Twelve Mile Creek*
Dittrick Street	5037	*Twelve Mile Creek*
Hillcrest-Rockcliffe, Glenridge-Rockcliffe, South-Rockcliffe, Highland-Rockcliffe, Glenwood-Ridgewood	5050	*Twelve Mile Creek*
Westchester & O.W. Canal	5057	*Twelve Mile Creek*
Argyle PS	5061	*Twelve Mile Creek*
Parkway & O.W. Canal	5150	*Twelve Mile Creek*
Carlisle-Church, James-King, King Street, Carlisle-St.Paul, James-St.Paul, Court-St.Paul	5257	*Twelve Mile Creek*
Riordan & Gale	5551	*Old Welland Canal*
Eastchester PS	5851	*Old Welland Canal*
Capner & Oakdale	6051	*Twelve Mile Creek*
Hamilton Street	7051	*Twelve Mile Creek*
Kent Street	7152	*Twelve Mile Creek*
Kinsey Street	7153	*Twelve Mile Creek*
Port Dalhousie WPCP Overflow	56	*Lake Ontario*

Port Weller Sewershed

The are 39 CSOs outfalls within the Port Weller collection system. As with the Port Dalhousie system, these CSOs have the potential to discharge to a number of different local water bodies. Table 2 summarizes the location of each CSO and the ultimate receiving water body.

TABLE 2
Port Weller CSO Locations and Receiving Water Bodies

CSO Location	***Outfall ID***	**Receiving Water Body**
Port Weller WPCP By-pass	151	*Lake Ontario*
Elmwood Ave & QEW	2351	*Lake Ontario*
Beachview & Lake Ontario	252	*Lake Ontario*
Hartzel & CNR line	OF3405	*Old Welland Canal*
Oakdale & Marren	OF3498	*Old Welland Canal*
Lincoln & Oakdale at corner	OF3501	*Old Welland Canal*
Turner Cres. & Oakdale	3650	*Old Welland Canal*
Phelps St. & Old Welland Canal	3750	*Old Welland Canal*
Haight St. & Disher	OF3803	*Old Welland Canal*
131 Moffat	OF3997	*Old Welland Canal*
Spring Garden PS Old Coach Rd.	OF413	*Spring Garden Creek*
Chestnut & Briarsdale Dr. (node 4102 & 4103)	4150	*Old Welland Canal*
Aerial Sewer Briarsdale	OF4153	*Dicks Creek*
Brookdale & Glengarry	OF4201	*Old Welland Canal*
Burleigh Hill & Glendale	OF4202	*Welland Canal*
Old Coach Rd. & Spring Garden Creek	OF424	*Spring Garden Creek*
Wedsworth & Hastings	OF4302	*Old Welland Canal*
Chestnut & Merritt	OF4304	*Old Welland Canal*
Almond & Merritt	OF4306	*Old Welland Canal*
Walnut & Merritt	OF4309	*Old Welland Canal*
Forster St. & Linwell (node 422 & 423)	OF457	*Spring Garden Creek*
Guy Road (nodes 421, 462, 420 & 419)	OF461	*Spring Garden Creek*
Bradley & Dundas Cres.	4650	*Old Welland Canal*
Ball & Merritt	4750	*Ball Avenue West Creek*

Ursula & Rountree	OF4801	*Old Welland Canal*
Upstream of Parshal Flume	OF4998	*Old Welland Canal*
Regent & Front St.	OF5301	*Old Welland Canal*
Portland Ave	OF5351	*Old Welland Canal*
Pine Plaza	OF5400	*Old Welland Canal*
Whyte & Ann St.	OF5412	*Old Welland Canal*
Front St. & St. David's	5454	*Old Welland Canal*
Pine Plaza (node 5414 & 5401)	5455	*Old Welland Canal*
Front St. & Regent	5650	*Old Welland Canal*
Garden St.	OF5801	*Old Welland Canal*
Pine St. & Richmond St.	OF5853	*Old Welland Canal*
Sullivan & CNR	OF5996	*Old Welland Canal*
Peel Street PS	6550	*Beaverdams Creek*
Centre St. PS	6552	*Davis Creek*
Blackhorse PS	6553	*Davis Creek*

Appendix C
Emergency Pump SOP

SOP – WASTEWATER PUMPING STATION WET WEATHER FLOW OPERATION

Scope

The following procedure provides staff operating guidelines for Wastewater pumping stations during instances of increased flow as a result wet weather conditions.

Personal Protective Equipment & Safety

Staff should proceed with caution during a wet weather event and allocate extra time when travelling to pumping stations.

Staff must wear all Personal Protective Equipment that may be required for the task they are performing. This may include hard hats, safety glasses, rubber gloves, air monitors and hearing protection.

Procedure

- As part of their daily duties and responsibilities Wastewater Operations staff will monitor the wet well levels of the pumping stations in their area through the plant SCADA (Supervisory Control and Data Acquisition) system.
- If a wet well and/or CSO reaches high level, Regional Operations staff will assess the situation and to assess that the station is operating at designed capacity.
- If corrective maintenance is required, Operations staff will request Regional Maintenance staff to address the issue.
- If the pumping station is equipped with an overflow; Regional Operations staff will ensure the required samples are collected, record bypass flows, operate tertiary treatment (if available) and report to the appropriate parties. (i.e. SAC)
- In the event that the levels are such that the upstream collection system may surcharge which may require intervention by the local municipality; Operations staff will contact said municipality via the emergency contact list, as supplied and updated by the local municipalities' public works management staff.
- It is within the local municipalities' jurisdiction to take action to relieve the local municipalities' collection system and associated wastewater storage devices for protection of customers, property and the environment. These remedial activities may include deploying staff to the location and arranging for any hauling, and/or pumping. The local municipality will be responsible as may be required by regulation and as a result of their remedial activity to sample and report to the appropriate agencies.
- Regional Operational Staff will assist the local municipality where possible by sharing any information that may be beneficial to the local municipal crew on site.
- Following the Wet Weather event Regional Staff will inspect the affected facilities, complete their data collection and report their findings to the Wastewater Operations Manager.

Notes

Wet Weather events may be infrequent but can be problematic when they arise. Staff must be diligent in monitoring the event and document all activities and collect all data that may be necessary for future audits. As the local municipalities may need to participate; it is important to maintain a amiable working relationship and good two way communications. Any issues should be addressed in a timely and efficient manner.

Appendix D
Detailed Policy Review

Policy Document Review

The following section summarizes growth information from various policy documents from the Cities of St. Catharines and Thorold as well as the Regional Municipality of Niagara. The purpose of the review is to summarize known or projected growth/intensification in the City of St. Catharines and the City of Thorold that relate to pressures on the municipal wastewater system.

Name	Author	Year	Relevant information
City of Thorold Policy			
Thorold OP	City of Thorold	2005	**4.1 Residential** 4.1.8 (p. 4.7) Infill residential development in unserviced residential areas: a) allanburg= current sanitary but no municipal water. "it is the intent of the municipality to service… Allanburg with a piped water supply during the life of this Plan." b) Beaverdams = current municipal water but no sanitary. "it is the intent of this plan that residential development in beaverdams be of a low density residential infill nature… the municipality may service this area with sanitary sewerage during the life of this plan, depending upon local need." c) Port Robinson = currently partially serviced w municipal water, but no sanitary. Secondary plan will "determine future limits of development and the limits of servicing." **4.2 Commercial** 4.2.8.2 highway commercial lands along hwy 20 corridor are not serviced and therefore are intended for light industrial development of dry nature **4.3 Industial** 4.3.2 Serviced Industrial f) a hotel and convention centre is permitted in the Brock Business Park (Plan 59M-131) 4.6 and 4.7 – agricultural and rural areas Generally, severances of agricultural and rural areas for residential use are discouraged. **4.8 Special Rural Area**

Name	Author	Year	Relevant information
			4.8.3 Policies for non-farm residential subdivisions a) rural subdivision density shall not exceed 1.25uph (0.5upa) **4.9 Port Robinson West Secondary Plan** 4.9.6.1.2 target residential density of 20uph (net) over specified residential area of approx 1-1.25 sq km (schedule B-3, Port Robinson West Secondary Plan) **7.16 Community Improvement Policies** 7.16.5 areas identified as CIP areas are Downtown Thorold, Port Robinson, Thorold South, Allanburg/Blackhorse, Thorold Centre (see Schedule B-1) **OP Appendix A – Urban Areas** Projected population growth rate of 4.2%/year at 2.56persons/unit. Based on regional projections, the City will require 100 new units/year (p. a-2)
Rolling Meadows Secondary Plan	City of Thorold	July 2006	**2.1 Residential** 2.1.3 (p. 4) 60% at 19uph (<8upa) net; 30% 20-35uph (8-14upa) net; 10% 36-100uph (15-40upa)net = avg net density of 21-32uph (11-13upa) **3.1 Commercial** 3.1.3.10 max total gross leasable floor area per "individual" 300sqm 9.1 servicing and transportation 9.1.1.7 to accommodate development infrastructure upgrades required: i) extension of allanburg rd trunk sanitary E to rolling meadows; ii) construction of trunk sanitary on Thorold twnln rd; iii) extension of allanburg rd trunk watermain E to rolling meadows Background (p. 33) - Port Robinson W community is planned to have 12500 residents in 2700 units
Downtown Thorold and Thorold Centre CIP	City of Thorold	Sept 2005	No specific density targets, however important to note that CIP area has been designated by municipal by-law for area from collier rd -> welland canal, St. David's Rd/Townline Rd --> Beaverdams Rd. (see Schedule A, p. 34) CIP may increase current occupancy rates, as well as lead to intensification of employment and residential uses in this

Name	Author	Year	Relevant information
			area.
City of St. Catharines Policy			
City of St. Cats Official Plan	City of St. Cats	Mar 2006	**3.2 Supply Of Land For Housing** "An objective of this Plan is to continue to designate sufficient land for… residential development and residential intensification… some of the City' s residential needs, particularly low density detached housing, will be met outside municipal boundaries in the long term. Other dwelling unit needs can be met within St. Catharines through a combination of residential development and residential intensification." (p. 3.2) **Section 12 - Development Policies** "The provision of municipal services to our existing and new developing areas will be of major concern to the municipality in the years to come. The continually increasing costs of public works dictate a compact form of development that can be serviced in a relatively economical way." (p. 12.1) **12.2 Population And Density** 12.2.1 For the purposes of this Plan, a design population of 148,800 has been used for the urban area fully developed. (p. 12.1) 12.2.3 It is expected that future population growth will largely occur through redevelopment and infilling. (p. 12.2) 12.2.4 The expected population for each planning district is as follows: North District 68,000; South District 10,700; East District 19,900; West District 20,900; Central District 29,300 - **Urban Area Total 148,800** (p. 12. 2)
Central Area Secondary Plan	City of St. Cats (OP)	Mar 2006	Mostly commercial/institutional/office to the south and east, with high density residential in the north and low- to medium-density residential to the west (including parks, open space, and environmental protection areas along 12 mile creek. (p. 15.14)
Port Dalhousie secondary plan	City of St. Cats (OP)	Mar 2006	**Western Residential Area** 16.20 "…only area with any large amount of undeveloped land. It is this area that will supply the bulk of new housing to meet future demands." (p. 16.5)

Name	Author	Year	Relevant information
The West St. Cats Secondary Plan	City of St. Cats (OP)	Mar 2006	**17.1 General Policies** 17.1.1 "West St. Catharines is a largely undeveloped area located along the City' s western boundary. It is the policy of this Plan to create within this area a community…" (p. 17.1) 17.2.3 "Residential densities have been calculated by applying the average gross residential density of 20 units per hectare to all vacant developable land." (p. 17.1) **17.3 Commercial** 17.3.1 a) 50,000 sqft commercial centre will be located in Martindale neighbourhood (p. 17.3)
The Hartzel Road - Merritton Area Secondary Plan	City of St. Cats (OP)	Mar 2006	**18.2 Goal And Objectives** 18.2.1 "It is the goal of this secondary plan that the Hartzel Road-Merritton Area will be an active corridor of mixed land uses and strong residential areas. The efficient redevelopment of vacant and underutilized commercial and industrial lands will open up these lands for new mixed residential and commercial lands uses." (p. 18.1)
The Queenston Area Secondary Plan	City of St. Cats (OP)	Mar 2006	**19.2 Goals and Objectives** 19.2.2 The following objectives are established in support of this goal: a) To increase the resident population within the secondary plan area by adding new dwelling units. e) To increase the number of employees within the secondary plan area, by supporting existing and new industrial and commercial activities.
Regional Policy			
Places to Grow	MPIR	2006	2.2.7.2 minimum density target for designated Greenfield area is 50 residents and jobs per hectare (p. 19) (Schedule 4) Downtown St. Catharines designated as "urban growth centre" 2.2.4.5 c) target density for Downtown St. Catharines Urban Growth Centre is 150 residents and jobs per gross hectare (p. 17)

Appendix E
Detailed Data Review

Pollution Control Plan Data Review

As part of this undertaking the following key documents have been reviewed:

1. St. Catharines Area Pollution Control Plan (1990)
2. The updates for the Port Weller and Port Dalhousie sewersheds (1999/2006)
3. Water and Wastewater Master Plan for the Region of Niagara (2003)
4. The Niagara Water Quality Protection Strategy Report (2003)
5. Combined Sewer Separation Project Remedial Works Class EA (2004)
6. City of St. Catharines CSO HRT Feasibility Study (2005)
7. The Evaluation and Audit of Sanitary Combined Sewer Overflows (2006)
8. Twelve Mile Creek Watershed Plan (2006)

Additional documents have been reviewed as part of the PPCP process. The information from these documents has been incrorporated, but full summaries are not included. A list of references for additional documentation reviewed is included within the reference section of this technical memorandum and subsequent reports.

St. Catharines Area Pollution Control Plan (SCAPCP) (1990)

The SCAPCP was undertaken in partnership with the Ministry of the Environment (MOE), the City of St. Catharines, the RMON and the City of Thorold. The purpose of the study was to develop a plan to improve water quality in the St. Catharines area. The objectives of the study were:

- To identify and quantify existing and potential sources of water pollution;
- To develop and evaluate a series of management options; and
- To select a preferred strategy with recommendations for implementation

The main deliverable from this initiative was a 20 year strategy including recommendations for capital work upgrades and ongoing programs.

The recommendations from the report included:

- Annual programs
  - Dry Weather Seepage Abatement Program
  - Enhanced Anti-little By-Law Enforcement
  - Monitoring
  - Annual Review and Public Consultation
- Recommendations for implementation in the near term (5-years)
- Long term recommendations

TABLE 1 – RECOMMENDATIONS FROM SCAPCP (1990)

Project/Program
Dry Weather Seepage Abatement Program
Enhance anti-litter by-law enforcement
Monitoring
Annual Review and Public Consultation
Roof Leader Disconnections
Infrastructure Needs Study
Storage – Ontario Street
Welland & Ontario, Lake & Welland, Welland & Clark; 2725 m³ storage
Storage – Lock St. PS
Storage – CNR line and 12 mile creek (W and E Bank)
Storage – Oakdale and Westchester
Storage – Merrit and Ball St.
Storage – Geneva and Glenpark Rd.
Storage – Pine St. Shopping Plaza (Thorold)
Storage – Westchester overflow
Sewer upgrade – Carlton St.
Sewer upgrade – Gale Cres.
Sewer upgrade – Page St.
Sewer upgrade – Yale/Berryman/Lancaster
Sewer upgrade – Corbett St.

Port Weller Sanitary Trunk Sewer Analysis (1999)

The Port Weller Sanitary Trunk Sewer Analysis was commenced in 1997 in response to flooding caused by a severe thunderstorm in 1996. It was also an update to the original SCAPCP. As part of the update, the Port Weller model was updated to reflect the sewer separation and roof leader disconnect programs as well capital works improvements implemented from 1989 to 1997. The system was evaluated based on real and design storm events and the system constraints and bottle necks were identified. Recommendations were made to address issues within the sewer system. The recommendations from the report are summarized in Table 2.

TABLE 2 – RECOMMENDATIONS FROM SEWER SYSTEM UPDATE REPORT (1999)

Recommendation
Capacity Upgrade – Walkers Creek
Capacity Upgrade – Hartzel Road
Capacity Upgrade – Bunting Road, Battersea to QEW
Capacity Upgrade – Regional Trunk, Petrie St. to QEW
Capacity Upgrade – Briarsdale/Brookdale
Capacity Upgrade – Bunting/Cushman Road, Carlton to Goldsmith Avenue
Storage – Lockview Park
Storage – Kernahan Park
Storage – Walkers Creek

Port Dalhousie Trunk Sewer and CSO Study (2006)

The Port Dalhousie Trunk Sewer System Update was initiated in 1999 as an update to the 1990 SCAPCP. The purpose of the study was to re-evaluate the sewer system and determine current capacities and identify constraints within the system. The deliverable from the study was a long-term plan to address these constraints and reduce the impact of CSOs. The recommendations for improvements to the sewer system are summarized in Table 3.

TABLE 3 – RECOMMENDATIONS FROM SEWER SYSTEM UPDATE REPORT (2006)

Recommendation
Replace sewer on Riverview Boulevard
Replace sewer on Haig St. from Perry St. to Scott St.
Replace sewer on Manning St. from Fritzgerald to Vine St. and Erie St.
Replace sewer on Ontario St. from King St. to Lake St.
Replace sewer on Russell Ave. from Rodman St. to George St.
Replace sewer on Westchester Ave and Glenridge Ave
Storage Tank – Argyle Pumping Station
Storage Tank – Cole Farm Pumping Station
Storage Tank – Eastchester Pumping Station
Storage Tank – Lakeside Pumping Station
Storage Tank – Capner and Oakdale
Storage Tank – Corbett and Bayview
Storage Tank – Kent Street
Storage Tank – Michigan Avenue

Storage Tank – Page South of Welland, Ida Street, Berryman and Richmond
Storage Tank – Welland and Ontario, Lake and Welland, Welland and Clark
Storage Tank – Westchester and Old Welland Canal
High Rate Treatment – Renown Road Pump Station CSO
High Rate Treatment – Thomas Street CSO

Water and Wastewater Master Plan Update (2003)

The Water and Wastewater Master Plan was an initiative lead by the Regional Municipality of Niagara (RMON). The project included an assessment of water and wastewater infrastructure across the entire region. This included a review of both regionally and municipally owned and operated infrastructure. The plan includes recommendations to address the issues outlined within the report. The section of the MSP which will be reviewed and summarized as part of this undertaking relates to combined sewer overflow and wastewater quality issues.

In addition to the main reports, the working papers completed as part of the MSP process were reviewed. In particular, the working papers relating to the Port Dalhousie and Port Weller WPCP were reviewed and summary of these papers has been included.

Combined Sewer Overflow Issues

The MSP recognized that CSOs are a major issue within the Niagara Region. A general review of CSO controls was completed with the recommendation to proceed with the following “best practices”:

- Roof leader/foundation drain disconnection
- Sewer separation
- In-line/off-line storage
- Disinfection of CSOs
- Sewer rehabilitation/replacement

The report also includes cost estimates for on-line and off-lines storage to comply with Procedure F-5-5, as determined by the hydraulic modelling of the wastewater system. The total cost estimate for the entire region is approximately $70 million with the breakdown for the St. Catharines sewersheds shown in Table 4.

TABLE 4
Estimated costs for compliance with Procedure F-5-5 (RMON, W&WW MSP, 2003)

	Region of Niagara	St. Catharines	Total
Port Dalhousie WPCP	$2,890,000	$150,000	$3,040,000
Port Weller WPCP	$11,380,000	$3,600,000	$14,980,000

Wastewater Quality Issues

The MSP listed the following as potential general issues in terms of wastewater quality:

- Ammonia toxicity
- Chlorine residual
- Endocrine disruptors
- Phosphorous removal
- Persistent toxic chemical
- Biosolids management
- Odour control

Table 5 includes a summary of environmental issues and recommended upgrades to the two St. Catharines WPCPs.

TABLE 5
Summary of Recommended Wastewater Treatment Plant Upgrades (RMON, W&WW MSP, 2003)

System	Receiving Water	Recommended long term capacity (m^3/d)	Environmental Issues	Next Steps
Port Dalhousie WPCP	Port Dalhousie Harbour to Lake Ontario	60,000	Assimilative capacity of Twelve Mile Creek Fisheries (trout, salmon) E. Coli, swimming beach issues Tributary toxin trackdown (PCBs) Ammonia, chlorine, phosphorus Possible non-acutely lethal effluent requirements	The Port Dalhousie WPCP is not expected to require future expansion to meet its long-term capacity requirements. The receiver for the Port Dalhousie WPCP is Twelve Mile Creek, a limited receiver in terms of overall assimilation capacity.
Port Weller WPCP	Welland Canal	39,320	Out of date effluent criteria Fish spawning Flow reduction in winter (due to shutdowns) Ammonia, chlorine, phosphorus E. coli, swimming beach issues Possible non-acutely lethal effluent requirements	Expansion of the Port Weller WPCP could likely be accommodated on the existing plant site through facilities re-rating and new construction, possibly requiring stacking of some plant components or use of innovative technologies. A receiving water assessment may be required for any future expansion to the Port Weller WPCP to set effluent criteria in accordance with PWQO requirements. Since the receiver comes under the federal jurisdiction as an international waterway, consideration must also be given to Department of Fisheries and Oceans (DFO) effluent discharge requirements.

Port Dalhousie WPCP Sewershed

The purpose of the review of the Port Dalhousie WPCP sanitary sewer system was to determine future available capacity and to make recommendations for general improvements to the system.

Wastewater Flow Projections

Wastewater flow projections were calculated for the existing conditions, 25 years out and 50 years in the future. Tables 6 and 7 show the flow projections in relation to the capacity of the existing treatment and conveyance infrastructure.

TABLE 6
Wastewater Flow Projections for the Port Dalhouise WPCP System (RMON, W&WW MSP, 2003)

	Existing	2026	Built-Out (2051)
	Ave DWF (L/s)	Ave DWF (L/s)	Ave DWF (L/s)
Total Flow	501.05	614.77	691.71

Note: The capacity of Port Dalhousie WPCP is 710.3 L/s.

TABLE 7
Wastewater Flow Projections for the Port Dalhousie Pumping Stations (RMON, W&WW MSP, 2003)

Pump Facility	Firm Capa-city	Existing			2026			Built-Out (2051)		
	L/s	Ave DWF L/s	Peak DWF L/s	Peak WWF L/s	Ave DWF L/s	Peak DWF L/s	Peak WWF L/s	Ave DWF L/s	Peak DWF L/s	Peak WWF L/s
Cole Farm PS	64.7	30.0	64.81	83.51	30.00	64.81	83.51	30.00	64.81	83.51
Lakeside PS	97.0	44.40	97.31	535.70	42.80	93.61	535.70	43.20	94.27	535.70
Renown Road PS	1060.8	472.00	934.50	1035.50	486.80	991.85	1070.65	450.00	857.40	991.40
Confederation Heights PS	173.7	27.60	71.40	243.30	59.20	143.27	286.97	77.60	181.90	302.30
Wellandvale PS	30.2	3.40	10.36	60.16	3.30	10.06	60.01	3.30	10.06	60.01
Argyle PS	34.1	26.50	70.10	665.10	37.80	98.12	693.12	37.80	96.10	691.10
Eastchester PS	50.6	7.30	18.89	1241.54	8.20	20.62	1241.92	8.20	20.23	1241.53
Port Dalhousie WPCP	710.3	550.7	1048.06	4829.01	748.10	1410.90	4951.75	909.30	1712.89	5053.44

Treatment Plant and Pumping Station Capacities

The Port Dalhousie WPCP appears to have adequate capacity to 2051 under dry weather flow conditions. Bypass may occur during high rain events, but will receive disinfection prior to discharge.

The majority of the pumping stations show sufficient capacity to accept additional flows, with the exception of the Argyle PS. Increasing the pumping rates will help to reduce in the incidents of surcharge to the upstream system.

Gravity Sewers

During wet weather such as the 2-year design storm and the typical rainfall year 1989, some of the gravity sewers in the downtown core and in the older areas with combined sewers were found to surcharge under existing and projected future conditions.

CSOs

The following summary was provided in the MSP for the built-out conditions of the system in 2051. The total volumes for Built-Out condition 2051 for the typical year analysis are summarized below:

1. Total volume to treatment = 18,449,000 m^3
2. Dry weather flow volume to treatment = 16,202,440 m^3
3. Wet weather volume to treatment (1) – (2) = 2,246,560 m^3
4. Wet weather flow volume released (total CSO) = 312,000 m^3
5. Wet weather flow captured for treatment = 86%
6. MOE Procedure F-5-5 Compliance for Built-Out 2051 condition, No

Recommended Improvement Works

The recommended improvement works for the Port Dalhousie WPCP system as outlined in the MSP are summarized in Table 8

TABLE 8
Recommended Improvement Works for Port Dalhousie WPCP System – 2051 built-out (RMON, W&WW MSP, 2003)

Item	Nature	Timing	Estimated Cost
1. Overflow – Michigan Avenue; 300 m^3 storage	Non-Growth related	0 to 20 years	$75,000
2. Overflow – Lakeside Pumping Station; 190 m^3 storage	Non-Growth related	0 to 10 years	$190,000
3. Overflow – Corbett and Bayview; 345 m^3 storage	Non-Growth related	0 to 20 years	$86,250
4. Overflow – Cole Farm Pumping Station; 110 m^3 storage	Non-Growth related	0 to 10 years	$110,000
5. Overflow – Page South of Welland, Ida Street, Berryman & Richmond; 920 m^3 storage	Non-Growth related	0 to 20 years	$230,000
6. Overflow – Welland & Ontario, Lake & Welland, Welland & Clark; 2725 m^3 storage	Non-Growth related	0 to 20 years	$681,250

Item	Nature	Timing	Estimated Cost
7. Overflow – Westchester & O. W. Canal; 1800 m³ storage	Non-Growth related	0 to 20 years	$450,000
8. Overflow – Argyle Pumping Station; 160 m³ storage	Non-Growth related	0 to 10 years	$160,000
9. Overflow – Eastchester Pumping Station; 660 m³ storage	Non-Growth related	0 to 10 years	$660,000
10. Overflow – Capner & Oakdale; 1030 m³ storage	Non-Growth related	0 to 20 years	$275,500
11. Overflow – Kent Street; 180 m³ storage	Non-Growth related	0 to 20 years	$45,000
12. Investigation of physical conditions of forcemains and their capacities in meeting future requirements	Growth related	0 to 10 years	$500,000
13. Port Dalhousie WPCP upgrades	Growth related	10 to 25 years	$5,000,000
	Total Improvement Cost		**$8,463,000**
1. Overflow – Michigan Avenue; 300 m³ storage	Non-Growth related	0 to 20 years	$225,000
3. Overflow – Corbett and Bayview; 345 m³ storage	Non-Growth related	0 to 20 years	$258,750
5. Overflow – Page South of Welland, Ida Street, Berryman & Richmond; 920 m³ storage	Non-Growth related	0 to 20 years	$690,000
6. Overflow – Welland & Ontario, Lake & Welland, Welland & Clark; 2725 m³ storage	Non-Growth related	0 to 20 years	$2,043,750
7. Overflow – Westchester & O. W. Canal; 1800 m³ storage	Non-Growth related	0 to 20 years	$1,350,000
10. Overflow –	Non-Growth related	0 to 20 years	$772,500

Item	Nature	Timing	Estimated Cost
Capner & Oakdale; 1030 m³ storage			
11. Overflow – Kent Street; 180 m³ storage	Non-Growth related	0 to 20 years	$135,000
14. CSO structure inspection, monitoring, modifications, and consolidation, etc. (3-year program)	Non-Growth related	0 to 10 years	$150,000
15. Replace sewer on Haig St. from Perry St. to Scott St. 200 m – 1050 mm	Non-Growth related	0 to 10 years	$240,000
16. Replace sewer on Manning St. from Fritzgerald to Vine St. & Erie St. 840 m – 1050 mm	Non-Growth related	0 to 10 years	$1,008,000
17. Replace sewer on Westchester Cres and Glenridge Ave. 710 m – 750 mm	Non-Growth related	0 to 10 years	$639,000
18. Replace sewer on Ontario St. from King St. to Lake St. 300 m – 900 mm	Non-Growth related	0 to 10 years	$270,000
19. Replace sewer on Russell Ave. from Rodman St. to George St. 350 m – 900 mm	Non-Growth related	0 to 10 years	$315,000
20. Replace Riverview Boulevard sewer 250 m – 1050 mm	Non-Growth related	0 to 10 years	$250,000
	Total Improvement Cost		**$8,347,000**

Port Weller WPCP Sewershed

The purpose of the review of the Port Weller WPCP sanitary sewer system was to determine future available capacity and to make recommendations for general improvements to the system.

Wastewater Flow Projections

Wastewater flow projections were calculated for the existing conditions, 25 years out and 50 years in the future. Tables 9 and 10 show the flow projections in relation to the capacity of the existing treatment and conveyance infrastructure.

TABLE 9
Wastewater Flow Projections for the Port Weller WPCP System (RMON, W&WW MSP, 2003)

Wastewater Facility	Existing	2026	Built-Out (2051)
	Ave DWF (L/s)	**Ave DWF (L/s)**	**Ave DWF (L/s)**
Serviced Area	348.67	406.37	449.88
Glendale Industrial Park	7 **(2)**	69.48 **(3)**	91.15 **(3)**
Thorold	104.17 **(4)**	229.19	330.83
Total Flow	**459.84**	**705.04**	**871.86**

Note:

1. The capacity of Port Weller WPCP is 650.23 L/s.
2. Based on flows measured by Glendale meter.
3. Future flow from Glendale Airport 18.75 L/s is included.
4. Thorold flow estimates based on flows measured at Thorold flume, but future flows for 2026 and 2051 are calculated using design unit rates as listed in text.

TABLE 10
Wastewater Flow Projections for the Port Weller Pumping Stations (RMON, W&WW MSP, 2003)

Pump Facility	Firm Capacity	Existing			2026			Built-Out (2051)		
		Ave DWF	**Peak DWF**	**Peak WWF**	**Ave DWF**	**Peak DWF**	**Peak WWF**	**Ave DWF**	**Peak DWF**	**Peak WWF**
	L/s	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**
Allanburg PS	17.0	7.63	21.81	21.81	7.63	21.30	21.30	7.63	20.76	20.80
Black Horse PS	50.0	28.60	85.18	85.18	53.30	127.00	127.00	60.40	135.68	135.70
Peel Street PS	142.0	49.00	131.14	131.14	137.40	210.99	210.99	142.00	294.66	294.70
Spring Garden PS	537.0	267.0	615.90	855.40	266.00	614.76	829.76	276.00	638.82	838.80
Lombardy PS	34.0	14.10	35.44	260.44	12.30	30.50	255.50	12.30	30.25	255.25
Port Weller East PS	38.0	3.36	9.98	714.98	7.44	20.68	725.68	11.10	30.02	735.02
Carleton St. PS	106.0	9.30	26.04	26.04	11.70	33.18	33.18	13.40	38.00	38.00
Port Weller WPCP		544.50	1079.28	4767.00	685.00	1402.88	4789.00	774.00	1594.40	4806.00

Treatment Plant and Pumping Station Capacities

The Port Weller WPCP has a rated capacity of 56.18 MLD and will require an expansion to handle the average daily flows by 2022. It a new treatment plant is constructed in Niagara-on-the-Lake flows may be diverted, eliminated the need for expansion at the Port Weller WPCP. Bypass may occur during high rain events, but will receive disinfection prior to discharge.

The majority of the pumping stations show sufficient capacity to accept additional flows. For the Blackhorse pumping station, the existing pumping rate of 50.5 L/sec can be increased to 70 L/sec, which is the downstream sewer capacity. Increasing the pumping rates further will cause surcharge downstream.

Gravity Sewers

The MSP found that some City sewers shown signs of deficiencies, and/or were under surcharge for present and future conditions. The upgrades based on the 1999 Port Weller - Sanitary Trunk Sewer Analysis - Phase 2 still apply as follows:

1). Hartzel Road **-** the existing sewer system should be twinned with a system of the following size and quantity:

200 m – 250 mm diameter
430 m – 450 mm diameter
430 m – 525 mm diameter
200 m - 610 mm diameter
1,100 m – 750 mm diameter

2). Bunting Road **-** Battersea Ave to QEW; a storage facility in combination with a separate new sewer on Bunting Road as follows:

920 m – 525 mm diameter
1,150 m – 1050 mm diameter

With the construction of the new sewers, the following storage capacities are required to achieve the 2-year level of protection against system surcharge.

3). Lockview Park - a 1,300m^3 storage facility is recommended
4). Kernahan Park - a 600m^3 storage facility is recommended
5). Walker's Creek - a 350m^3 storage facility is recommended

CSOs

The following summary was provided in the MSP for the built-out conditions of the system in 2051. The total volumes for Built-Out condition 2051 for the typical year analysis are summarized below:

1. Total volume to treatment = 14,416,000 m^3
2. Dry weather flow volume to treatment = 13,772,900 m^3
3. Wet weather volume to treatment (1) – (2) = 643,100 m^3
4. Wet weather flow volume released (total CSO) = 143,500 m^3
5. Wet weather flow captured for treatment = 78%

6. MOE Procedure F-5-5 Compliance for Built-Out 2051 condition, No

Recommended Improvement Works

The recommended improvement works for the Port Weller WPCP system as outlined in the MSP are summarized in Table 11.

TABLE 11
Recommended Improvement Works for Port Weller WPCP System – 2051 built-out (RMON, W&WW MSP, 2003)

Item	Nature	Timing	Estimated Cost
1. Upgrade Allanburg Pumping Station from 17 L/sec to 40 L/sec	Non-Growth related	0 to 10 years	$50,000
2. Upgrade Black Horse Pumping Station from 49 L/sec to 70 L/sec	Non-Growth related	0 to 10 years	$50,000
3. Investigation of physical conditions of forcemains and their capacities in meeting future requirements	Growth related	0 to 10 years	$250,000
4. Port Weller WPCP upgrades	Growth related	10 to 25 years	$5,000,000
5. Overflow – Elmwood Ave. & QEW; 910 m^3 storage	Non-Growth related	0 to 20 years	$227,500
6. Overflow – Beachview & Lake; 310 m^3 storage	Non-Growth related	0 to 20 years	$77,500
7. Overflow – Hartzel & CNR line; 2360m^3 storage	Non-Growth related	0 to 20 years	$600,000
8. Overflow – Lincoln & Oakdale; 73 m^3 storage	Non-Growth related	0 to 20 years	$18,750
9. Overflow – Chestnut & Briarsdale Dr.; 155 m^3 storage	Non-Growth related	0 to 20 years	$38,750
10. Overflow – Aerial Sewer Briarsdale; 300 m^3 storage	Non-Growth related	0 to 20 years	$75,000
11. Overflow – Brookdale &	Non-Growth	0 to 20 years	$22,500

Item	Nature	Timing	Estimated Cost
Glengarry; 90 m^3 storage	related		
12. Overflow – Burleigh Hill & Glendale; 235 m^3 storage	Non-Growth related	0 to 20 years	$58,800
13. Overflow – Wedsworth & Hasting; 1005 m^3 storage	Non-Growth related	0 to 20 years	$250,000
14. Overflow – Guy Road; 670 m^3 storage	Non-Growth related	0 to 10 years	$167,500
15. Overflow – Ursula & Rountree; 20 m^3 storage, or adjust overflow structure and upstream sewers	Non-Growth related	0 to 5 years	$5,000
16. Overflow – Pine Plaza; 6100 m^3 storage	Non-Growth related	0 to 10 years	$1,220,000
	Total Improvement Cost		**$8,111,300**

Item	Nature	Timing	Estimated Cost
5. Overflow – Elmwood Ave. & QEW; 910 m^3 storage.	Non-Growth related	0 to 20 years	$682,500
6. Overflow – Beachview & Lake; 310 m^3 storage	Non-Growth related	0 to 20 years	$232,500
7. Overflow – Hartzel & CNR line; 2360m^3 storage	Non-Growth related	0 to 20 years	$1,800,000
8. Overflow – Lincoln & Oakdale; 73 m^3 storage	Non-Growth related	0 to 20 years	$56,250
9. Overflow – Chestnut & Briarsdale Dr.; 155 m^3 storage	Non-Growth related	0 to 20 years	$116,250
10. Overflow – Aerial Sewer Briarsdale; 300 m^3 storage	Non-Growth related	0 to 20 years	$225,000
11. Overflow – Brookdale & Glengarry; 90 m^3 storage	Non-Growth related	0 to 20 years	$67,500
12. Overflow – Burleigh Hill &	Non-Growth	0 to 20 years	$176,250

Glendale; 235 m^3 storage	related		
13. Overflow – Wedsworth & Hasting; 1005 m^3 storage	Non-Growth related	0 to 20 years	$750,000
14. Overflow – Guy Road; 670 m^3 storage	Non-Growth related	0 to 10 years	$502,500
15. Overflow – Ursula & Rountree; 20 m^3 storage, or adjust overflow structure and upstream sewers	Non-Growth related	0 to 5 years	$15,000
16. Overflow – Pine Plaza; 6100 m^3 storage	Non-Growth related	0 to 10 years	$3,660,000
17. CSO structure inspection, monitoring, modifications, and consolidation, etc. (3-year program)	Non-Growth related	0 to 10 years	$150,000
18. Twinning Hartzel road with 200m-250mm, 430m-450mm, 430m-525mm, 200m-610mm, 1100m-750mm	Non-Growth related	0 to 10 years	$1,600,000
19. Installation of new sewers on Bunting Road including 920m–525mm and 1150m–1050mm	Non-Growth related	0 to 10 years	$1,700,000
20. Walker's Creek provide an additional 350m^3 storage.	Non-Growth related	0 to 10 years	$ 350,000
21. Lockview Park provide an additional 2,500m^3 storage.	Non-Growth related	0 to 10 years	$2,500,000
22. Kernahan Park provide an additional 600m^3 storage.	Non-Growth related	0 to 10 years	$ 600,000
	Total Improvement Cost		**$15,183,750**

Niagara Water Quality Protection Strategy Final Reports (2003)

The Niagara Water Quality Protection Strategy (NWQPS) was initiated in 2002 by the Regional Municipality of Niagara, the Niagara Peninsula Conservation Authority and the Ministry of the Environment. The strategy development included a watershed characterization which addressed land and water use, study area features and functions and potential contaminant sources.

A detailed assessment was performed by dividing the watersheds into Local Management Areas (LMAs). Each land parcel was summarized in terms of area statistics, key resources, major land use/activities, contaminant sources, form and function, key issues, general approach for water protection and key actions. The St. Catharines area is generally covered by LMAs 1.6 and 1.8. The key issues related to these LMAs are:

- Protection/improvement of critical and important fish habitat
- Water level fluctuations, shoreline stability and sediment budgets in Martindale Pond
- Effect of urbanization and Old Welland Canal pollution on aquatic habitat and marshes
- Urban encroachment on agricultural land and some riparian forest on west boundary
- Agriculture water use is high for irrigation and greenhouse productions
- Combined sewer overflows
- Non-point source pollutants from urban run-off through stormwater discharge
- Potential leachate from old dump/fill sites
- Sensitive groundwater areas are susceptible to contamination from surface sources
- Low forest and wetland extent
- Moderate lack of tributary buffers cuasing non-point source loading
- Decew water diversion altering natural systems
- Maintaining spring discharge for Escarpment natural areas
- Flooding risk/problems in Dicks, Beamer, Walker and Spring Garden Creeks
- Erosion and slope failure along Beamer Creek at Arthur St. Docks, Second and Rosedale Creek also experience moderate to mild erosion
- Lack of stormwater management facilities to treat urban run-off
- Beach closures due to microbial and other visible contamination
- Shoreline erosion
- Effluent discharge from industrial sites

In addition to the local assessments, a list of core issues which are common to the majority of the Niagara watersheds was developed. The core issues which most readily relate to Pollution Control Planning are:

- #8 – Point source contamination
- #17 – Beach closures
- #20 – Terrestrial/aquatic impacts

In order to address the core issues a number of action items were developed. The action items relating to pollution control planning include:

- Review of CSO policies (programs)
- Mandate sewer separation (new development areas)
- Develop Regional storm sewer pollution elimination program

- Establish sewer system computer models to identify system deficiencies
- Assess the impacts of sanitary sewer overflows on ecosystem; develop appropriate methods to manage impacts including holding tanks and other technologies
- Undertake sewer repair or replacement, pipe lining or internal grouting
- Undertake inflow/infiltration control studies (plans)
- Phase out combined sewer overflows (where appropriate)

Combined Sewer Separation Project Remedial Works Class EA (2004)

As described previously in this report, a residential area in North Thorold serviced by a combined sewer system underwent sewer separation. During and following commission basement flooding continued in the area, necessitating the installation of six temporary overflow connections. In order to address ongoing system surcharging, basement flooding and overflow issues, the City of Thorold completed a Class Environmental Assessment (EA) study. The report recommended the construction of multiple storage tanks to alleviate the pressure to the system during wet weather events. The City of Thorold constructed three of these storage tanks in 2007. The system will be monitored for effectiveness and the need for further storage facilities will be examined if necessary.

City of St. Catharines CSO HRT Feasibility Study (2005)

The objective of the CSO HRT Feasibility Study was to evaluate high rate treatment (HRT) options for handling CSOs in the Port Dalhousie and Port Weller sewersheds. Off line storage tanks have been and remain a popular approach for wet weather CSO control. The cost of these storage facilities is often high. In some cases, alternate options, such as HRT, may be a feasible alternative.

The objectives of the report were to:

- Examine the approach, designs and methods used from recent HRT studies and demonstrations in other jurisdictions
- Identify sites suitable for monitoring and an evaluation of HRT technologies, conduct flow monitoring and water quality sampling for specific areas
- Establish the type and combination of HRT technologies that are most suitable and the expected performance, efficiency, and the number and size of treatment units required, and prepare preliminary conceptual design layouts and cost estimates for the selected sites
- Determine the effectiveness of the HRT technologies identified in terms of meeting MOE guidelines and overall effect on receiving waters
- Provide the opportunity for public input through an open house, in anticipation of future Environmental Assessment projects

The following recommendations were made from this study:

- HRT was found to be feasible for the CSO sites considered (Renown Road, Thomas Street, Hartzel & CNR and Wedsworth & Hastings) and in general was the most cost effective option. If HRT is considered at sites in St. Catharines, the recommended technology is the RTB with polymer assisted settling.

- If HRT is to be installed, consideration should be given to stating the installations to allow for optimization of the process and review the need for polymer aids. The recommended schedule included a year of further characterization and possible pilot testing and then proceeding with installations at Renown Road, Thomas Street, Hartzel & CNR and Wedsworth & Hastings in succession.

- Monitoring of the Twelve Mile Creek should be undertaken at the recreational area to monitor and confirm the impact of CSO treatment on water quality.

Evaluation and Audit of Sanitary Combined Sewer Overflows – *Draft* (2006)

This study was initiated as part of the implementation of the Niagara Water Strategy (NWS). The purpose of the evaluation was to examine current CSO management initiatives across the Region and to develop a prioritization of projects to assist in funding allocation. In addition, recommendations were made on how CSO management might occur in a more coordinated approach throughout the Region. At the time of this background data review, only a draft version of the Evaluation and Audity of Sanitary Combined Sewer Overflows report was available and was included in the review.

CSO reduction targets were developed with input from the CSO Study Panel. These targets are:

- Compliance with the F-5-5 requirements within the next 15 years
- Inflow and infiltration reduction as follows
  - 100% of downspouts disconnected within 2 years
  - Complete foundation drain and sump pump disconnections in high volume areas within 8 years
  - Establishment of by-laws and incentive programs within 1 year

As part of the study an Action Plan was developed. The main elements of the CSO Management Action Plan included:

- Ongoing and Future CSO Control projects
- Third Party Funding
- Extraneous Flow Reduction Program
- Pollution Control Plan Updates
- Installation of Permanent Flow Monitors
- Inspection and Maintenance
- Public Awareness Program
- CSO Control By-Law

The City of St. Catharines is already implementing all of these recommendations.

As part of the prioritization process, the study identified the “Top 40 CSO Control Projects” for the Niagara area. Of the 37 engineering projects listed, 22 of the projects are located within the Port Dalhousie and Port Weller sewer sheds. The top 9 of the 37 Engineering Projects are located within these two sewer sheds and include:

- Welland & Ontario storage
- 6 CSO tanks in Thorold

- Page/Ida/Berryman storage
- Guy Road Park storage
- Sewer replacement on Ontario
- Kent Street storage
- Argyle pumping station storage
- Riverview boulevard sewer replacement
- Eastchester storage

Twelve Mile Creek Watershed Plan (2006)

The Twelve Mile Creek watershed includes the Town of Pelham, City of Thorold, City of St. Catharines and the Town of Lincoln. The Twelve Mile Creek Watershed Plan compiles watershed issues from previous studies and public input to form a set of watershed objectives to guide the development of subwatershed restoration strategies and an implementation plan.

The watershed objectives which relate to the pollution control plan include

Water Resources

- Protect all municipal drinking water supplies and designated vulnerable areas
- Ensure that storm water management practices optimize storm water volumes and minimize contaminant loads, and maintain or increase the extent of vegetative and pervious surfaces

Urban Development

- Promote environmentally-sound land use decision-making in the watershed for current and future urban development
- Identify opportunities to optimize restoration and rehabilitation as part of urban growth and development

Communication and Education

- Increase awareness of the linkages between healthy water, healthy lifestyles and the economic viability of rural and urban land uses
- Promote the efficient and sustainable use of water resources, including practices for water conservation and sustaining water quality

Recommended Management Actions relating to the Pollution Control Plan include:

- Create and implement downspout disconnection by-laws for the Town of Pelham and the City of Thorold.
- Create, fund and implement and urban Rain Barrel Program
- Disseminate material pertaining to alternative fertilizer use for residential lawns

Appendix F
Ministry of the Environment Procedures

Procedure F-5-1

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PROCEDURE F-5-1
(formerly referenced by 08-01)

Determination of Treatment Requirements for Municipal and Private Sewage Treatment Works Discharging to Surface Waters

PROCEDURE F-5-1

DETERMINATION OF TREATMENT REQUIREMENTS FOR MUNICIPAL AND PRIVATE SEWAGE TREATMENT WORKS DISCHARGING TO SURFACE WATERS

1.0 Rationale

Effluent requirements within the Province of Ontario are determined under the provisions of Procedure B-1-1: "Water Management-- Guidelines and Procedures of the Ministry of Environment and Energy (The "Blue Book")". In accordance with the procedures outlined in that publication, effluent requirements are established on a case-by-case basis considering the characteristics of the receiving water body, as well as Federal and Provincial effluent regulations and procedures, where applicable.

For discharges from municipal and private sewage treatment works, Provincial jurisdiction applies, except for Federal facilities. Federal facilities are covered by the effluent guidelines, "Guidelines for Effluent Quality and Wastewater Treatment at Federal Establishments". Normally, the Federal government consults with the Province to ensure that the effluent from Federal plants will be consistent with Provincial policies.

Guideline F-5 takes the approach that all sewage treatment works shall provide secondary treatment or equivalent as the "normal" level of treatment, unless individual receiving water assessment studies indicate the need for higher levels of treatment. In setting the "normal" level of treatment as secondary, various factors were considered, including: minimization of adverse health-related and environmental effects, aesthetic nuisance and toxic effects of effluent discharges from heavily populated areas to rivers and streams or to littoral zones of lakes where intensive water use and re-use occur; minimization of potential interference of effluent discharges with other water uses; possibility of more stringent future phosphorus removal requirements and the capability of secondary sewage treatment processes to be upgraded to meet such requirements; relatively low additional cost and significant additional benefits of secondary treatment over primary treatment with respect to removal of conventional contaminants and, potentially, the removal of hazardous trace organics.

2.0 Definitions

2.1 Ministry

For purposes of Guideline F-5 and its procedures, the term Ministry is defined as the Ministry of Environment and Energy, unless otherwise stated.

2.2 Municipal and Private Sewage Treatment Works

The term "municipal and private sewage treatment works", for purposes of Guideline F-5 and its associated procedures, includes works owned by municipalities, private groups or companies, institutions or government agencies, treating either strictly domestic, or combinations of domestic, commercial and industrial waste, which are owned by municipalities, private groups or companies, institutions or government agencies, which discharge their effluent to surface waters, but does not include sewage works exempted from the requirement of Section 53 of the OWR Act (R.S.O. 1990).

2.3 Secondary Treatment, or Equivalent

Secondary treatment, or equivalent, may be that provided by biological processes including the activated sludge variations or lagoon systems, physical-chemical, or combinations of these processes producing an effluent quality as stated in Table 1.

Sewage treatment works which provide only primary settling of solids and the addition of chemicals primarily for the purpose of improving the removal of total phosphorus and/or solids are not considered as secondary treatment, or equivalent for purposes of Guideline F-5.

2.4 Five Day Biochemical Oxygen Demand "BOD_5"

For purposes of Guideline F-5, BOD_5 is defined as carbonaceous BOD_5. It is a measure of the oxygen utilized over a 5 day period for the bio-chemical degradation of organic materials and the oxygen utilized to oxidize such inorganic materials as sulfides and ferrous ion.

3.0 Guidelines

In selecting the level of treatment required for municipal and private sewage treatment works discharging to surface waters, the following shall be adhered to:

3.1 Receiving Water Assessment

Receiving water assessments must be performed in all cases. Technical guidance for water assessment studies may be obtained from Regional staff or staff of the Science and Technology Branch. The carrying out of receiving water assessment studies and the interpretation of results will be the responsibility of the proponent of any new sewage treatment works or of any works undergoing expansion. Any relevant data in the possession of the Ministry will, upon request, be made available for such assessments. In certain cases, the necessary receiving water assessment may have already been carried out

by the Ministry and, if so, all pertinent information will be made available to the proponent. If not the Ministry may at its discretion agree to do such assessments, or assist in their completion.

3.2 Higher Than Normal Treatment

If the effluent requirement determined by the receiving water assessment is more stringent than the "normal" level of treatment as required in the Provincial guideline, then the treatment requirement derived from the assessment will be imposed.

Since BOD_5 does not include the oxygen demand due to the bio-chemical oxidation of total ammonia, for those sewage treatment works discharging into receivers where nitrogenous oxygen demand is important, a total ammonia nitrogen "$(NH_3+NH_4^+)$-N" and/or total kjeldahl nitrogen limits should be derived and incorporated into the works' Certificates of Approval.

3.3 Sewage Bypass From Nominally Separate Sewer Systems

Bypassing of raw sewage and primary effluent from nominally separate sewerage systems will not be allowed except in emergency conditions.

In accordance with Section 15 of the *Environmental Protection Act (R.S.O. 1990)*, and with Section 30(2) *OWR Act (R.S.O. 1990)*, bypass incidence shall be recorded and the appropriate agencies (i.e. MOEE Region and/or Spills Action Centre, and Medical Officer of Health) notified. In addition, the measured or estimated volume, duration and reasons for bypassing shall be documented and reported to the MOEE Regional office.

For new works, emergency bypass facilities which permit by-passing from sewers, sewage pumping stations and sewage treatment works of sewage not satisfying the prescribed treatment requirements, must receive approval as required by Section 24 to 53 of the *OWR Act*. It is understood, however, that the approval required is an integral part of normal review procedures for sewers, pumping stations or treatment works in question and that a separate approval is not required. These emergency bypasses will be permitted only to provide protection from basement flooding, to prevent damage to equipment at treatment works or pumping facilities or to prevent treatment process wash-out.

To reduce the frequency and volume of sewage discharged from emergency by-passes to an acceptable minimum, measures shall be taken to provide adequate sewer and pumping station capacity, stand-by equipment, stand-by power, reserve storage capacity in sewers, and/or at treatment facilities and adequate capacity in sewage treatment works. For recommended design criteria, reference should be made to **"Guidelines for the Design of Sewage Treatment Works"** and to **"Guidelines for the Provision of Equipment to Handle Emergency Conditions in New Sewage Works".**

Where existing sewer systems are found to experience excessive infiltration/inflow

problems, which result in unacceptable frequencies or quantities of raw sewage and/or primary effluent by-passing, and where the above measures alone are either impractical or uneconomical to reduce the by-passing to acceptable levels, staged programs should be developed for the ultimate containment of these flows by a combination of the above measures and the reduction of infiltration/inflow to the sewer systems. These programs should outline the approaches to solving the problems along with the anticipated timing of when the changes to the sewer systems could be made.

3.4 Bypassing from Combined Sewer Systems

It is the goal of the Ministry to abate all discharges of untreated sanitary wastewater. With combined sewer systems, it is realized that a certain degree of overflowing will occur for some period both during and shortly after severe storm events and spring melts . All municipalities serviced by combined sewerage should however prepare a staged program leading towards the ultimate goal of total containment for treatment of all sewage flows. This program should outline the sewerage works required along with their anticipated timing of implementation. Details of requirements are discussed in the Ministry Guideline (draft, copy enclosed) dealing with by-passing and combined sewage overflows. New or expanded sewage treatment works servicing sewer systems containing combined sewer areas should be designed taking into account the problem of combined sewage overflows.

3.5 Excess Primary Treatment Capacity

Where reduction and/or containment followed by secondary treatment of extraneous wet weather flows is impractical or uneconomical , secondary/tertiary sewage treatment works may be designed with excess primary treatment capacity to accommodate the extraneous wet weather peak flows.

For the present, effluent criteria need not be specified for excess primary effluent discharged in wet weather. Consequently, no compliance assessment program is currently necessary, although the frequencies of occurrence, volume and duration should be measured or estimated, recorded and reported to the Ministry Regional office as secondary by-pass. The Region in consultation with Program Development Branch, in specific instances may require both effluent criteria and a compliance assessment program for excess primary effluent discharges. The details of requirements including the means of assessing non-compliance will be specified by the Ministry for such cases.

3.6 Non-compliance of Existing Sewerage Systems

Existing municipal and private sewerage works not complying with Guideline F-5 shall be upgraded to meet the requirement of this guideline as soon as possible. It will be the responsibility of the Ministry's Regions to develop upgrading schedules taking into account local, national and international obligations.

3.7 Effluent Design Objectives and Effluent Guidelines

Table 1 is provided to assist in selection of sewage treatment processes to meet specific effluent quality criteria. Two sets of effluent criteria are given in Table 1 - Effluent Design Objectives and Effluent Guidelines. The Effluent Design Objectives are those levels of performance which can be achieved by treatment processes treating normal strength municipal sewage under optimum conditions. The Effluent Guidelines criteria were developed based upon the effluent quality data of sewage treatment works in operation in Ontario in 1982 and earlier. Sewage treatment works designed in accordance with the Ministry **"Guidelines for the Design of Sewage Treatment Works"** should be able to produce annual average effluent quality approximately equal to the Effluent Design Objectives, but not to exceed the Effluent Guidelines criteria.

There will be some circumstances, when sewage treatment works will be required to achieve somewhat better quality than the Effluent Guidelines criteria in order to satisfy effluent requirements determined from receiving water assessment studies. For example, a situation could occur where the receiving water assessment study for a proposed plant indicates that the effluent BOD_5 should be 17 mg/L and the suspended solids should be 25 mg/L. Plant performance better than the Effluent Guidelines criteria (25 mg/L BOD_5) for conventional activated sludge plants will, therefore, be necessary, but the effluent requirement is still within the possible range for conventional activated sludge plants, since under optimum conditions such a plant should be capable of meeting the Effluent Design Objectives criteria (15 mg/L BOD_5). In this circumstance, a conventional activated sludge plant could be approved with effluent BOD_5 and suspended solids requirements of 17 and 25 mg/L. Reference should be made to Procedure F-5-3: "Derivation of Sewage Treatment Works Effluent Requirements for the Incorporation of Effluent Requirements into Certificates of Approval for New or Expanded Sewage Treatment Works" for the parameters requiring documentation and the procedures required to determine compliance with the effluent requirements.

While many primary sewage treatment plants are being upgraded to provide secondary treatment or equivalent, some primary plants will remain in service for a few more years. In the interim, effluent guidelines for primary treatment without total phosphorus removal shall remain as 30% and 50% removal of BOD_5 and suspended solids, respectively; the guidelines for primary treatment with total phosphorus removal shall remain as 50% and 70% removal of BOD_5 and suspended solids, respectively.

3.9 Industrial Wastes

In selecting a sewage treatment process, consideration must be given to industrial waste inputs to ensure that the sewage treatment process will be compatible with the waste requiring treatment. Pre-treatment of industrial wastes may be necessary. In all cases, sewer use by-laws should be in effect and under enforcement to control the wastes being discharged to the sewer system by industries.

3.10 Sewage From Pressure or Vacuum Sewer Systems

Special consideration may be required in selecting and designing a sewage treatment process for municipalities serviced either wholly or extensively by pressure or vacuum sewers. The sewage quality tends to be more concentrated in such systems since it is unlikely to be affected by inflow/infiltration.

Table 1 Effluent Criteria

Treatment Level and Processes	Effluent Design Objectives[1] (mg/L)				Effluent Guidelines[2] (mg/L)	
	BOD_5	SS	TP	$(NH_3+NH_4^+)$-N	BOD_5	SS
SECONDARY TREATMENT OR EQUIVALENT						
Conventional Activated Sludge without TP removal	15	15	-	-	25	25
Conventional Activated Sludge with TP removal	15	15	1.0	-	25	25
Contact Stabilization without TP removal	20	20	-	-	25	25
Contact Stabilization with TP removal	20	20	1.0	-	25	25
Extended Aeration without TP removal	15	15	-	-	25	25
Extended Aeration with TP removal	15	15	1.0	-	25	25
Continuous Discharge Lagoon without TP removal	25	30	-	-	30	40
Continuous Discharge Lagoon with TP removal	25	30	1.0	-	30	40
Seasonal Retention Lagoon without TP removal	25	30	-	-	30	40
Seasonal Lagoon with TP removal by batch chemical dosage	15	20	0.5 to 1.0	-	25	25

to be continued

Table 1 Effluent Criteria (Continued)

Treatment Level and Processes	Effluent Design Objectives[1] (mg/L)				Effluent Guidelines[2] (mg/L)	
	BOD_5	SS	TP	$(NH_3+NH_4^+)$-N	BOD_5	SS
SECONDARY TREATMENT OR EQUIVALENT						
Seasonal Retention Lagoon with TP removal by continuous chemical dosage	25	30	1.0	-	30	40
Physical-chemical Treatment	20	20	1.0	-	25	25
ADVANCED TREATMENT						
Conventional Activated Sludge with TP removal and filtration	10	5	0.3	-	---[3]	---[3]
Conventional Activated Sludge with nitrification	15	15	-	<1.0[4]	---[3]	---[3]
Extended Aeration with TP removal and filtration	5	5	0.3	-	---[3]	---[3]

Notes:

1 Expected effluent quality under optimum conditions when treating raw sewage with BOD_5=170 mg/L, soluble BOD_5=50%, SS=200 mg/L, TP=7 mg/L, (NH_3+NH_{4+})-N= 20 mg/L.

2 Criteria which the average annual effluent quality should not exceed (based upon performance data collected in 1983 of sewage treatment works in operation in Ontario).

3 Effluent quality and permissible periods of discharge will be stipulated as a result of receiving water assessment studies. Where effluent BOD_5 and suspended solids concentrations are not found to be critical, then Effluent Guideline BOD_5 and suspended solids concentrations of 25 and 25 mg/L should be used.

4 Expected warm weather effluent concentration.

Procedure F-5-5

PROCEDURE F-5-5

DETERMINATION OF TREATMENT REQUIREMENTS FOR MUNICIPAL AND PRIVATE COMBINED AND PARTIALLY SEPARATED SEWER SYSTEMS

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1. RATIONALE

Procedure F-5-5 is a supporting document for Guideline F-5 "Levels of Treatment for Municipal and Private Sewage Treatment Works Discharging to Surface Waters".

A Combined Sewer System (CSS) is a wastewater collection system designed to convey both sanitary wastewater and stormwater runoff through a single-pipe system to a sewage treatment works. During dry weather, it conveys sanitary wastewater. During a precipitation event (rainfall or snowmelt) the capacity of the CSS and/or treatment facility may be exceeded by the total wastewater flow. This results in the occurrence of a combined sewer overflow (CSO) which is an untreated mixture often containing high levels of floatables, pathogenic microorganisms, suspended solids, oxygen-demanding organic compounds, nutrients, oil and grease, toxic contaminants and other pollutants. The CSOs represent a potential health hazard and can have adverse effects on aquatic life, recreational uses and water supplies. The goals of this Procedure are to:

(a) eliminate the occurrence of dry weather overflows
(b) minimize the potential for impacts on human health and aquatic life resulting from CSOs
(c) achieve as a minimum, compliance with body contact recreational water quality objectives (Provincial Water Quality Objectives (PWQO) for Escherichia coli (E. coli)) at beaches impacted by CSOs for at least 95% of the four-month period (June 1 to September 30) for an average year.

2. DEFINITIONS

A "combined sewer system (CSS)" is a wastewater collection system which conveys sanitary wastewaters (domestic, commercial and industrial wastewaters) and stormwater runoff through a single-pipe system to a Sewage Treatment Plant (STP) or treatment works. Combined sewer systems which have been partially separated and in which roof leaders or foundation drains contribute stormwater inflow to the sewer system conveying sanitary flows are still defined as combined sewer systems in this Procedure.

A "combined sewer overflow (CSO)" is a discharge to the environment from a combined sewer system that usually occurs as a result of a precipitation event when the capacity of the combined sewer

is exceeded. It consists of a mixture of sanitary wastewater and stormwater runoff and often contains high levels of floatables, pathogenic microorganisms, suspended solids, oxygen-demanding organic compounds, nutrients, oil and grease, toxic contaminants and other pollutants.

An "overflow event" occurs when there is one or more CSOs from a combined sewer system, resulting from a precipitation event. An intervening time of twelve hours or greater separating a CSO from the last prior CSO at the same location is considered to separate one overflow event from another.

"Dry weather flow" is sewage flow resulting from both:

(i) Sanitary wastewater (combined input of industrial, domestic and commercial flows); and
(ii) Infiltration and inflows from foundation drains or other drains occurring during periods with an absence of rainfall or snowmelt.

"Wet weather flow" is the combined sewage flow resulting from:

(i) Sanitary wastewater; and
(ii) Infiltration and inflows from foundation drains or other drains resulting from rainfall or snowmelt; and
(iii) Stormwater runoff generated by either rainfall or snowmelt that enters the combined sewer system.

A "regulator" is any structure that in dry weather permits the passage of all flows to treatment and in wet weather permits discharge to an outfall or relief sewer of all flows in excess of some specific flowrate.

An "average year" refers to:

(i) the long term average of flow based on using simulation of at least twenty years of rainfall data and/or
(ii) a year in which the rainfall pattern (e.g. intensity, volume and frequency) is consistent with the long-term mean of the area; and/or
(iii) a year in which the runoff pattern resulting from the rainfall (e.g. rate, volume and frequency) is consistent with the long-term mean of the area.

A "swimming and bathing beach" is a strip of shoreline with the physiographic, climatic, access, and ownership attributes necessary to accommodate significant water contact and non-contact recreation under favourable aquatic conditions.

3. SEPARATE VERSUS COMBINED SEWERS

The Ministry "Guidelines for the Design of Sanitary Sewage Systems, July 1985" states that

"All new sewer construction within the Province of Ontario should be of the 'separate' type, with all forms of storm and groundwater flow being excluded to the greatest possible extent. New 'combined' sewer systems will not be approved."

However, existing combined sewers may undergo rehabilitation or be replaced by new combined sewers provided the municipality or operating authority has met the Ministry requirements as set out in this document.

4. MINISTRY REQUIREMENTS FOR MUNICIPAL & PRIVATE COMBINED SEWER SYSTEMS

To meet the goals of this Procedure each municipality or operating authority of a combined sewer system will be expected to:

(a) develop a Pollution Prevention and Control Plan (PPCP) as outlined in Section 5;
(b) meet minimum CSO controls as outlined in Section 6; and
(c) provide additional controls
- for beaches impaired by CSOs where water quality is not meeting the PWQO for E. coli as outlined in Section 9
- where required by receiving water quality conditions as specified in Procedure B-1-1 "Water Management - Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy, July 1994".

The site-specific nature and impacts of CSOs are recognized in this Procedure. There is flexibility for selecting controls for local situations.

5. POLLUTION PREVENTION AND CONTROL PLAN (PPCP)

A Pollution Prevention and Control Plan (PPCP) should be developed to meet the goals of the Procedure by:

- outlining the nature, cause and extent of pollution problems;
- examining alternatives and proposing remedial measures; and,
- recommending an implementation program.

Water quality problems may be caused primarily by combined sewer overflows or by a combination of sources including CSOs. Where the pollution problem is due to a combination of sources, the discharges will be investigated and prioritized based on the relevant significance of the various discharges. In some cases the receiving water quality and pollutant transport mechanisms will be assessed in the PPCP.

To address the impact of CSOs the components of the PPCP shall include:

(a) characterization of the combined sewer system (CSS);

- Monitoring, modelling and other appropriate means shall be used to characterize the CSS and the response of the CSS to precipitation events. The characterization shall include the

determination of the location, frequency and volume of the CSOs as well as the concentrations and mass of pollutants resulting from CSOs. Through this process the existence and severity of suspected deficiencies will be confirmed. Records shall be kept for combined sewer systems including the following:

- location and physical description of CSO outfalls in the collection system, emergency overflows at pumping stations, and bypass locations at STPs;
- location and identification of receiving water bodies for all combined sewer outfalls;
- combined sewer system flow and STP treatment capacities; present and future expected peak flow rates during dry weather and wet weather;
- capacity of all regulators; and
- location of cross-connections.

- Operational procedures shall be developed for combined sewer systems including the following:

  - combined sewer maintenance programs; and,
  - regulator inspection and maintenance programs.

(b) an examination of non-structural and structural CSO control alternatives that may include:

- source control;
- inflow/infiltration reduction;
- operation and maintenance improvements;
- control structure improvements;
- collection system improvements;
- storage technologies;
- treatment technologies;
- sewer separation.

(c) an implementation plan with cost estimates and schedule of all practical measures to eliminate dry weather overflows and minimize wet weather overflows.

- The implementation plan should show how the minimum CSO prevention and control requirements and other criteria in this Procedure are being achieved.

6. MINIMUM COMBINED SEWER OVERFLOW (CSO) CONTROLS

The minimum CSO controls consist of the following :

(a) Eliminate CSOs during dry-weather periods except under emergency conditions.

- Each municipality shall demonstrate that the combined sewer system, including the regulators, and associated treatment facilities are adequate for the transmission and treatment of all peak dry weather flows from the service area.
- An emergency condition would exist when e.g. basement flooding, damage to equipment at treatment works or pumping stations, or treatment process washout was occurring or was imminent.

(b) Establish and implement Pollution Prevention programs that focus on pollutant reduction activities at source e.g. reduced use of potential pollutants like fertilizer and pesticides in parks; public education programs on e.g. anti-littering and illegal dumping of used motor oil and other materials into catchbasins; water conservation to reduce dry weather sanitary flow and hence CSOs; street cleaning to reduce CSO floatables; roof-leader disconnection and installing rain barrels to reduce flows into the sewer system; education/assistance for industries to minimize the use/discharge of pollutants; and enforcement of municipal by-laws or regulations.

(c) Establish and implement proper operation and regular inspection and maintenance programs for the combined sewer system in order to ensure continued proper system operation.

(d) Establish and implement a floatables control program to control coarse solids and floatable materials e.g. by reducing the amount of street litter that enters the catchbasins and the CSS; by removing debris from CSOs at the outfalls using measures such as trash racks and screens; and by removing floatables from the surface of the receiving water after a CSO occurs.

(e) Maximize the use of the collection system for the storage of wet weather flows which are conveyed to the Sewage Treatment Plant for treatment when capacity is available e.g. by adjusting regulator settings.

(f) Maximize the flow to the Sewage Treatment Plant for the treatment of wet weather flows e.g. by removing obstructions to flow.

- The secondary treatment capacity should be utilized as much as possible for treating wet weather flows with the balance of flows being subject to primary treatment. Measures to increase the wet weather hydraulic capacity at the Sewage Treatment Plant (e.g. Step Feed operation) should be investigated.

(g) During a seven-month period commencing within 15 days of April 1, capture and treat for an average year all the dry weather flow plus 90% of the volume resulting from wet weather flow that is above the dry weather flow. The volumetric control criterion is applied to the flows collected by the sewer system immediately above each overflow location unless it can be shown through modelling and on-going monitoring that the criterion is being achieved on a system-wide basis. No increases in CSO volumes above existing levels at each outfall will be allowed except where the increase is due to the elimination of upstream CSO outfalls. During the remainder of the year, at least the same storage and treatment capacity should be maintained for treating wet

weather flow. The treatment level for the controlled volume is described in Section 7.

7. LEVEL OF TREATMENT

The treatment processes of the sewage treatment plants should be optimized to minimize the pollutant loadings under wet weather conditions. The Pollution Prevention and Control Planning study should evaluate the operation of the Sewage Treatment Plant under wet weather conditions in consultation with Ministry Regional staff. This may lead to wet weather-specific operating conditions which may produce lower overall pollutant loadings.

During wet weather, the minimum level of treatment required for flows above the dry weather flow (as specified in sections 6 and 9) from combined sewer systems is primary treatment or equivalent. The effluent guideline for primary treatment is 30% carbonaceous biochemical oxygen demand (BOD_5) removal and 50% total suspended solids (TSS) removal for an average year during the seven month period as specified in section 6(g). The baseline for the calculation of the average pollutant removal is the influent passing the headworks of the treatment facility under wet weather conditions.

The dry weather flow from combined sewer systems is subject to the process effluent concentration criteria of the STP whether they are primary treatment plants or secondary treatment plants. During wet weather, for secondary treatment plants, the flows through the secondary treatment capacity will be subject to the process effluent concentration criteria of the STP. The flows in the STP which bypass the secondary treatment will be subject to a minimum level of primary treatment.

The treatment of wet weather flows from combined sewer systems may occur at the central Sewage Treatment Plant or at other locations such as satellite treatment facilities. Satellite treatment facilities may be built to treat wet weather flows where there are space limitations or limited capacity in the collection system to get the wet weather flows to the STP. There are a number of satellite treatment technologies some examples of which are vortex separators, high-rate sedimentation, dissolved air flotation and high-rate filtration. Satellite treatment facilities when used to treat wet weather flows from combined sewer systems are subject to the minimum level of primary treatment requirements specified above. In addition, for satellite treatment facilities the effluent concentration for total suspended solids should not exceed 90 mg/l for more than 50 % of the time for an average year during the seven-month period as specified in section 6(g).

8. EFFLUENT DISINFECTION

Effluent disinfection is required where the effluent affects swimming and bathing beaches and other areas where there are public health concerns. The local Medical Officer of Health identifies public health concerns such as e.g. whether recreational beaches are safe for swimming.

The interim effluent quality criterion for disinfected combined sewage during wet weather is a monthly geometric mean not exceeding 1000 E. coli per 100 ml. This criterion may be modified by the Regional staff of the Ministry on a case-by-case basis due to site-specific conditions.

In cases where chlorination is used as the disinfection process, subsequent dechlorination of the sewage works effluents shall be used to minimize the adverse effects of chlorine residuals on public health and the aquatic environment where necessary.

All bypasses at the Sewage Treatment Plant should be subjected to the disinfection process where available in order to reduce the bacterial loadings at discharge.

9. BEACH PROTECTION

Additional controls above the minimum CSO controls (section 6) are required for swimming and bathing beaches affected by CSOs and consist of the following :

(a) There should be no violation of the body contact recreational water quality objective (Provincial Water Quality Objectives (PWQO)) for E. coli of 100 E. coli per 100 ml. based on a geometric mean at swimming and bathing beaches as a result of CSOs for at least 95% of the four-month season (June 1 to September 30) for an average year.

(b) Controlling to not more than two overflow events per season (June 1 to September 30) for an average year in a combined sewer system with the combined total duration of the CSOs at any single CSO location being less than 48 hours and ensuring that the controlled combined sewage which does not overflow receives a level of treatment (as specified in section 7) plus disinfection (as specified in section 8) is deemed to satisfy section 9(a). An additional overflow event per season may be allowed if the proponent can demonstrate that section 9(a) will still be satisfied and the combined total duration of the CSOs at any single CSO location will be less than 48 hours.

10. MONITORING

Monitoring of wastewater flows and overflows should be undertaken at locations within the sewer system for the purposes of assessing upgrading requirements and determining compliance with Ministry requirements. The nature of monitoring programs shall be specified in the Pollution Prevention and Control Plan or as determined by the Ministry through its Regional staff. The responsibility for providing monitoring shall rest with the municipality or operating authority of the combined sewer system.

11. NEW SANITARY CONNECTIONS TO COMBINED SEWER SYSTEMS

When and where significant combined sewer system deficiencies exist, the Regional Office of the Ministry shall require that the provision of sanitary servicing for additional development tributary to the deficient system be curtailed to prevent aggravation of the problem until the necessary upgrading, as outlined by a Pollution Prevention and Control Plan is carried out in keeping with the requirements of this Procedure. Some development is allowed as upgrading proceeds, conditional upon its progress. The staged upgrading should at a minimum provide for the transmission and treatment of all flows from the additional development.

This provision applies to significant development i.e. not to simple, one lot infill cases.

12. NEW STORM CONNECTIONS TO COMBINED SEWER SYSTEMS

New storm drainage systems shall not be permitted to connect to existing combined systems if that increases the gross area serviced by the combined sewer system except where evaluations indicate that circumstances allow no other practical alternative. The evaluations must be documented as part of a Pollution Prevention and Control Plan.

"Piece-meal" construction on existing combined sewer systems will be permitted only with overriding justification such as for the purpose of relocation (e.g., to accommodate underground utilities, subway structures, new buildings and pedestrian tunnels, etc.) or for the purpose of capacity improvement (e.g., to relieve basement flooding or to provide emergency additional conveyance capacity to treatment works to reduce overflows) or for rehabilitating deteriorated sewer conditions.

13. ENFORCEMENT

Procedure F-5-5 will be used to:

(a) review applications for approval to ensure that the proponent is in compliance with the Procedure prior to the issuance of a Certificate of Approval.

(b) assist regional staff in setting minimum requirements in preparing Control Orders to bring systems into compliance with the Procedure.

(c) assist enforcement staff in evaluating a combined sewer system operator's due diligence when investigating violations of the Environmental Protection Act and/or the Ontario Water Resources Act.

Any deviation or relaxation from this Procedure should be reviewed by the Regional Director and the Director, Program Development Branch.

Procedure F-5-5 Checklist

353214_WB042008001KWO

MOE – Procedure F-5-5 Checklist

Evaluating Pollution and Prevention Control Plans

CRITERIA	
Developed a Pollution Prevention and Control Plan (PPCP) (within the last five years)	
A) Characterization the combined sewer system (CSS)	
▪ Monitoring	✓
▪ Modeling	✓
▪ Other appropriate means	**N/A**
▪ Determination of the location of CSOs	✓
▪ Determination of the frequency of CSOs	✓
▪ Determination of the volume of CSOs	✓
▪ Concentrations and mass of pollutants resulting from CSOs	✓
▪ Data collected on frequency of dry weather overflows	**N/A**
▪ Data collected on frequency of wet weather overflows	**Modelled**
▪ Records kept on:	
_ Location and physical description of CSO outfalls in the collection system, emergency overflows at pumping stations, and bypass locations at STPs	✓
_ Location and identification of receiving water bodies for all combined sewer outfalls	✓
_ CSS flow and STP capacities; present expected peak flow rates during dry weather	✓
_ CSS flow and STP capacities; present expected peak flow rates during wet weather	✓
_ CSS flow and STP capacities; future expected peak flow rates during dry weather	✓
_ CSS flow and STP capacities; future expected peak flow rates during wet weather	✓
_ Capacity of all regulators	**-**
_ Location of cross-connections	**N/A**
▪ Operational procedures developed for CSS including:	
_ Combined sewer maintenance programs	✓
_ Regulator inspection and maintenance programs	✓
B) Examination of non-structural and structural CSO control alternatives:	
- source control	✓
- inflow/infiltration reduction	✓
- operation and maintenance improvements	✓
- control structure improvements	✓
- collection system improvements	✓

- storage technologies	✓
- treatment technologies	✓
- sewer separation	✓
C) Implementation plan with cost estimates and schedule of all practical measures to eliminate dry weather overflows and minimize wet weather overflows	✓
_ Demonstrate how minimum CSO prevention and control requirements and other criteria are achieved	✓
Established Plan - Meet minimum CSO controls	
A) Eliminate CSOs during dry-weather periods except under emergency conditions	✓
_ Demonstrate that CSS are adequate for transmission and treatment of all peak dry weather flows	✓
B) Focus on pollutant reduction activities at source	✓
C) Establish proper operation and regular inspection and maintenance programs for the CSS	✓
D) Establish a floatables control program	**Has been recommended**
E) Maximize the use of the collection system for the storage of wet weather flows which are conveyed to the STP for treatment when capacity is available	✓
F) Maximize the flow to the STP for treatment of wet weather flows	✓
G) During a seven-month period commencing within 15 days of April 1, capture and treat for an average year all the dry weather flow plus 90% of the volume resulting from wet weather flow that is above the dry weather flow	**Will be achieved through recommended measures**
H) **Any additional controls provided for beaches or where required by receiving water quality**	**N/A**
I) Monitoring program specified in PPCP	✓
Implemented Plan - Meet minimum CSO controls	
Eliminate CSOs during dry-weather periods except under emergency conditions	✓
Focus on pollutant reduction activities at source	✓
Proper operation and regular inspection and maintenance programs for the CSS	✓
Floatables control program	**Has been recommended**
During a seven-month period commencing within 15 days of April 1, capture and treat for an average year all the dry weather flow plus 90% of the volume resulting from wet weather flow that is above the dry weather flow	**Will be achieved through recommended measures**
Monitoring program specified in PPCP	✓

MOE – Procedure F-5-5 Checklist

Evaluating Pollution and Prevention Control Plans

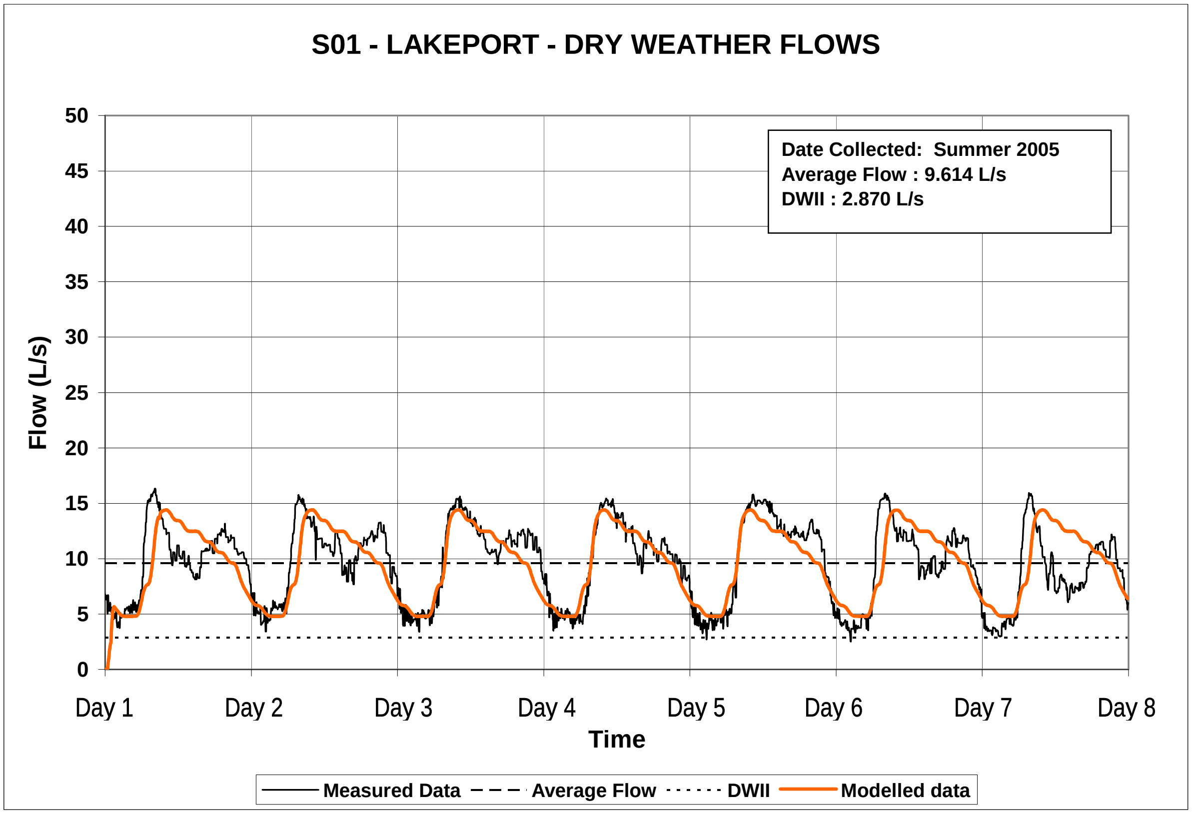
CRITERIA	
Developed a Pollution Prevention and Control Plan (PPCP) (within the last five years)	
A) Characterization the combined sewer system (CSS)	
▪ Monitoring	✓
▪ Modeling	✓
▪ Other appropriate means	**N/A**
▪ Determination of the location of CSOs	✓
▪ Determination of the frequency of CSOs	✓
▪ Determination of the volume of CSOs	✓
▪ Concentrations and mass of pollutants resulting from CSOs	✓
▪ Data collected on frequency of dry weather overflows	**N/A**
▪ Data collected on frequency of wet weather overflows	**Modelled**
▪ Records kept on:	
_ Location and physical description of CSO outfalls in the collection system, emergency overflows at pumping stations, and bypass locations at STPs	✓
_ Location and identification of receiving water bodies for all combined sewer outfalls	✓
_ CSS flow and STP capacities; <u>present</u> expected peak flow rates during dry weather	✓
_ CSS flow and STP capacities; <u>present</u> expected peak flow rates during wet weather	✓
_ CSS flow and STP capacities; <u>future</u> expected peak flow rates during dry weather	✓
_ CSS flow and STP capacities; <u>future</u> expected peak flow rates during wet weather	✓
_ Capacity of all regulators	-
_ Location of cross-connections	**N/A**
▪ Operational procedures developed for CSS including:	
_ Combined sewer maintenance programs	✓
_ Regulator inspection and maintenance programs	✓
B) Examination of non-structural and structural CSO control alternatives:	
- source control	✓
- inflow/infiltration reduction	✓
- operation and maintenance improvements	✓
- control structure improvements	✓
- collection system improvements	✓

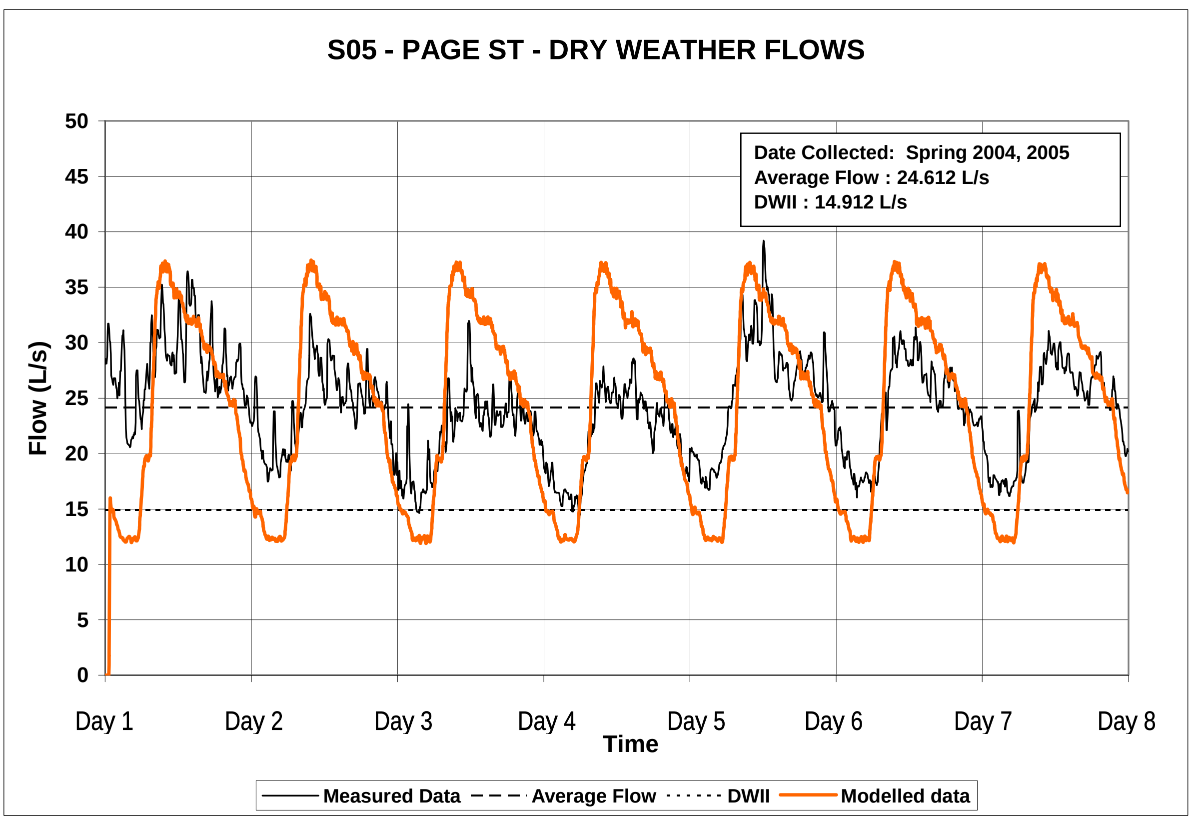
- storage technologies	✓
- treatment technologies	✓
- sewer separation	✓
C) Implementation plan with cost estimates and schedule of all practical measures to eliminate dry weather overflows and minimize wet weather overflows	✓
_ Demonstrate how minimum CSO prevention and control requirements and other criteria are achieved	✓
Established Plan - Meet minimum CSO controls	
A) Eliminate CSOs during dry-weather periods except under emergency conditions	✓
_ Demonstrate that CSS are adequate for transmission and treatment of all peak dry weather flows	✓
B) Focus on pollutant reduction activities at source	✓
C) Establish proper operation and regular inspection and maintenance programs for the CSS	✓
D) Establish a floatables control program	**Has been recommended**
E) Maximize the use of the collection system for the storage of wet weather flows which are conveyed to the STP for treatment when capacity is available	✓
F) Maximize the flow to the STP for treatment of wet weather flows	✓
G) During a seven-month period commencing within 15 days of April 1, capture and treat for an average year all the dry weather flow plus 90% of the volume resulting from wet weather flow that is above the dry weather flow	**Will be achieved through recommended measures**
H) **Any additional controls provided for beaches or where required by receiving water quality**	**N/A**
I) Monitoring program specified in PPCP	✓
Implemented Plan - Meet minimum CSO controls	
Eliminate CSOs during dry-weather periods except under emergency conditions	✓
Focus on pollutant reduction activities at source	✓
Proper operation and regular inspection and maintenance programs for the CSS	✓
Floatables control program	**Has been recommended**
During a seven-month period commencing within 15 days of April 1, capture and treat for an average year all the dry weather flow plus 90% of the volume resulting from wet weather flow that is above the dry weather flow	**Will be achieved through recommended measures**
Monitoring program specified in PPCP	✓

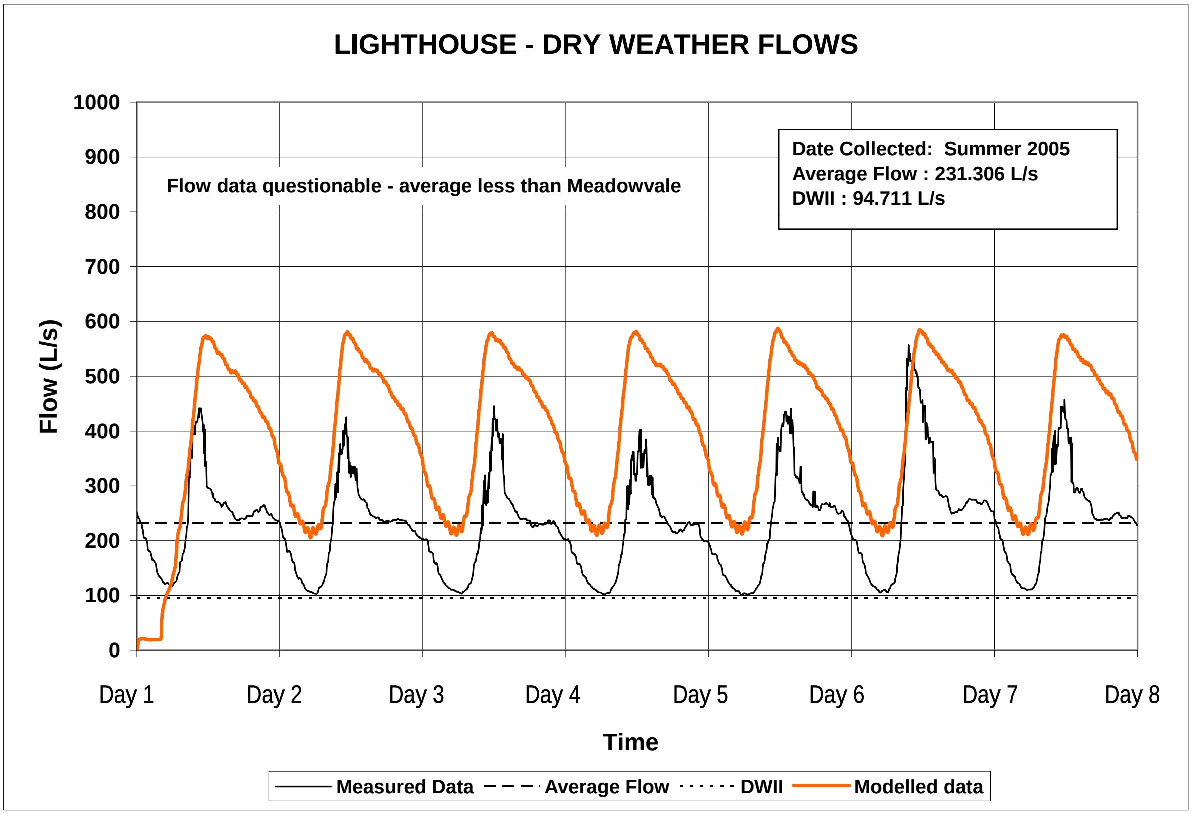
Appendix G
Model Calibration Data

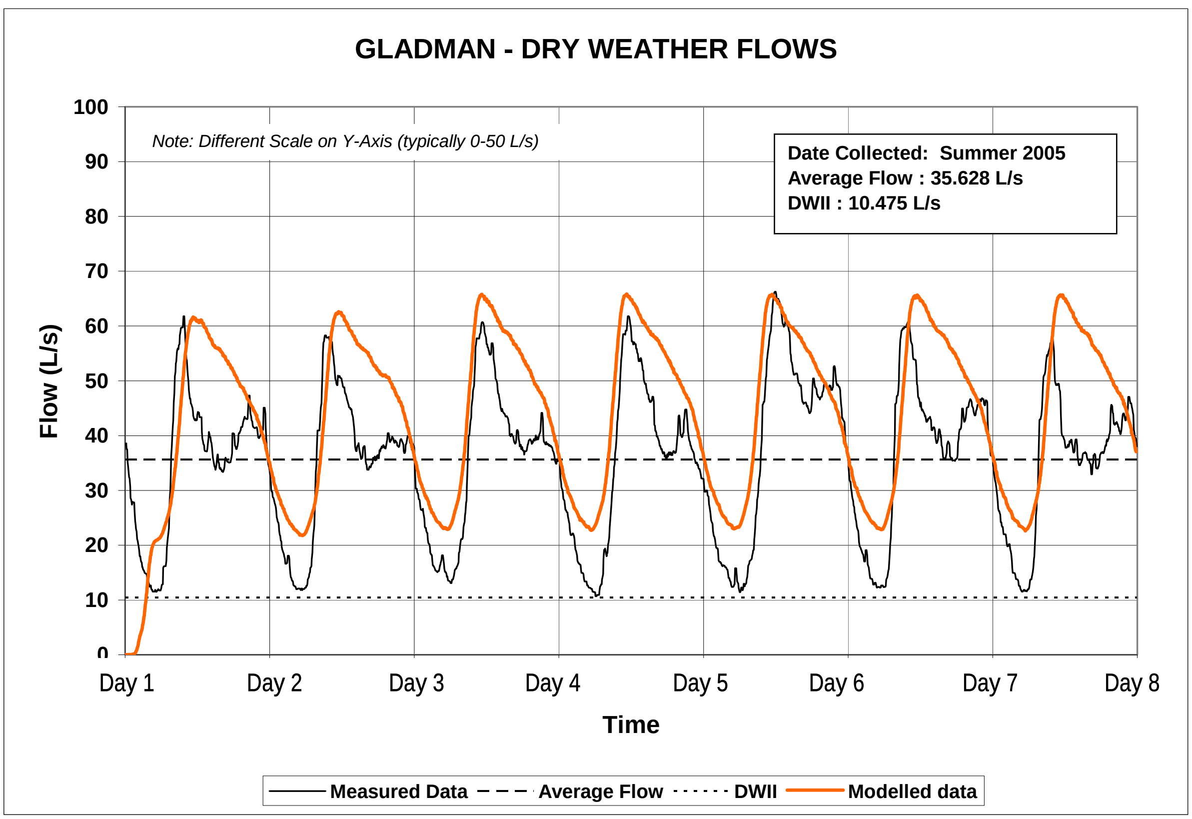
Dry Weather Flow Calibration Plots

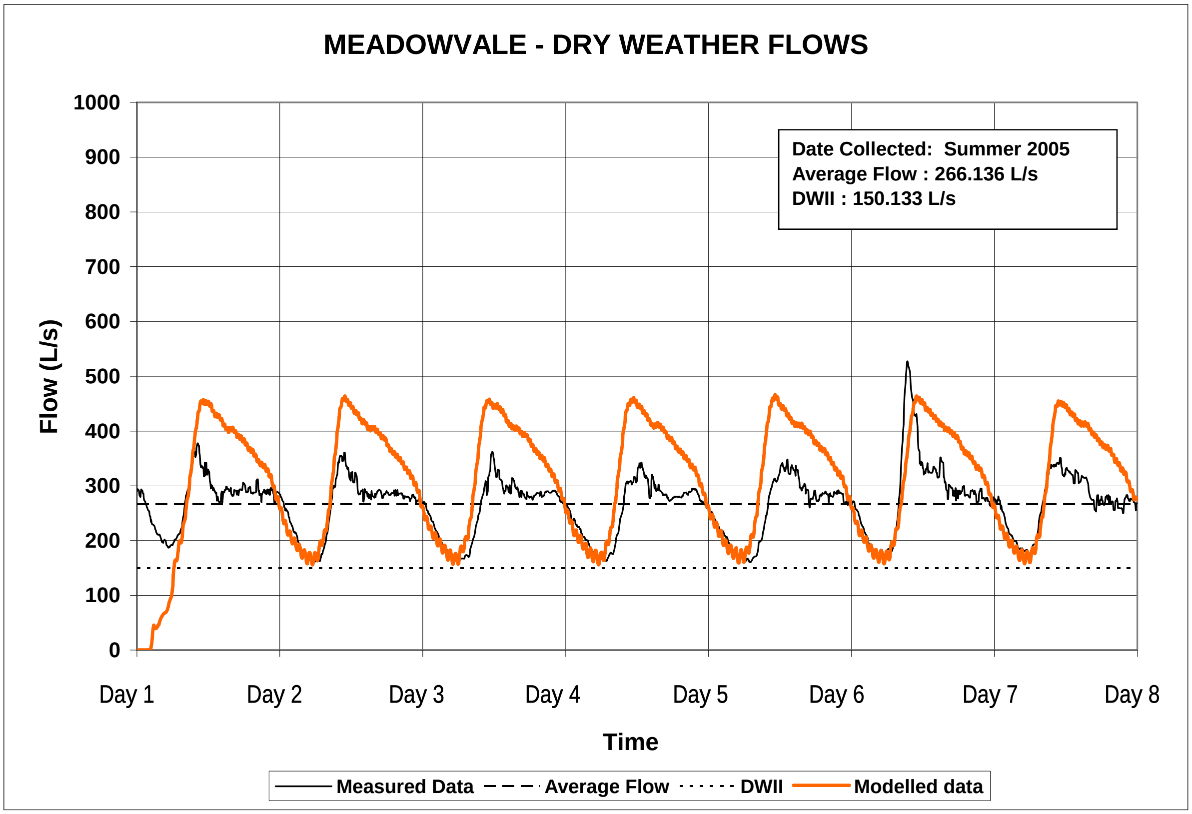
PORT DALHOUSIE





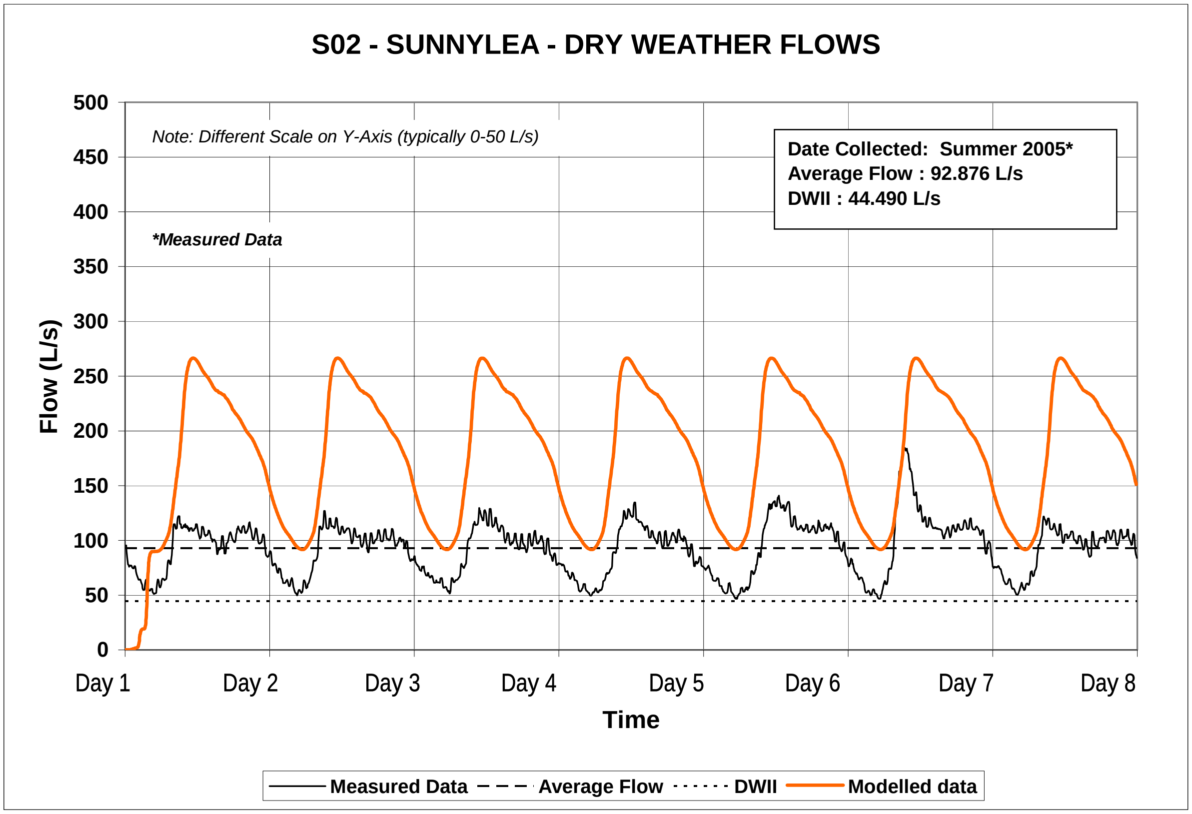

LIGHTHOUSE - DRY WEATHER FLOWS
Flow data questionable - average less than Meadowvale
Date Collected: Summer 2005
Average Flow : 231.306 L/s
DWII : 94.711 L/s
Flow (L/s)
1000
900
800
700
600
500
400
300
200
100
0
Day 1
Day 2
Day 3
Day 4
Day 5
Day 6
Day 7
Day 8
Time
Measured Data
Average Flow
DWII
Modelled data


GLADMAN - DRY WEATHER FLOWS
Note: Different Scale on Y-Axis (typically 0-50 L/s)
Date Collected: Summer 2005
Average Flow : 35.628 L/s
DWII : 10.475 L/s
Flow (L/s)
100
90
80
70
60
50
40
30
20
10
0
Day 1
Day 2
Day 3
Day 4
Day 5
Day 6
Day 7
Day 8
Time
Measured Data
Average Flow
DWII
Modelled data

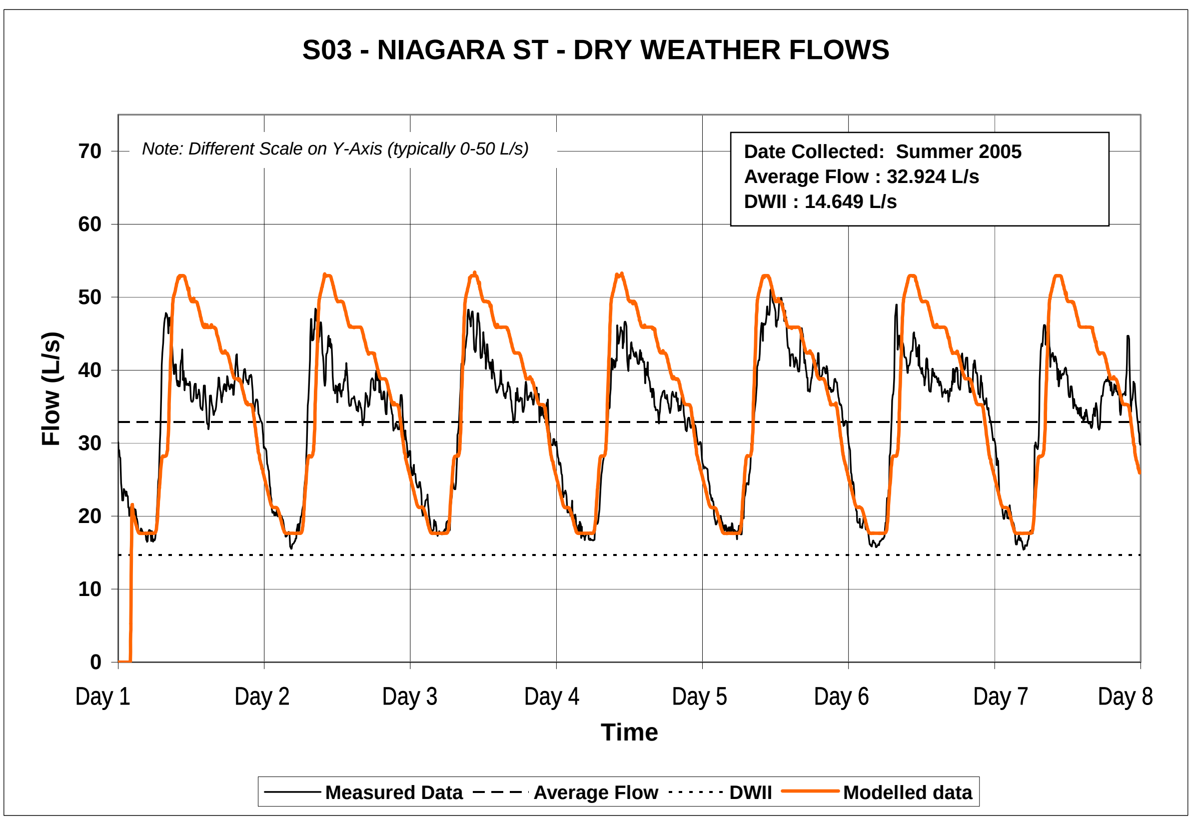


MEADOWVALE - DRY WEATHER FLOWS
Date Collected: Summer 2005
Average Flow : 266.136 L/s
DWII : 150.133 L/s
Flow (L/s)
1000
900
800
700
600
500
400
300
200
100
0
Day 1
Day 2
Day 3
Day 4
Day 5
Day 6
Day 7
Day 8
Time
Measured Data
Average Flow
DWII
Modelled data

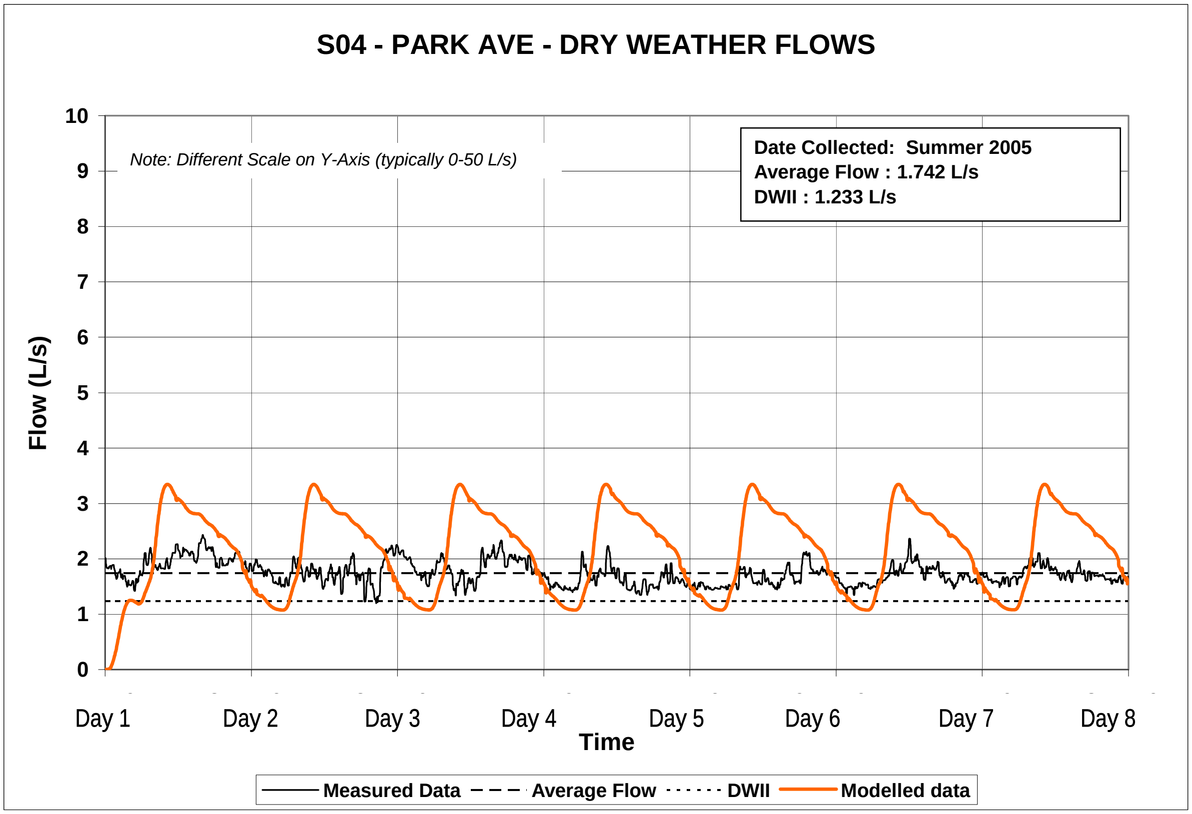
PORT WELLER

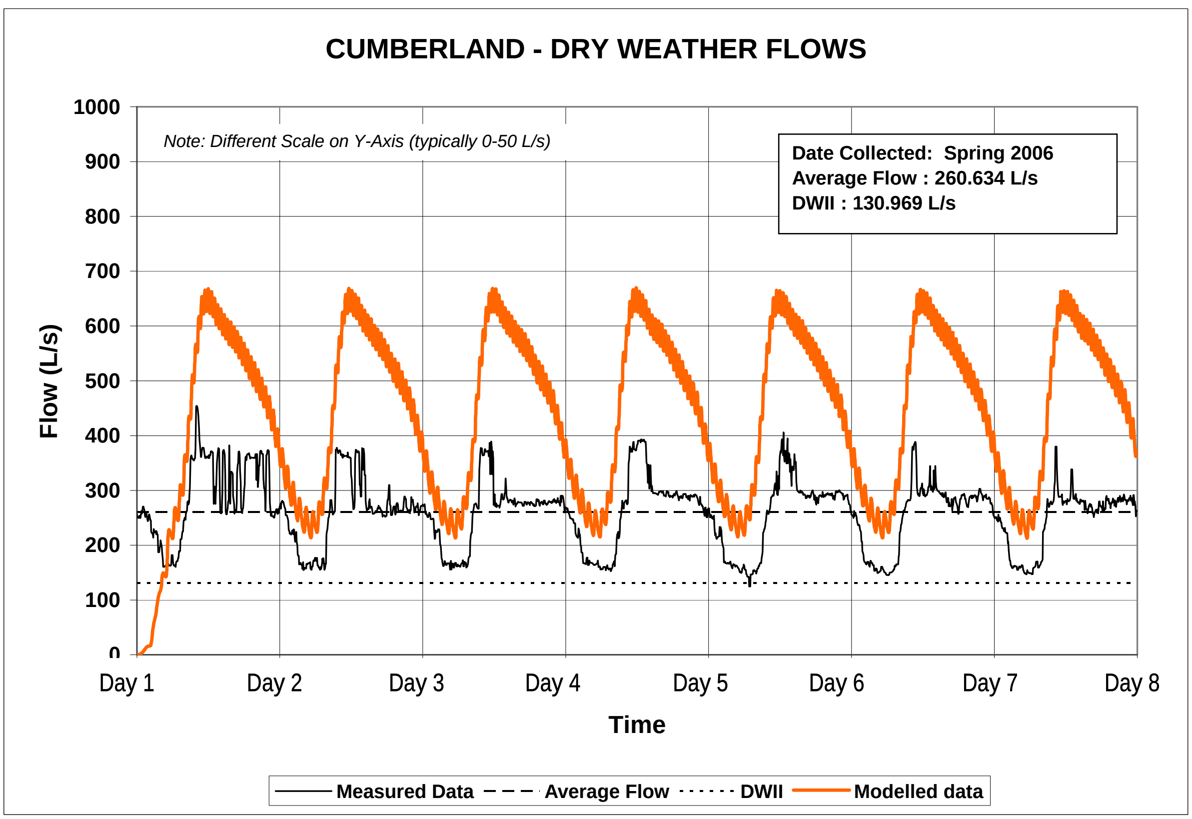


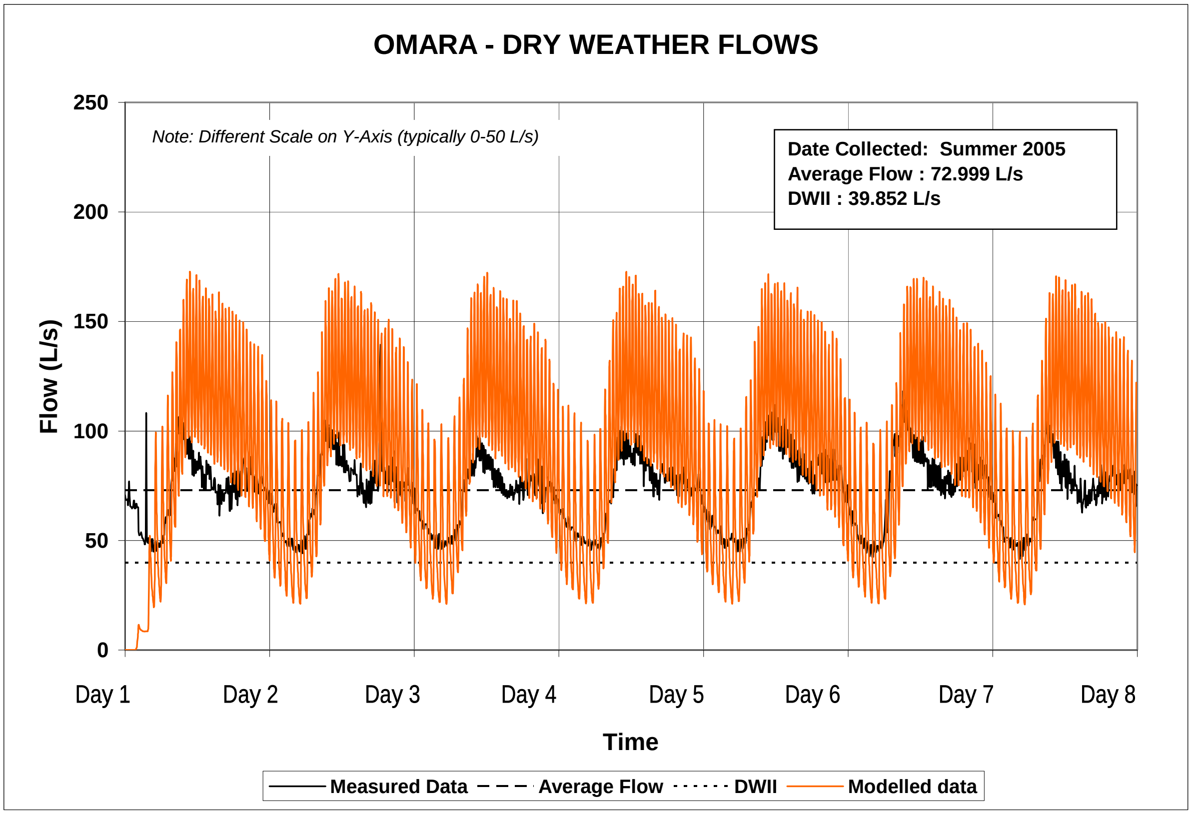
S02 - SUNNYLEA - DRY WEATHER FLOWS
Note: Different Scale on Y-Axis (typically 0-50 L/s)
*Measured Data
Date Collected: Summer 2005*
Average Flow : 92.876 L/s
DWII : 44.490 L/s
Flow (L/s)
0
50
100
150
200
250
300
350
400
450
500
Day 1
Day 2
Day 3
Day 4
Day 5
Day 6
Day 7
Day 8
Time
Measured Data
Average Flow
DWII
Modelled data



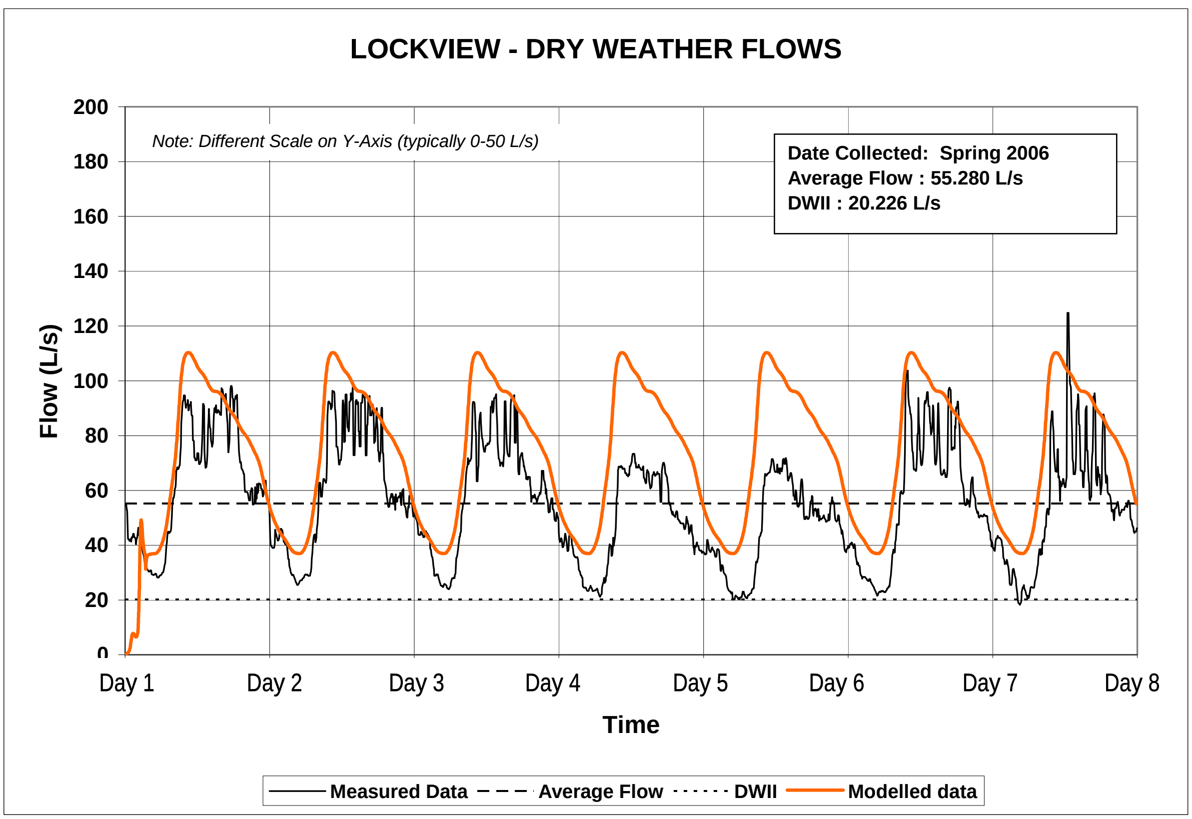
S03 - NIAGARA ST - DRY WEATHER FLOWS
Note: Different Scale on Y-Axis (typically 0-50 L/s)
Date Collected: Summer 2005
Average Flow : 32.924 L/s
DWII : 14.649 L/s
Flow (L/s)
0
10
20
30
40
50
60
70
Day 1
Day 2
Day 3
Day 4
Day 5
Day 6
Day 7
Day 8
Time
Measured Data
Average Flow
DWII
Modelled data


S04 - PARK AVE - DRY WEATHER FLOWS
Note: Different Scale on Y-Axis (typically 0-50 L/s)
Date Collected: Summer 2005
Average Flow : 1.742 L/s
DWII : 1.233 L/s
Flow (L/s)
0
1
2
3
4
5
6
7
8
9
10
Day 1
Day 2
Day 3
Day 4
Day 5
Day 6
Day 7
Day 8
Time
Measured Data
Average Flow
DWII
Modelled data

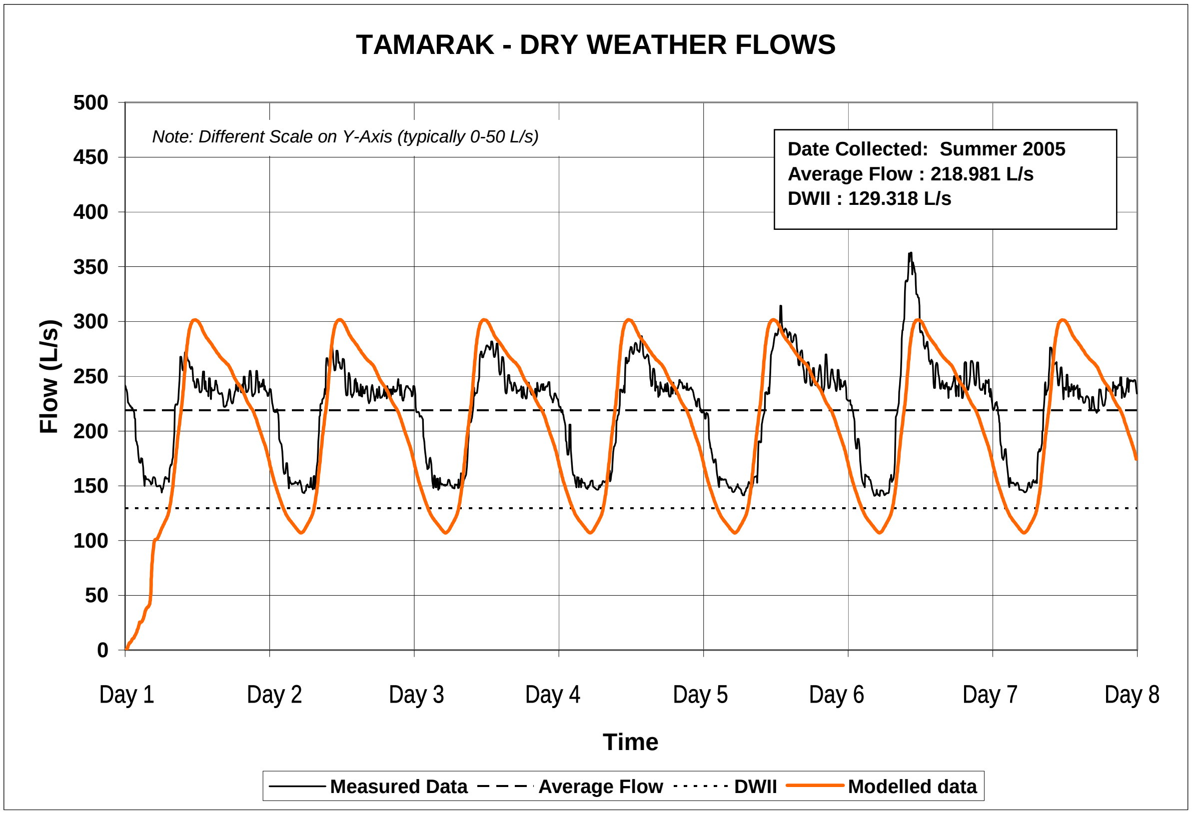

CUMBERLAND - DRY WEATHER FLOWS
Note: Different Scale on Y-Axis (typically 0-50 L/s)
Date Collected: Spring 2006
Average Flow : 260.634 L/s
DWII : 130.969 L/s
Flow (L/s)
0
100
200
300
400
500
600
700
800
900
1000
Day 1
Day 2
Day 3
Day 4
Day 5
Day 6
Day 7
Day 8
Time
Measured Data
Average Flow
DWII
Modelled data



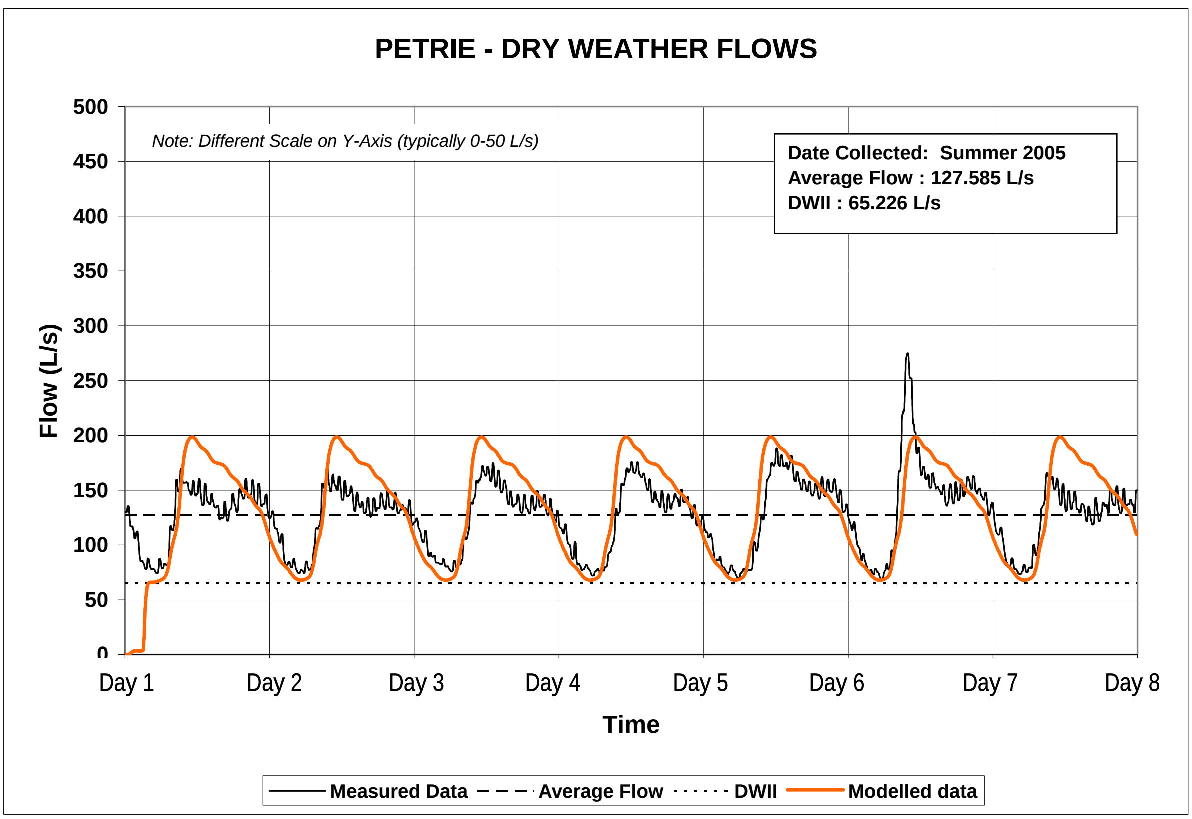
OMARA - DRY WEATHER FLOWS
Note: Different Scale on Y-Axis (typically 0-50 L/s)
Date Collected: Summer 2005
Average Flow : 72.999 L/s
DWII : 39.852 L/s
Flow (L/s)
250
200
150
100
50
0
Day 1
Day 2
Day 3
Day 4
Day 5
Day 6
Day 7
Day 8
Time
Measured Data
Average Flow
DWII
Modelled data



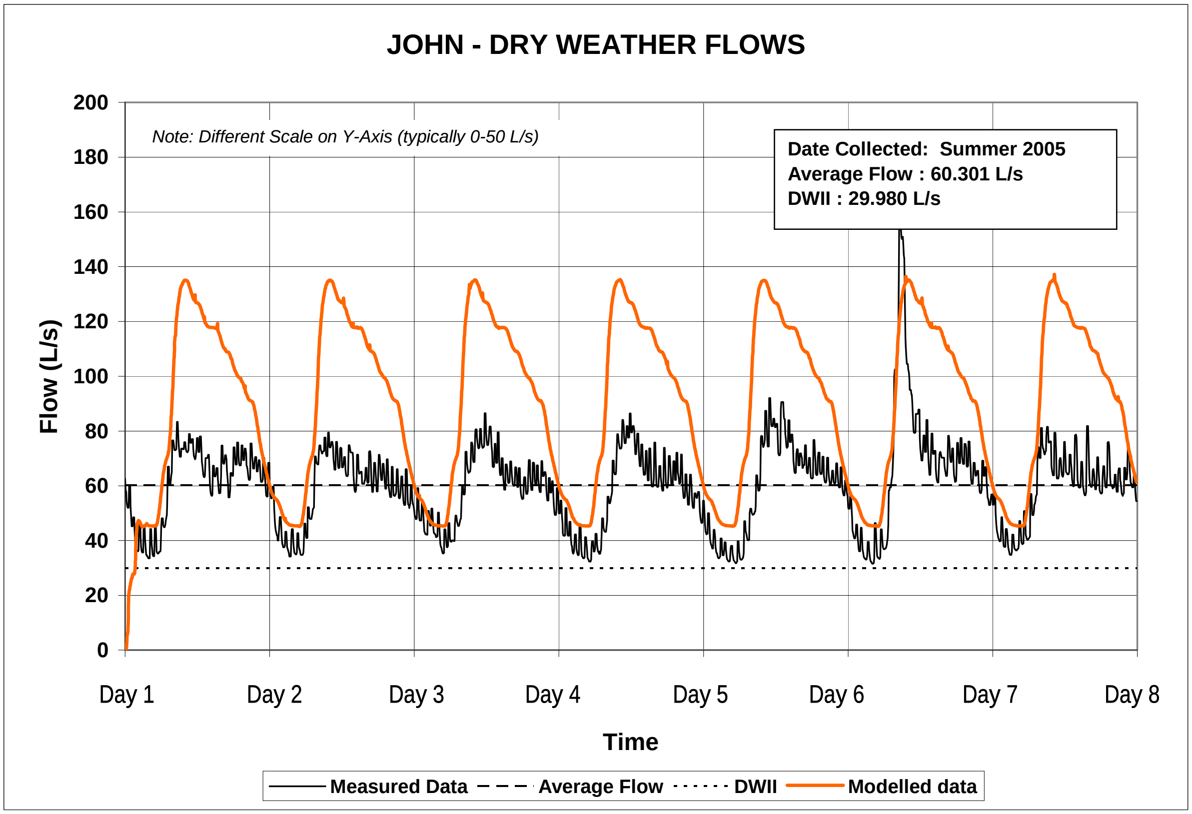
LOCKVIEW - DRY WEATHER FLOWS
Note: Different Scale on Y-Axis (typically 0-50 L/s)
Date Collected: Spring 2006
Average Flow : 55.280 L/s
DWII : 20.226 L/s
Flow (L/s)
200
180
160
140
120
100
80
60
40
20
0
Day 1
Day 2
Day 3
Day 4
Day 5
Day 6
Day 7
Day 8
Time
Measured Data
Average Flow
DWII
Modelled data



TAMARAK - DRY WEATHER FLOWS
Note: Different Scale on Y-Axis (typically 0-50 L/s)
Date Collected: Summer 2005
Average Flow : 218.981 L/s
DWII : 129.318 L/s
Flow (L/s)
500
450
400
350
300
250
200
150
100
50
0
Day 1
Day 2
Day 3
Day 4
Day 5
Day 6
Day 7
Day 8
Time
Measured Data
Average Flow
DWII
Modelled data

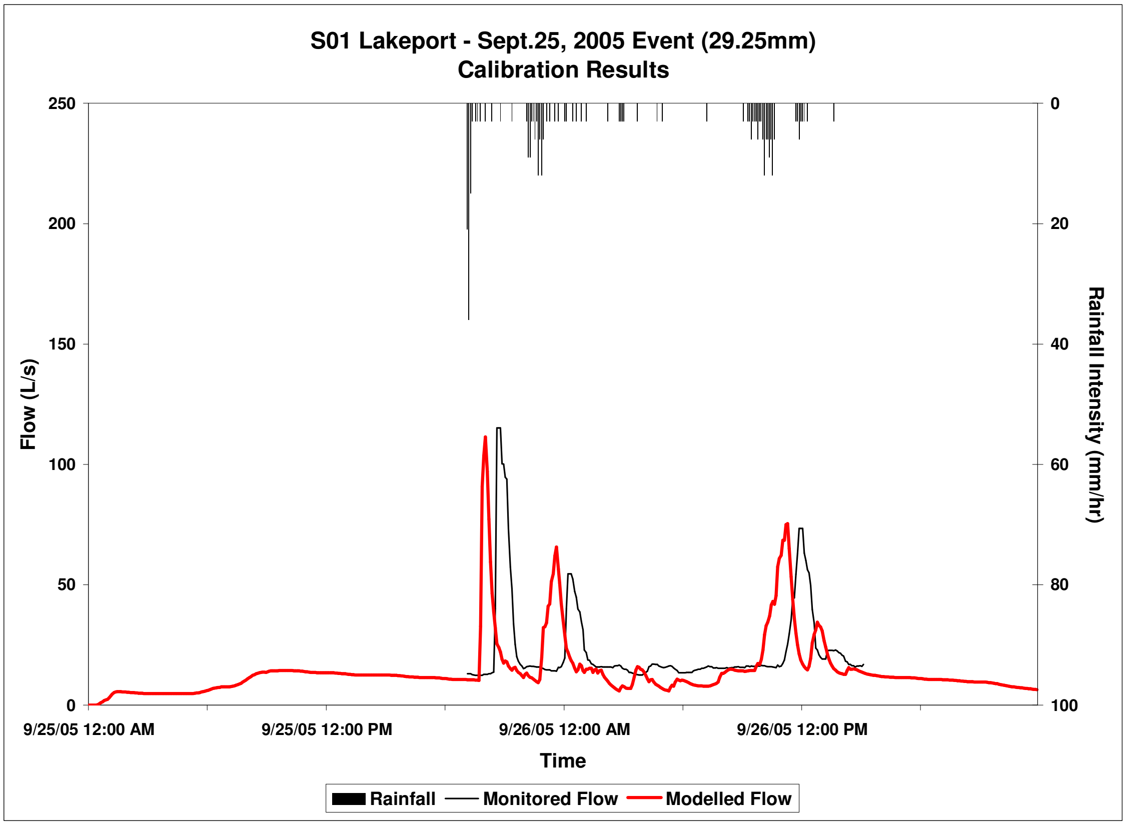


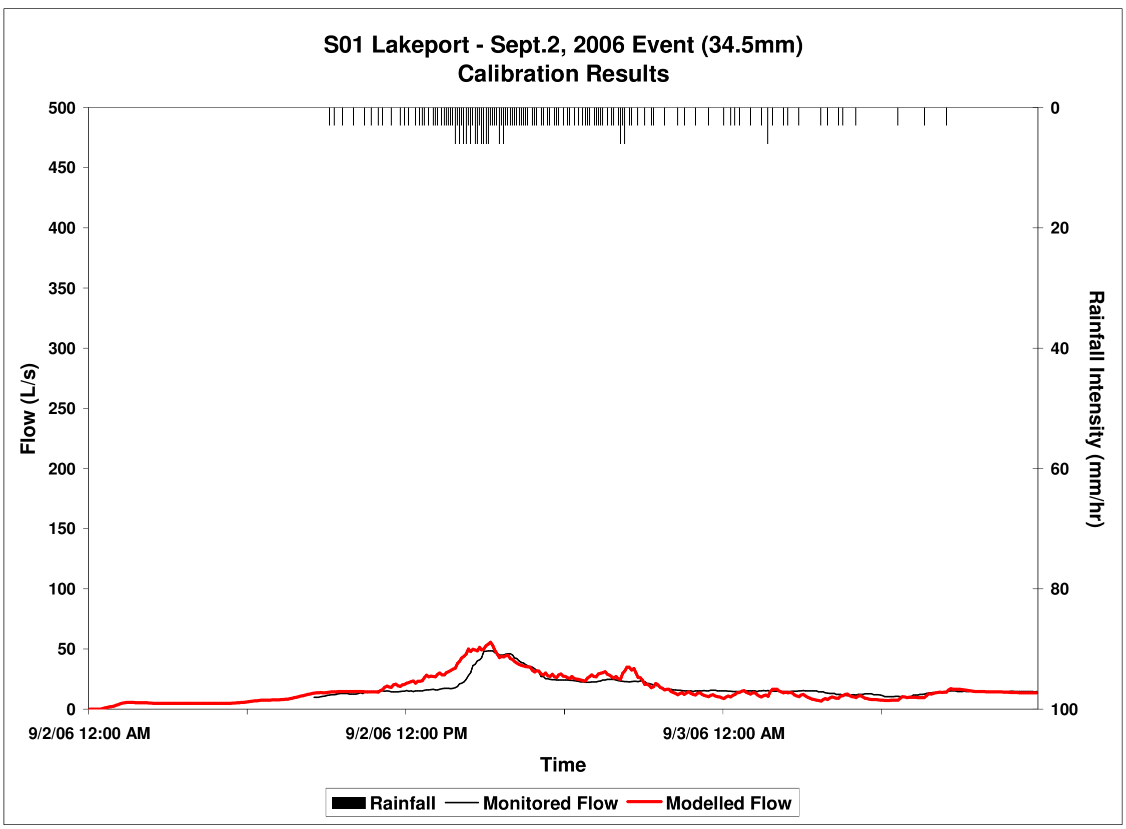
PETRIE - DRY WEATHER FLOWS
Note: Different Scale on Y-Axis (typically 0-50 L/s)
Date Collected: Summer 2005
Average Flow : 127.585 L/s
DWII : 65.226 L/s
Flow (L/s)
500
450
400
350
300
250
200
150
100
50
0
Day 1
Day 2
Day 3
Day 4
Day 5
Day 6
Day 7
Day 8
Time
Measured Data
Average Flow
DWII
Modelled data

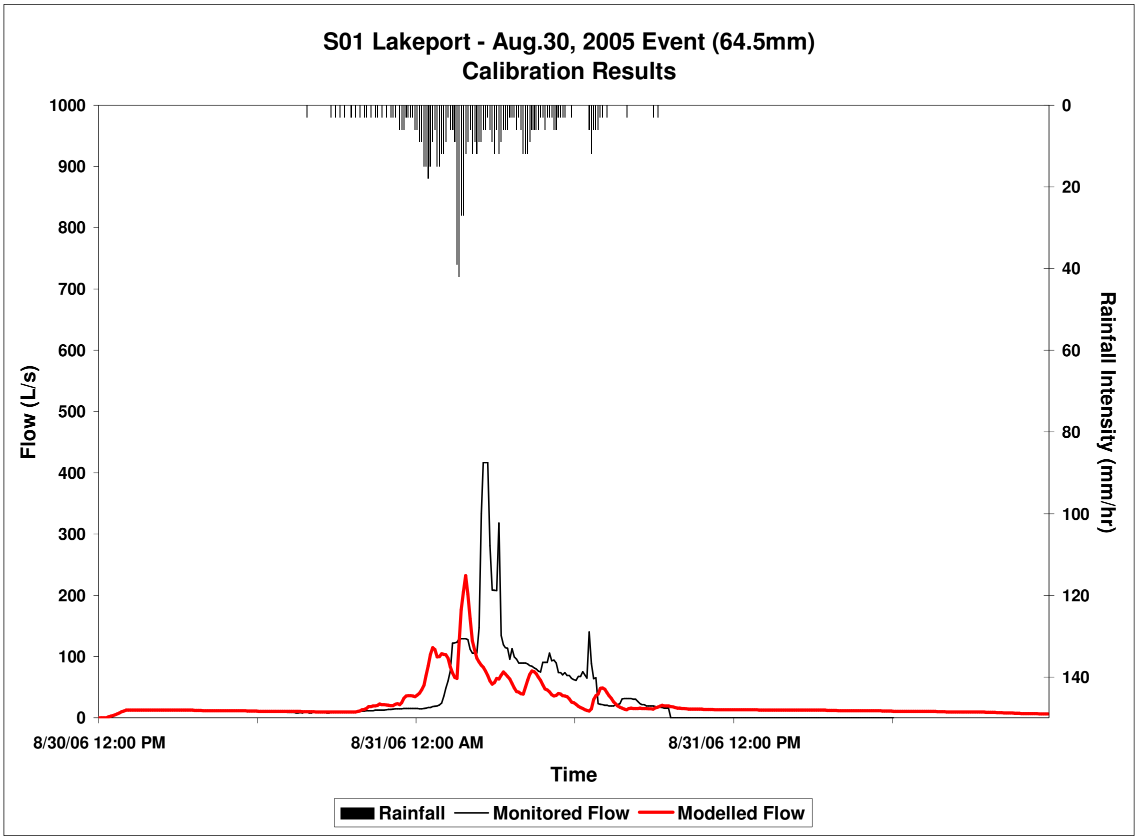

JOHN - DRY WEATHER FLOWS
Note: Different Scale on Y-Axis (typically 0-50 L/s)
Date Collected: Summer 2005
Average Flow : 60.301 L/s
DWII : 29.980 L/s
Flow (L/s)
200
180
160
140
120
100
80
60
40
20
0
Day 1
Day 2
Day 3
Day 4
Day 5
Day 6
Day 7
Day 8
Time
Measured Data
Average Flow
DWII
Modelled data

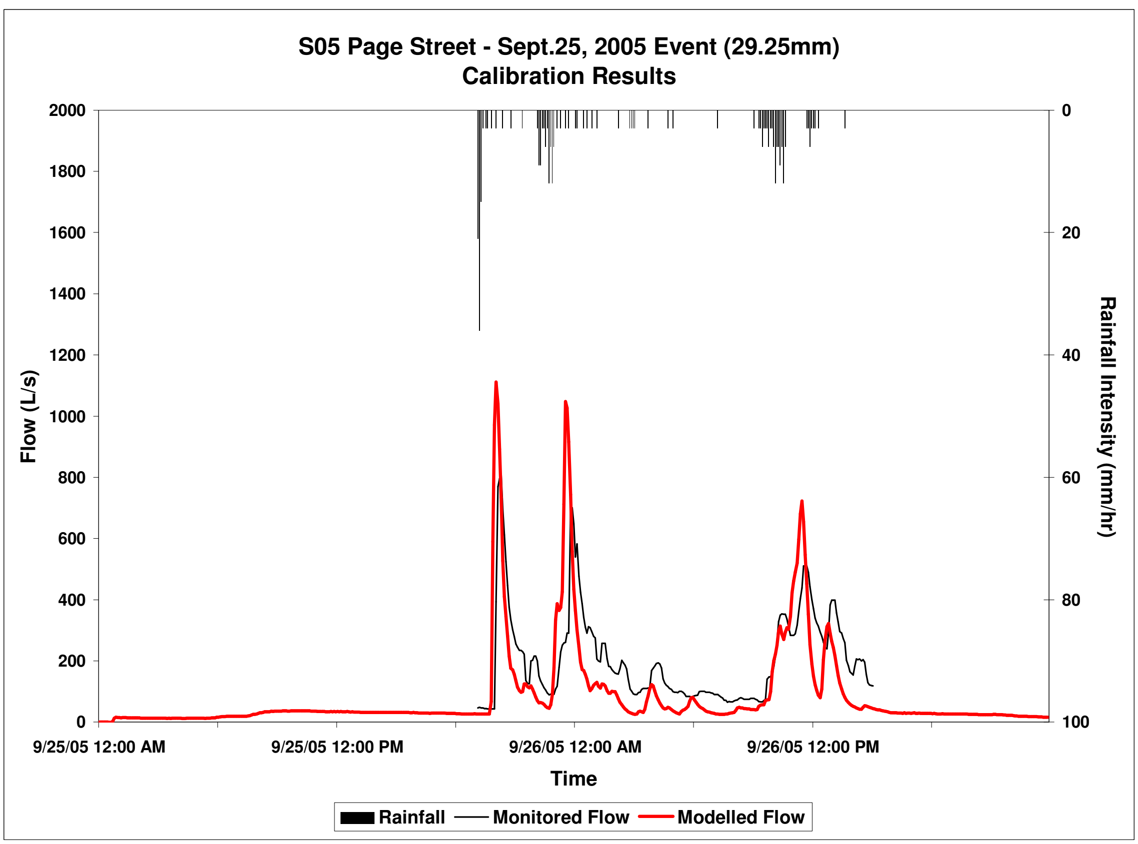
Wet Weather Flow Calibration Plots

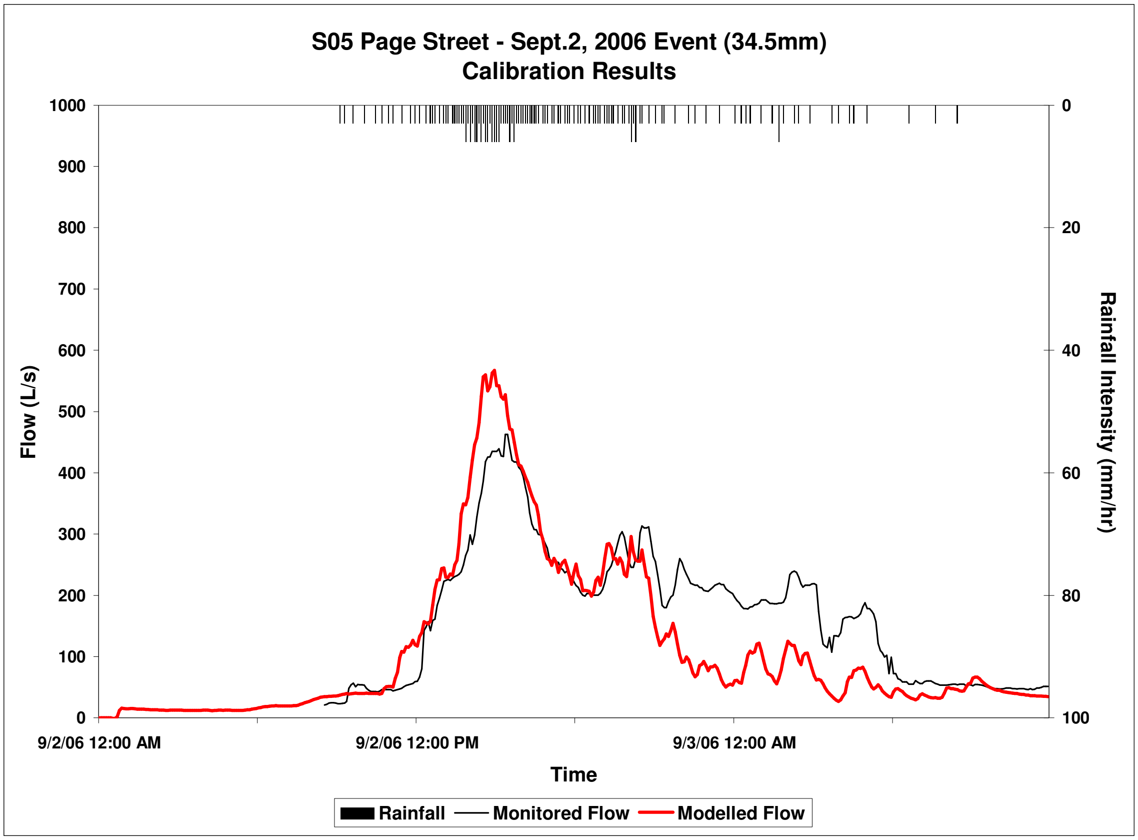
PORT DALHOUSIE

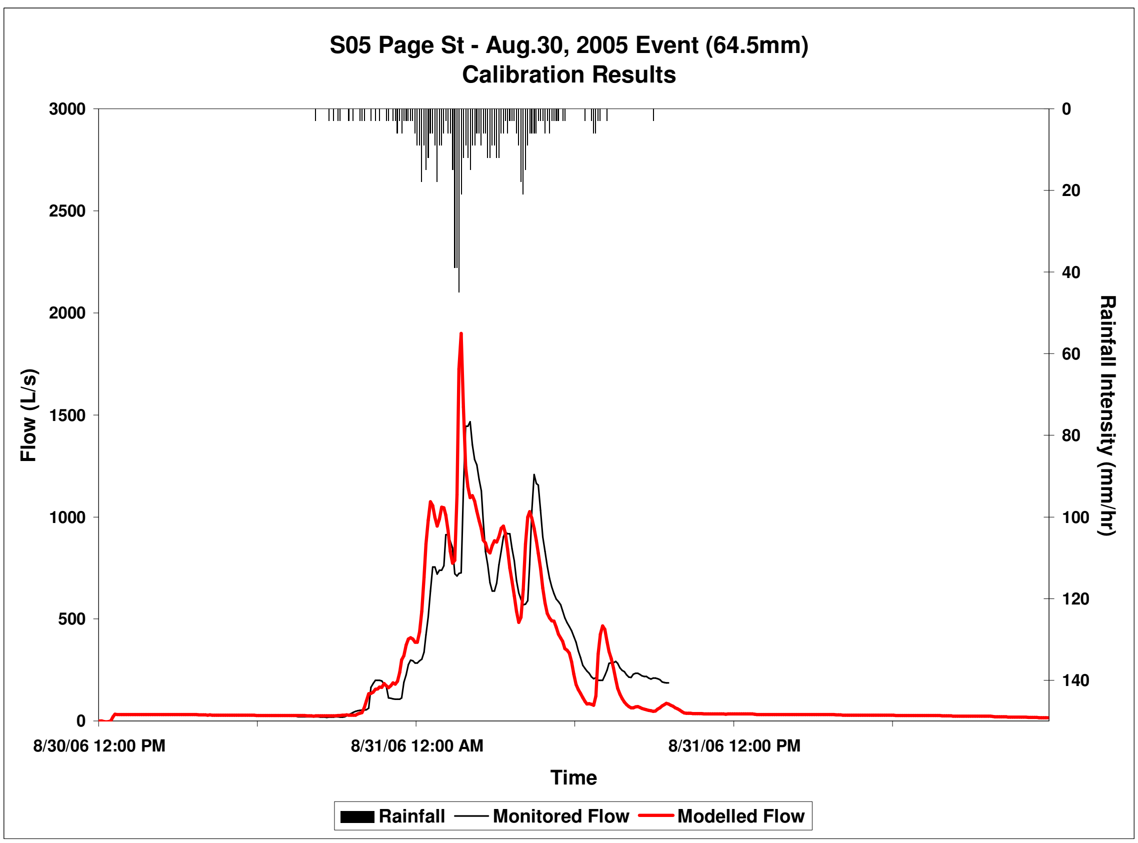




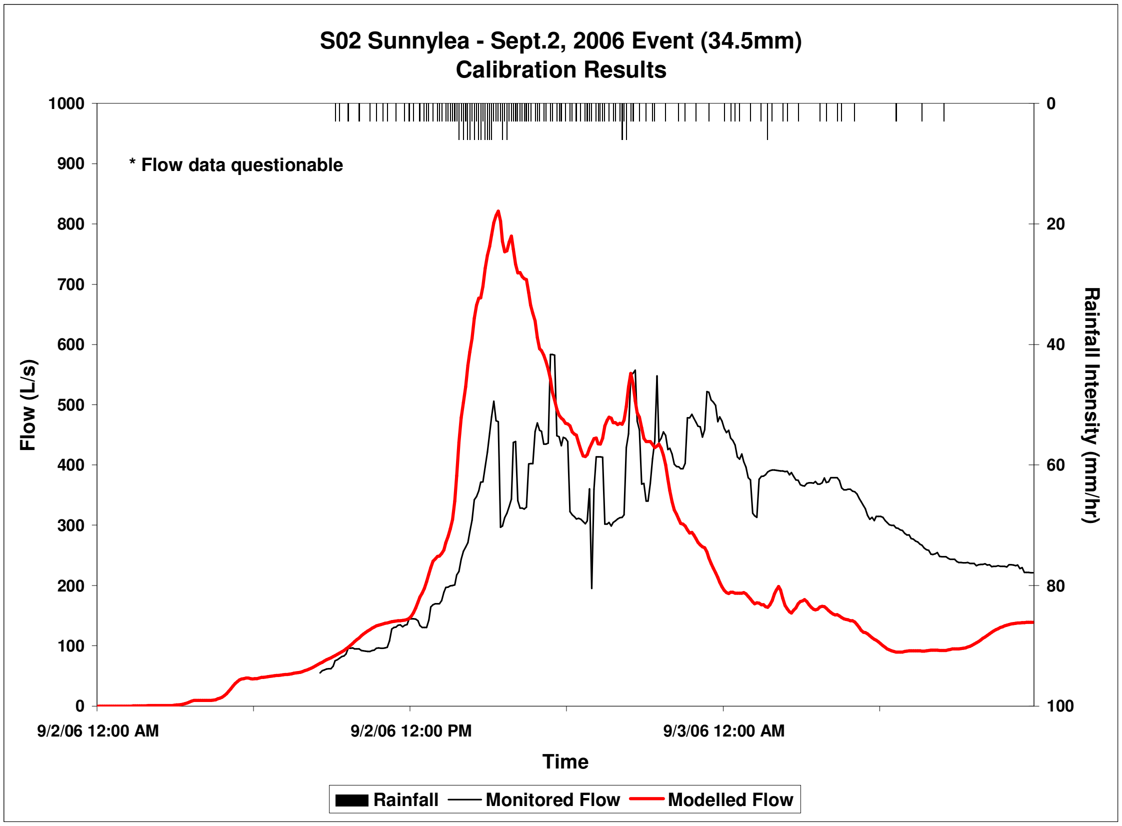

S01 Lakeport - Aug.30, 2005 Event (64.5mm)
Calibration Results
Flow (L/s)
Rainfall Intensity (mm/hr)
1000
900
800
700
600
500
400
300
200
100
0
20
40
60
80
100
120
140
8/30/06 12:00 PM
8/31/06 12:00 AM
8/31/06 12:00 PM
Time
Rainfall
Monitored Flow
Modelled Flow


S05 Page Street - Sept.25, 2005 Event (29.25mm)
Calibration Results
Flow (L/s)
Rainfall Intensity (mm/hr)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
20
40
60
80
100
9/25/05 12:00 AM
9/25/05 12:00 PM
9/26/05 12:00 AM
9/26/05 12:00 PM
Time
Rainfall
Monitored Flow
Modelled Flow

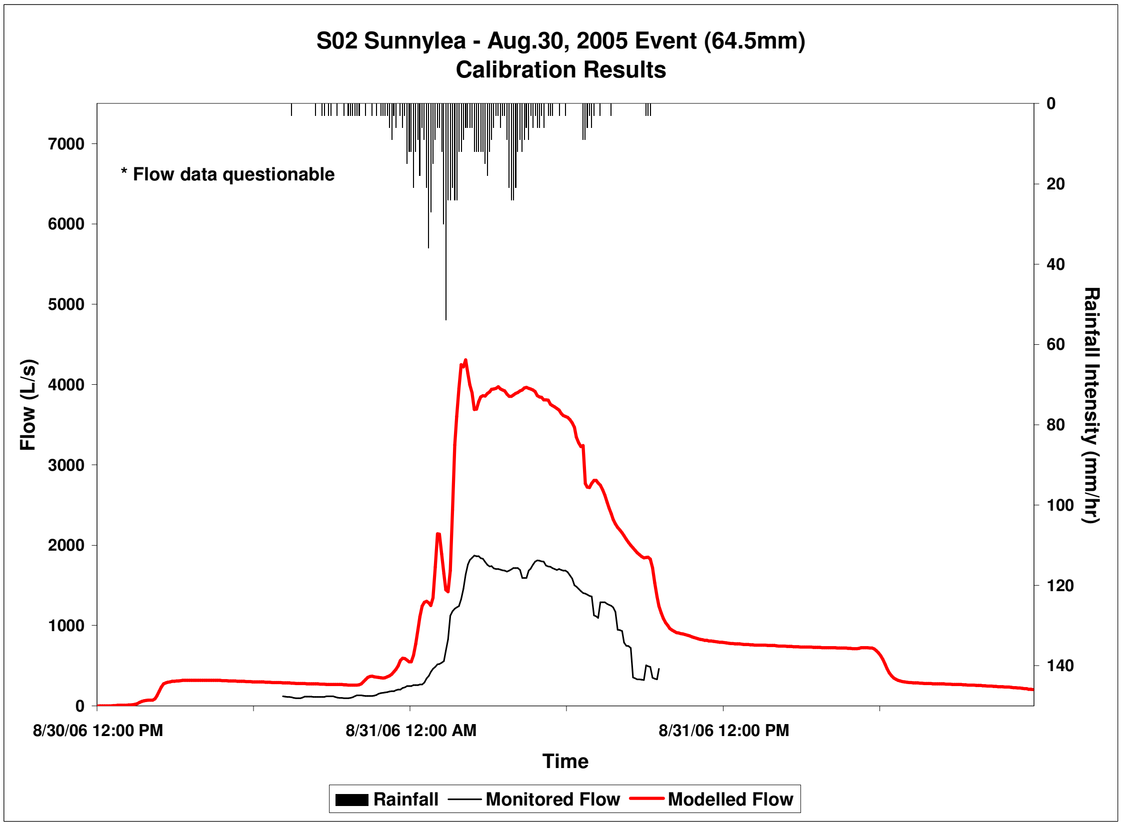

S05 Page Street - Sept.2, 2006 Event (34.5mm)
Calibration Results
Flow (L/s)
0
100
200
300
400
500
600
700
800
900
1000
Rainfall Intensity (mm/hr)
0
20
40
60
80
100
9/2/06 12:00 AM
9/2/06 12:00 PM
9/3/06 12:00 AM
Time
Rainfall
Monitored Flow
Modelled Flow


S05 Page St - Aug.30, 2005 Event (64.5mm)
Calibration Results
Flow (L/s)
0
500
1000
1500
2000
2500
3000
Rainfall Intensity (mm/hr)
0
20
40
60
80
100
120
140
8/30/06 12:00 PM
8/31/06 12:00 AM
8/31/06 12:00 PM
Time
Rainfall
Monitored Flow
Modelled Flow

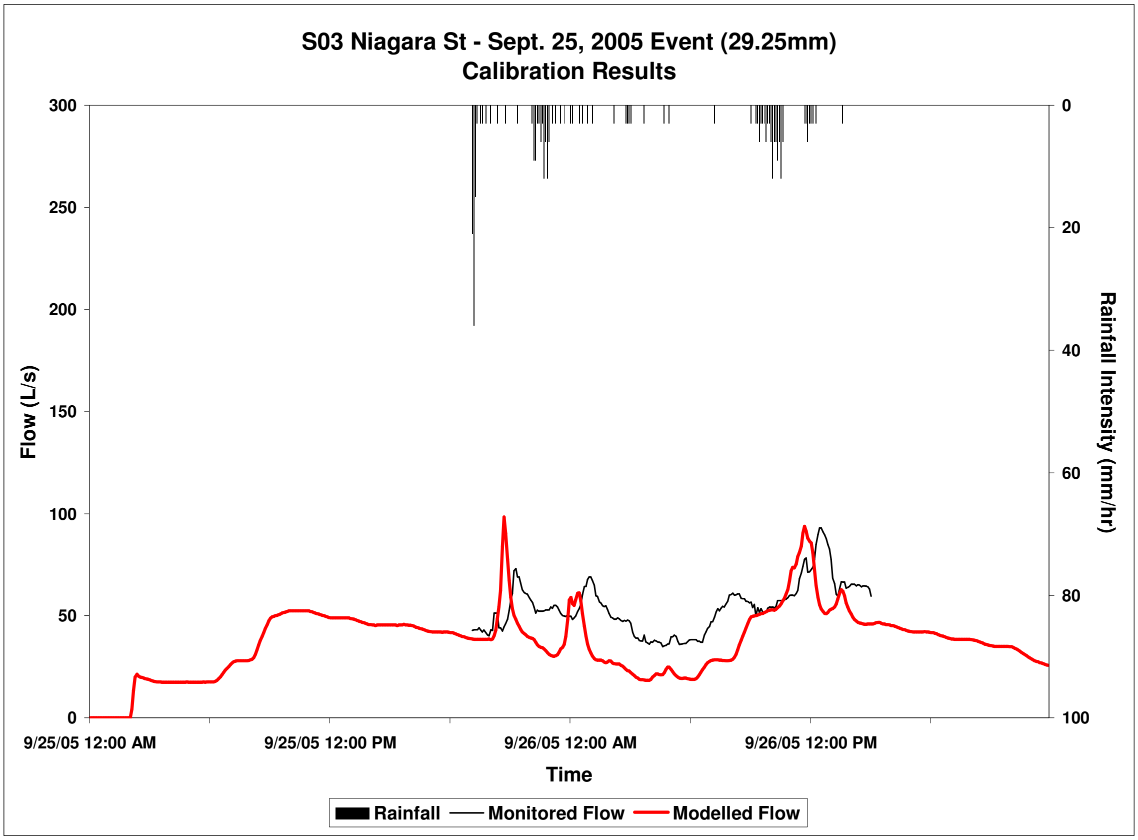
PORT WELLER

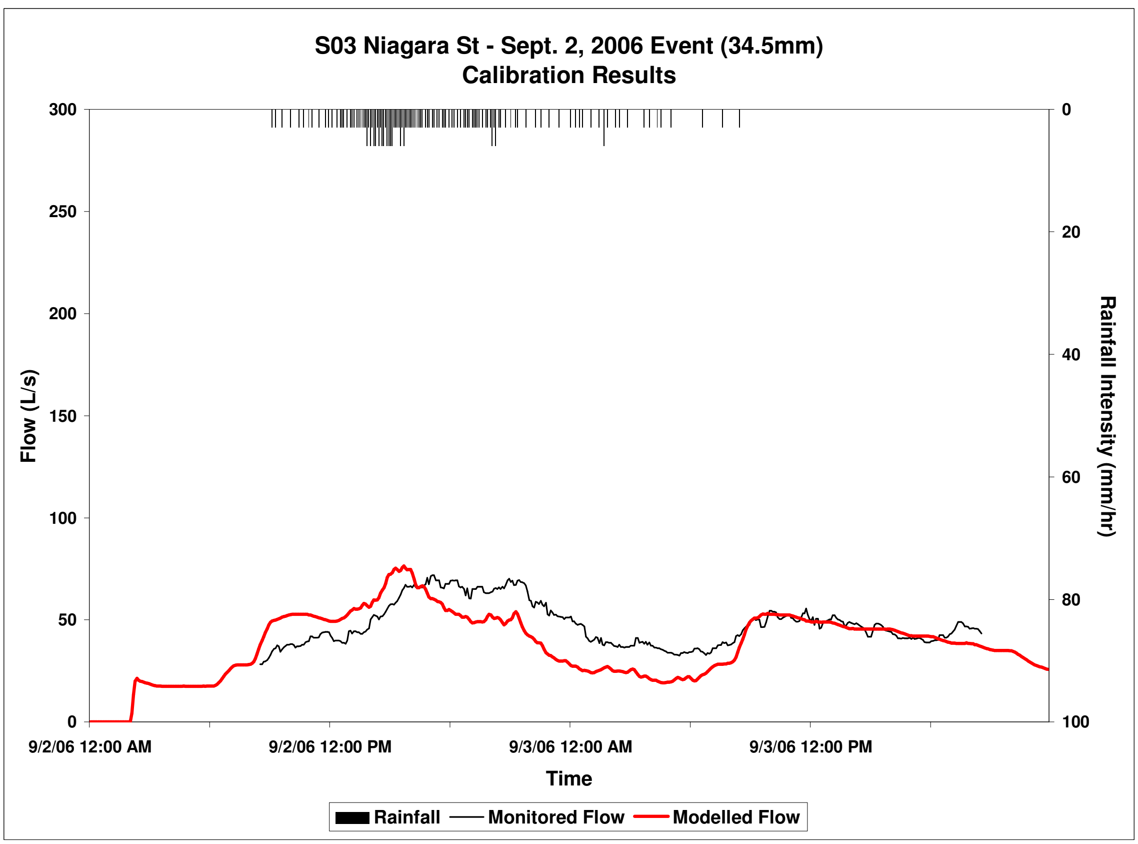


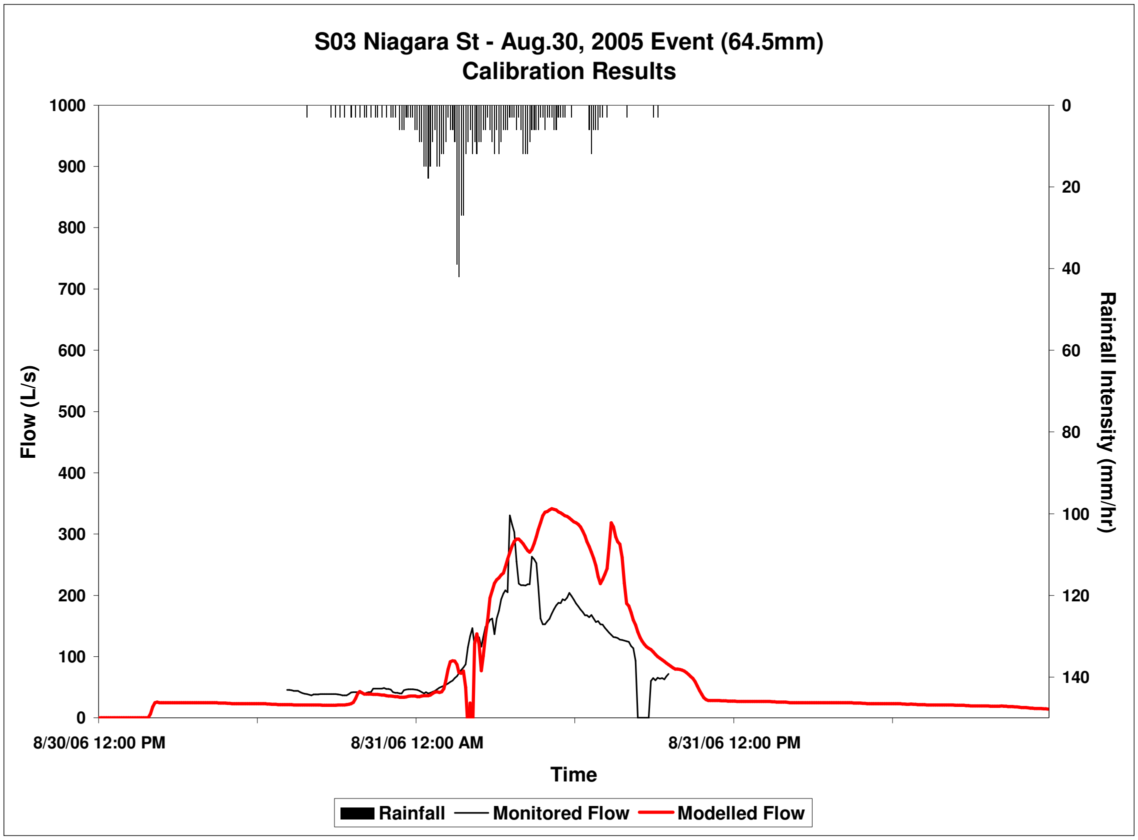
S02 Sunnylea - Sept.2, 2006 Event (34.5mm)
Calibration Results
* Flow data questionable
Flow (L/s)
Rainfall Intensity (mm/hr)
0
100
200
300
400
500
600
700
800
900
1000
20
40
60
80
9/2/06 12:00 AM
9/2/06 12:00 PM
9/3/06 12:00 AM
Time
Rainfall
Monitored Flow
Modelled Flow

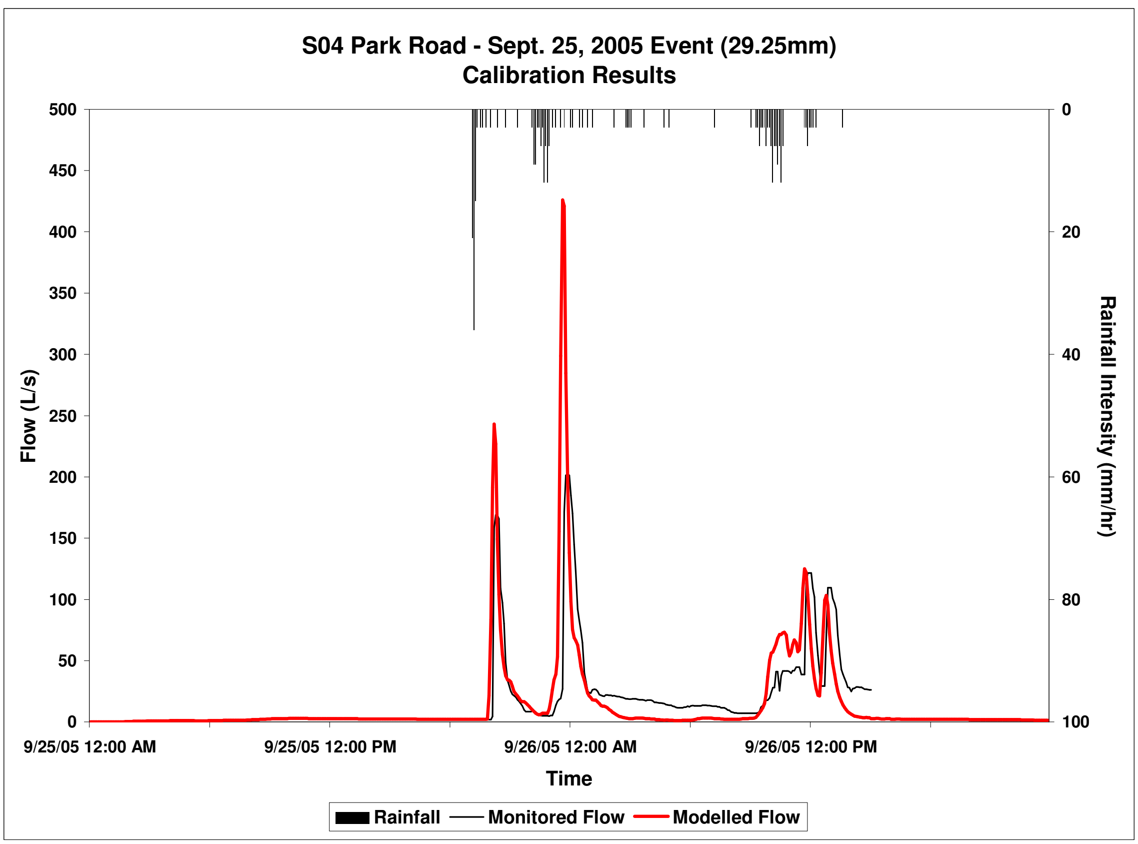


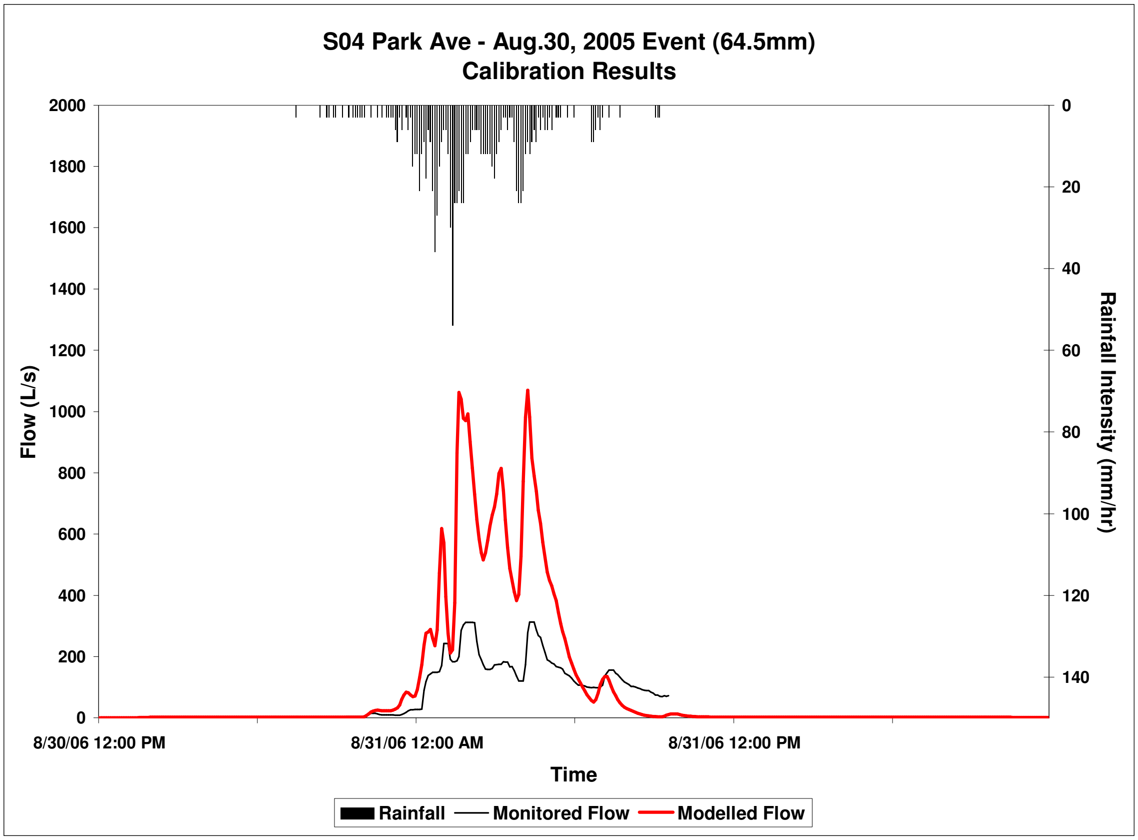
S02 Sunnylea - Aug.30, 2005 Event (64.5mm)
Calibration Results
* Flow data questionable
Flow (L/s)
Rainfall Intensity (mm/hr)
0
1000
2000
3000
4000
5000
6000
7000
20
40
60
80
100
120
140
8/30/06 12:00 PM
8/31/06 12:00 AM
8/31/06 12:00 PM
Time
Rainfall
Monitored Flow
Modelled Flow


S03 Niagara St - Sept. 25, 2005 Event (29.25mm)
Calibration Results
Flow (L/s)
300
250
200
150
100
50
0
Rainfall Intensity (mm/hr)
0
20
40
60
80
100
9/25/05 12:00 AM
9/25/05 12:00 PM
9/26/05 12:00 AM
9/26/05 12:00 PM
Time
Rainfall
Monitored Flow
Modelled Flow


S03 Niagara St - Sept. 2, 2006 Event (34.5mm)
Calibration Results
Flow (L/s)
300
250
200
150
100
50
0
Rainfall Intensity (mm/hr)
0
20
40
60
80
100
9/2/06 12:00 AM
9/2/06 12:00 PM
9/3/06 12:00 AM
9/3/06 12:00 PM
Time
Rainfall
Monitored Flow
Modelled Flow


S03 Niagara St - Aug.30, 2005 Event (64.5mm)
Calibration Results
Flow (L/s)
Rainfall Intensity (mm/hr)
1000
900
800
700
600
500
400
300
200
100
0
20
40
60
80
100
120
140
8/30/06 12:00 PM
8/31/06 12:00 AM
8/31/06 12:00 PM
Time
Rainfall
Monitored Flow
Modelled Flow


S04 Park Road - Sept. 25, 2005 Event (29.25mm)
Calibration Results
Flow (L/s)
Rainfall Intensity (mm/hr)
500
450
400
350
300
250
200
150
100
50
0
20
40
60
80
100
9/25/05 12:00 AM
9/25/05 12:00 PM
9/26/05 12:00 AM
9/26/05 12:00 PM
Time
Rainfall
Monitored Flow
Modelled Flow



S04 Park Ave - Aug.30, 2005 Event (64.5mm)
Calibration Results
Flow (L/s)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Rainfall Intensity (mm/hr)
0
20
40
60
80
100
120
140
8/30/06 12:00 PM
8/31/06 12:00 AM
8/31/06 12:00 PM
Time
Rainfall
Monitored Flow
Modelled Flow

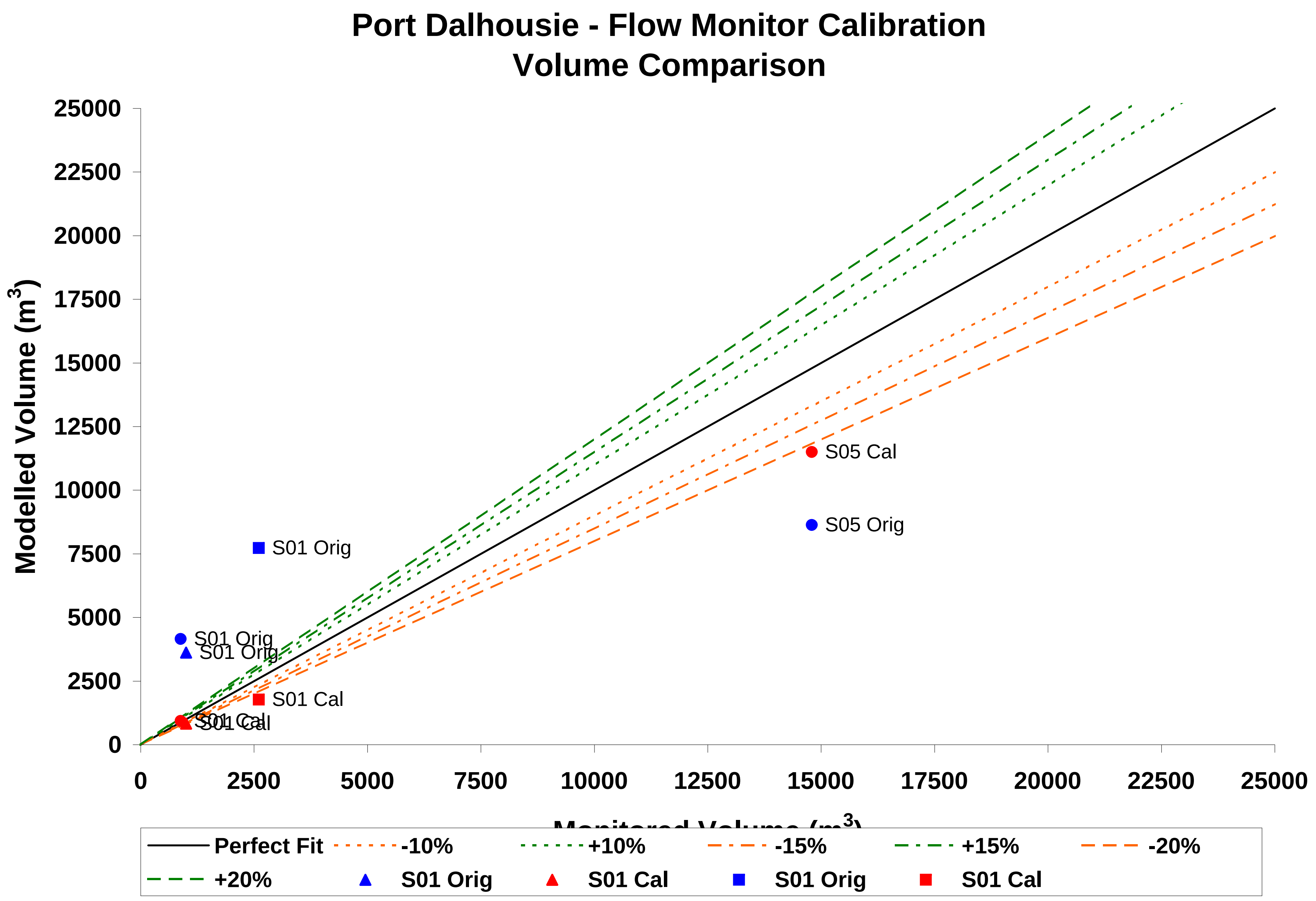
Dry Weather Flow Scatter Plots

September 2, 2006 Rainfall Event

Flow Monitor	Gauged Volume m^3	Original Model Volume m^3	Calibrated Model Volume m^3
S01	885	4154	934
S05	14792	8631	11503
Gladman			
Meadowvale			
Lighthouse			

Volume Comparison

0	0	0
25000	22500	27500
	21250	28750
	20000	30000



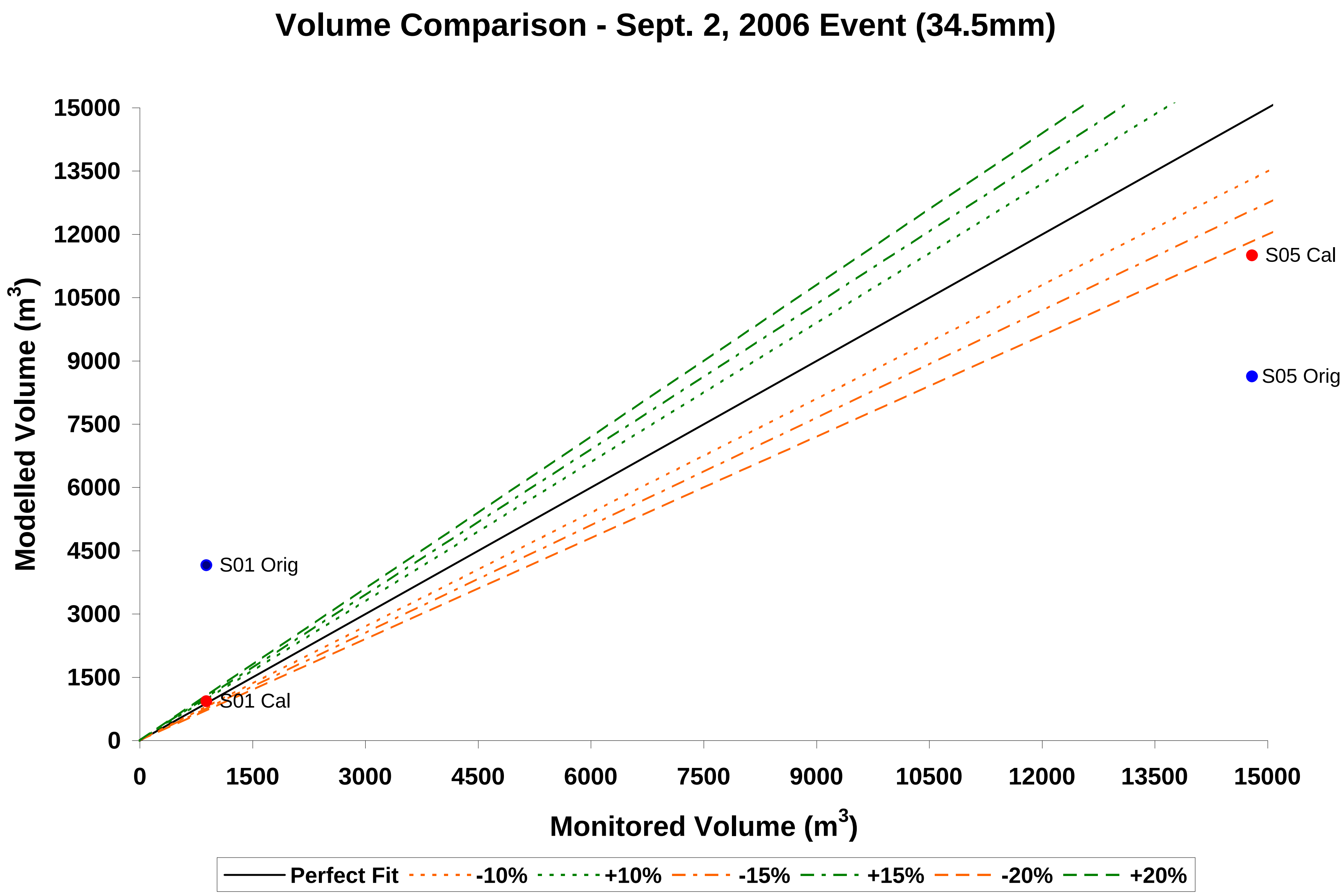
Port Dalhousie - Flow Monitor Calibration
Volume Comparison
Modelled Volume (m3)
Monitored Volume (m3)
0
2500
5000
7500
10000
12500
15000
17500
20000
22500
25000
S01 Orig
S01 Cal
S05 Cal
S05 Orig
Perfect Fit
-10%
+10%
-15%
+15%
-20%
+20%

September 25, 2005 Rainfall Event

Flow Monitor	Gauged Volume m^3	Original Model Volume m^3	Calibrated Model Volume m^3
S01	1002	3618	829
S05	13269	7765	10184
Gladman			
Meadowvale			
Lighthouse			

Volume Comparison

0	0	0
15000	13500	16500
	12750	17250
	12000	18000



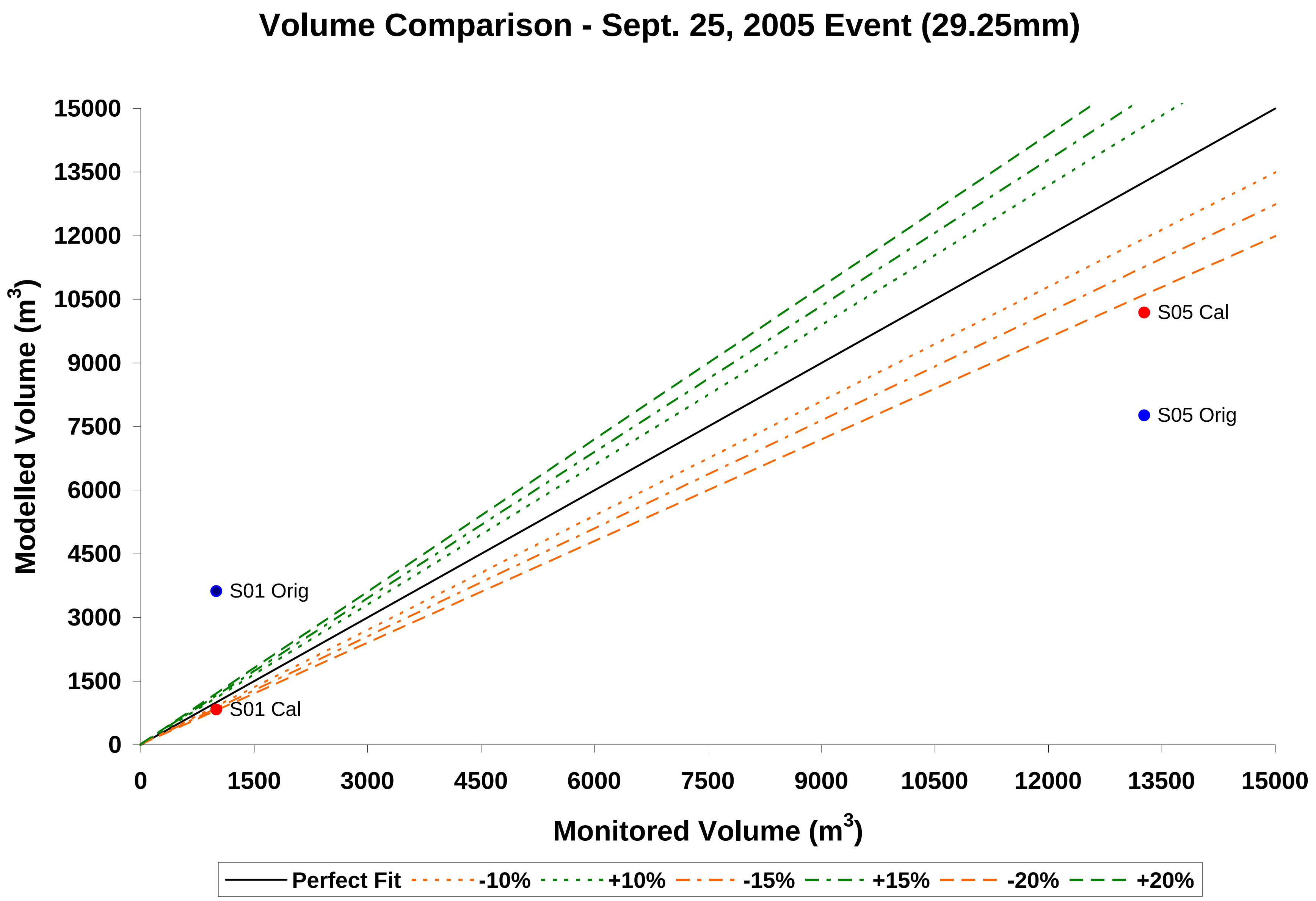
Volume Comparison - Sept. 2, 2006 Event (34.5mm)
Modelled Volume (m3)
Monitored Volume (m3)
15000
13500
12000
10500
9000
7500
6000
4500
3000
1500
0
S01 Orig
S01 Cal
S05 Cal
S05 Orig
Perfect Fit
-10%
+10%
-15%
+15%
-20%
+20%

Aug 30, 2005 Rainfall Event

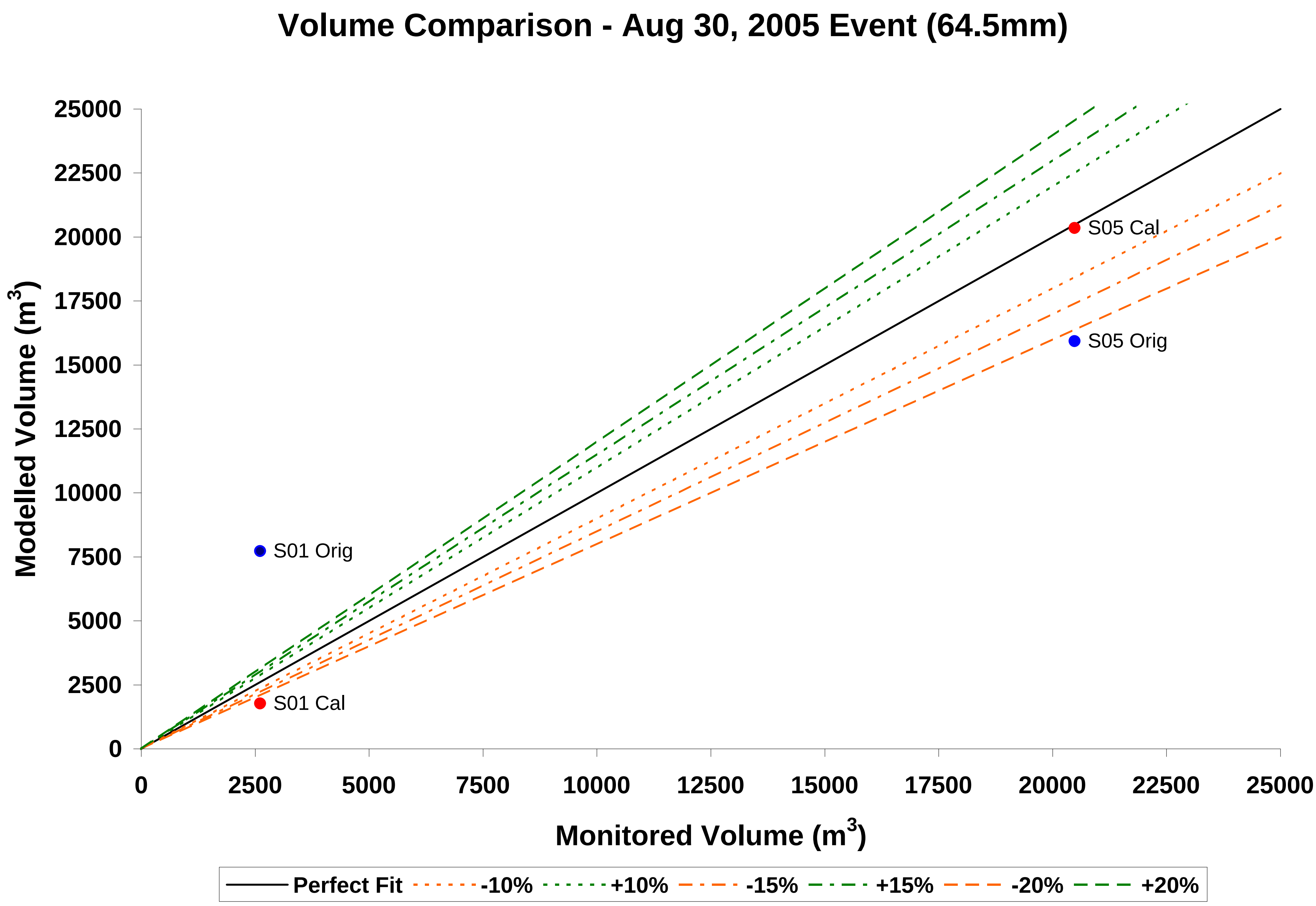
Flow Monitor	Gauged Volume m^3	Original Model Volume m^3	Calibrated Model Volume m^3
S01	2607	7730	1777
S05	20482	15930	20347
Gladman			
Meadowvale			
Lighthouse			

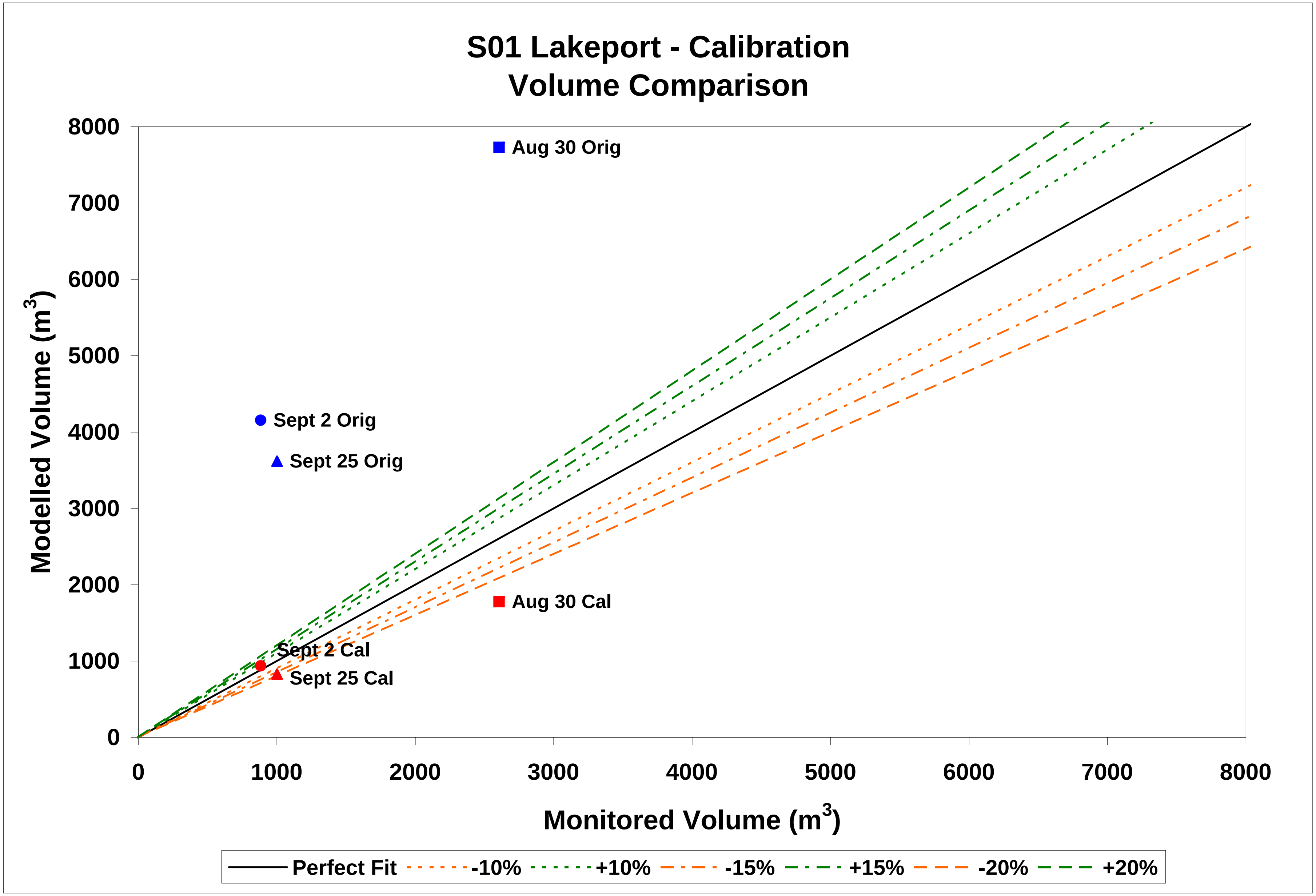
Volume Comparison

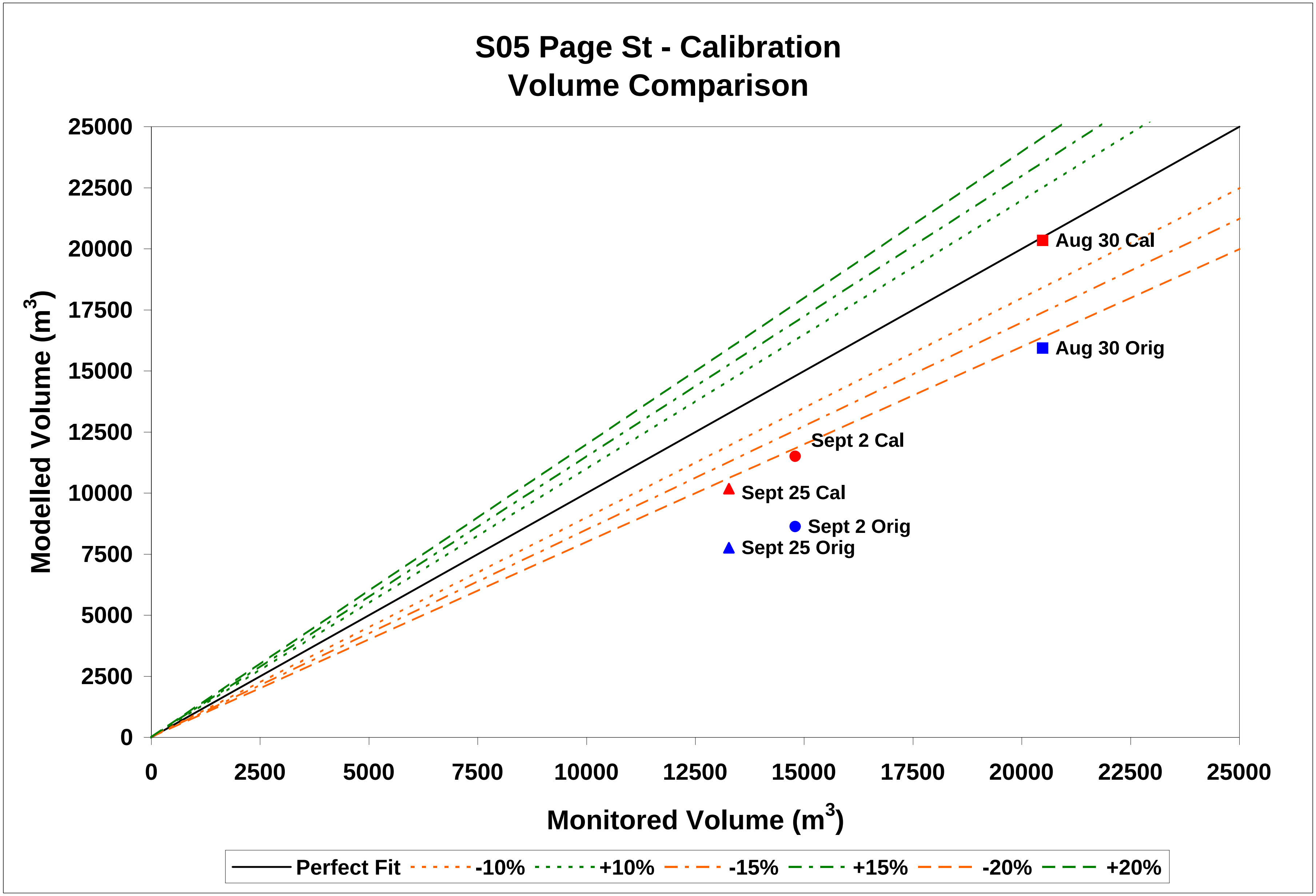
0	0	0
25000	22500	27500
	21250	28750
	20000	30000



Volume Comparison - Sept. 25, 2005 Event (29.25mm)
Modelled Volume (m3)
15000
13500
12000
10500
9000
7500
6000
4500
3000
1500
0
0
1500
3000
4500
6000
7500
9000
10500
12000
13500
15000
Monitored Volume (m3)
S01 Orig
S01 Cal
S05 Cal
S05 Orig
Perfect Fit
-10%
+10%
-15%
+15%
-20%
+20%


Volume Comparison - Aug 30, 2005 Event (64.5mm)
Modelled Volume (m3)
Monitored Volume (m3)
0
2500
5000
7500
10000
12500
15000
17500
20000
22500
25000
S05 Cal
S05 Orig
S01 Orig
S01 Cal
Perfect Fit
-10%
+10%
-15%
+15%
-20%
+20%


S01 Lakeport - Calibration
Volume Comparison
Modelled Volume (m3)
Monitored Volume (m3)
0
1000
2000
3000
4000
5000
6000
7000
8000
Aug 30 Orig
Sept 2 Orig
Sept 25 Orig
Aug 30 Cal
Sept 2 Cal
Sept 25 Cal
Perfect Fit
-10%
+10%
-15%
+15%
-20%
+20%

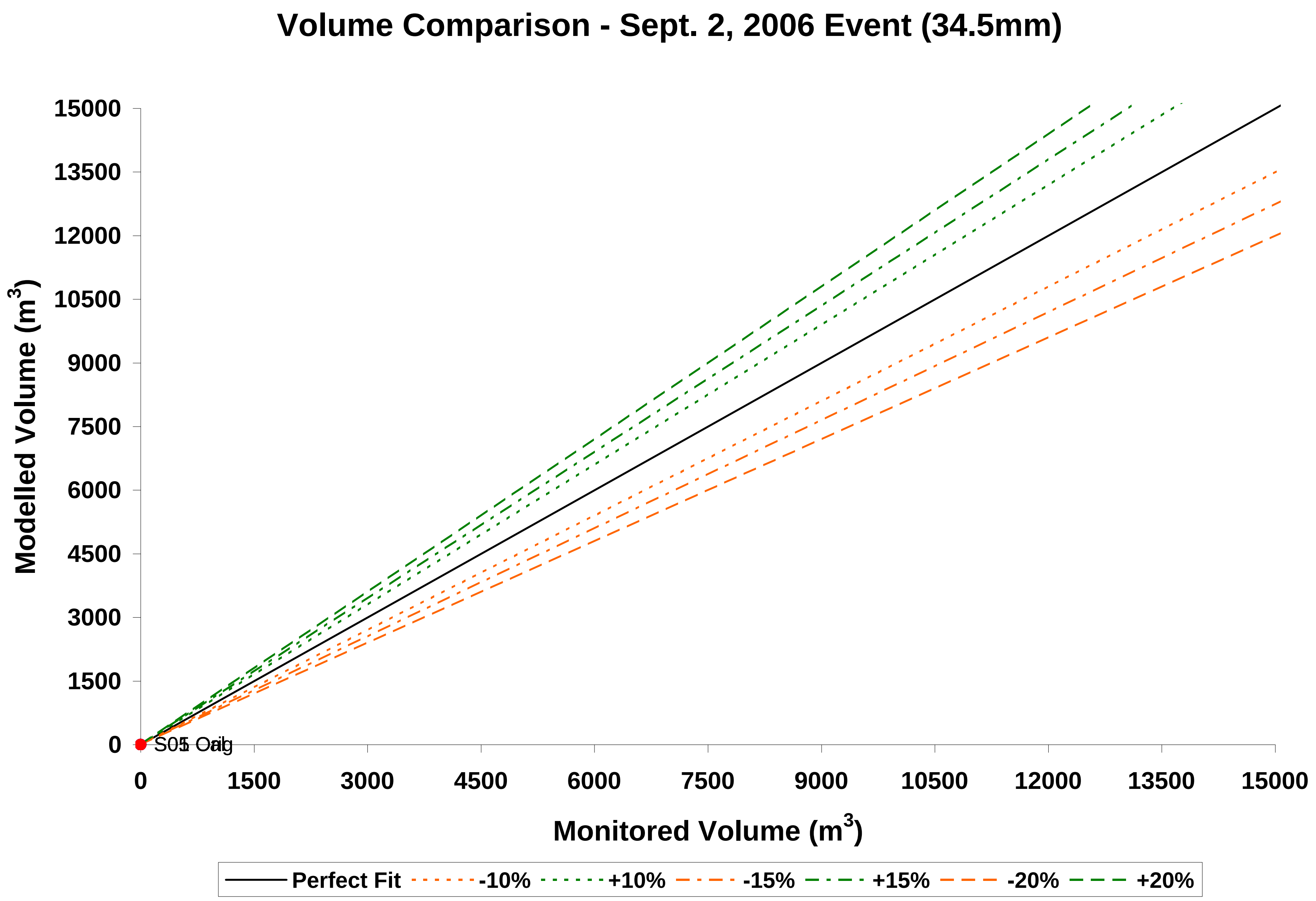

S05 Page St - Calibration
Volume Comparison
Modelled Volume (m^3)
Monitored Volume (m^3)
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
Aug 30 Cal
Aug 30 Orig
Sept 2 Cal
Sept 25 Cal
Sept 2 Orig
Sept 25 Orig
Perfect Fit
-10%
+10%
-15%
+15%
-20%
+20%

September 2, 2006 Rainfall Event

Flow Monitor	Gauged Volume m^3	Original Model Volume m^3	Calibrated Model Volume m^3
S02			
S03			
S04			
John			
Petrie			
Lockview			
Tamarak			
Omara			
Cumberland			

Volume Comparison

0	0	0
25000	22500	27500
	21250	28750
	20000	30000



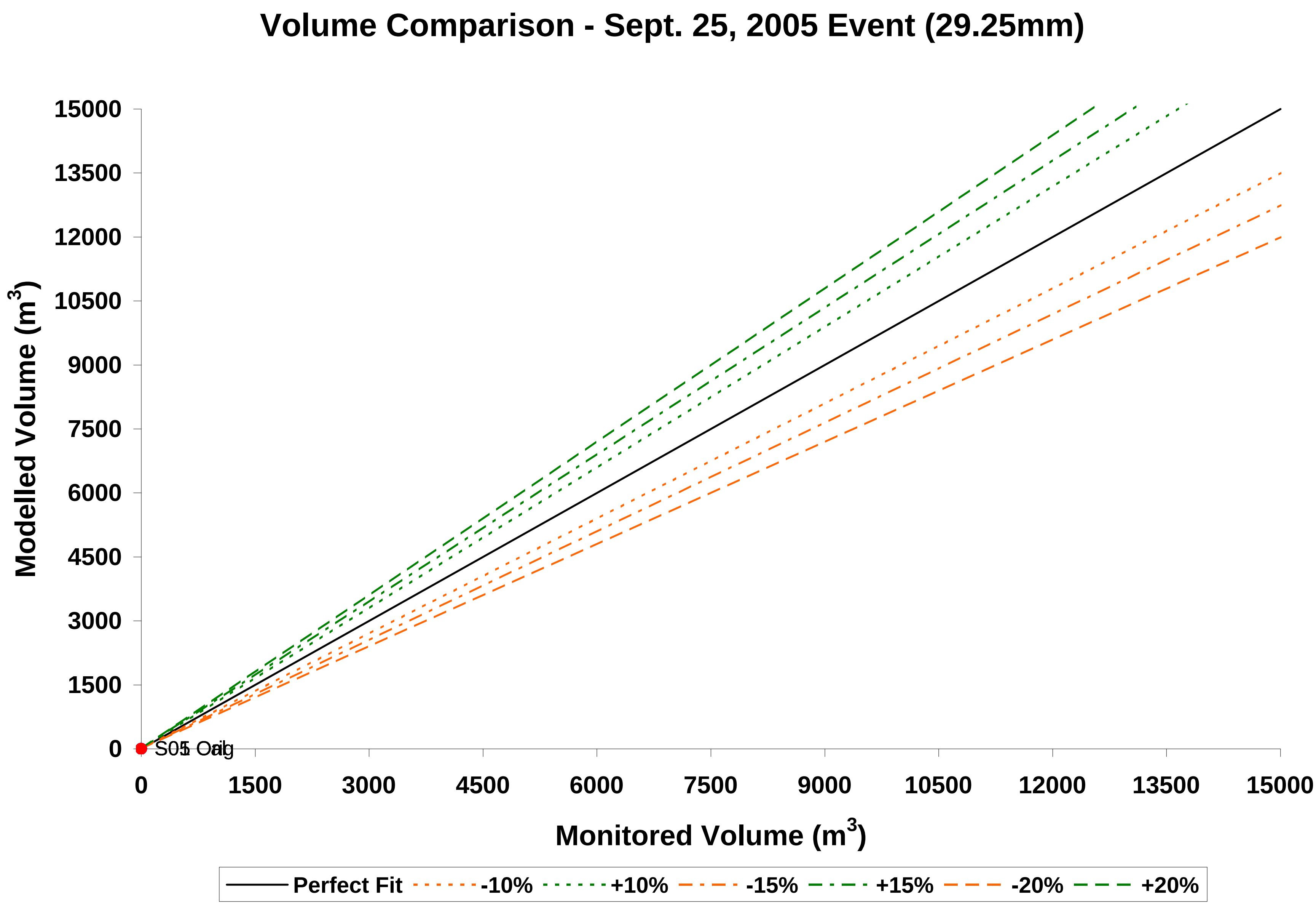
Volume Comparison - Sept. 2, 2006 Event (34.5mm)
Modelled Volume (m3)
Monitored Volume (m3)
15000
13500
12000
10500
9000
7500
6000
4500
3000
1500
0
S05 Orig
S05 Cal
0
1500
3000
4500
6000
7500
9000
10500
12000
13500
15000
Perfect Fit
-10%
+10%
-15%
+15%
-20%
+20%

September 25, 2005 Rainfall Event

Flow Monitor	Gauged Volume m^3	Original Model Volume m^3	Calibrated Model Volume m^3
S02			
S03			
S04			
John			
Petrie			
Lockview			
Tamarak			
Omara			
Cumberland			

Volume Comparison

0	0	0
15000	13500	16500
	12750	17250
	12000	18000

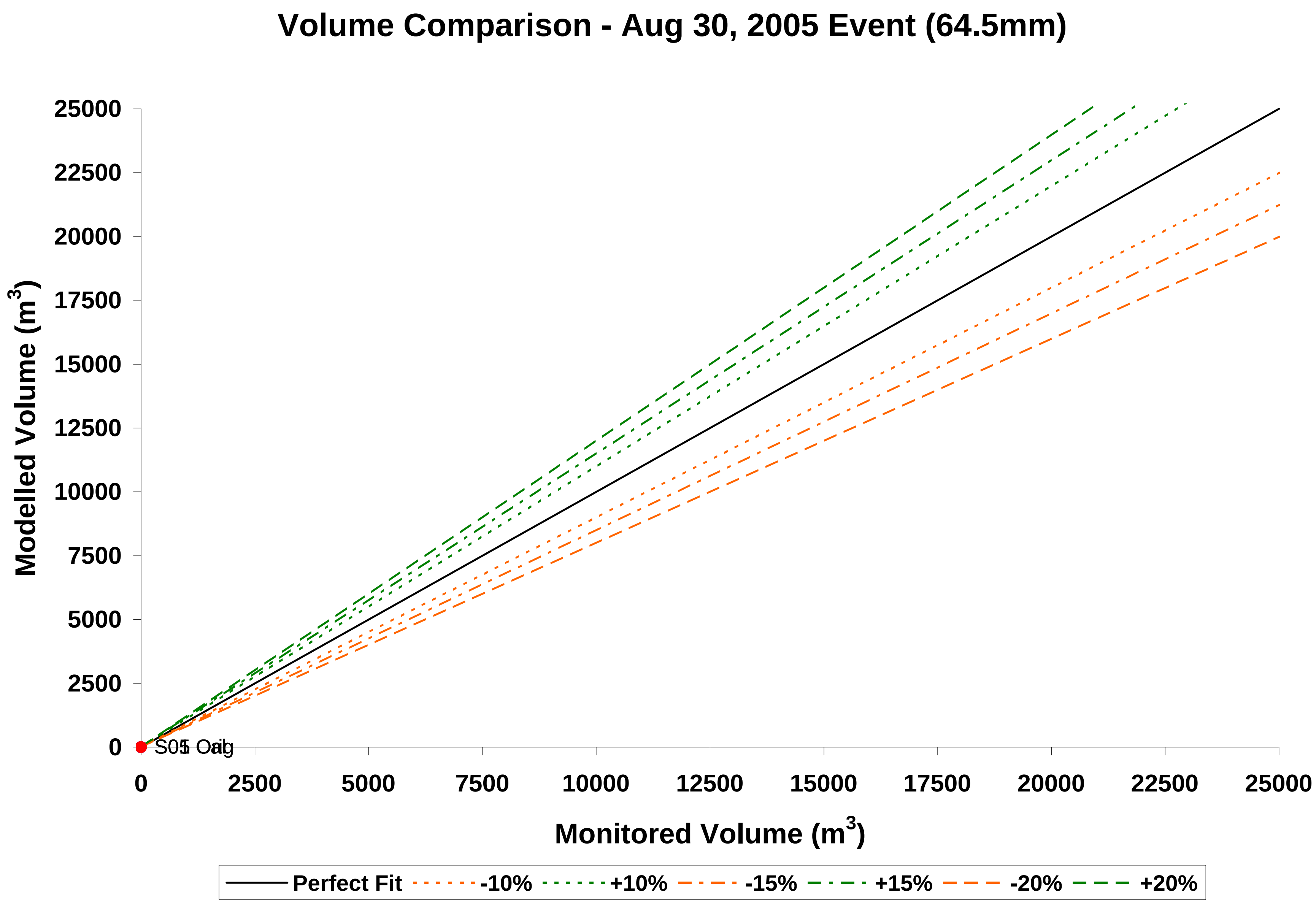

Volume Comparison - Sept. 25, 2005 Event (29.25mm)
Modelled Volume (m3)
Monitored Volume (m3)
15000
13500
12000
10500
9000
7500
6000
4500
3000
1500
0
0
1500
3000
4500
6000
7500
9000
10500
12000
13500
15000
S05 Calib
S01 Orig
Perfect Fit
-10%
+10%
-15%
+15%
-20%
+20%

Aug 30, 2005 Rainfall Event

Flow Monitor	Gauged Volume m^3	Original Model Volume m^3	Calibrated Model Volume m^3
S02			
S03			
S04			
John			
Petrie			
Lockview			
Tamarak			
Omara			
Cumberland			

Volume Comparison

0	0	0
25000	22500	27500
	21250	28750
	20000	30000



Volume Comparison - Aug 30, 2005 Event (64.5mm)
Modelled Volume (m3)
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
S05 Cal
S05 Orig
0
2500
5000
7500
10000
12500
15000
17500
20000
22500
25000
Monitored Volume (m3)
Perfect Fit
-10%
+10%
-15%
+15%
-20%
+20%

Appendix H
Future Flow Scenarios

Hatch Mott MacDonald

MEMO

Subject **Northeast Area Wastewater Servicing Study**
Average Daily Flows - Niagara Falls WWTP,
Port Weller WWTP and Port Dalhousie WWTP

As discussed in our meeting of September 11, 2007, there is a wide variation in the forecast average day flows (ADF) at the above-noted WWTPs in the Master Servicing Plan Update (MSP), 2003 and those which could be expected from likely population increases. Recognizing that estimates of ADFs are required for this study to proceed, a rationale to arrive at those estimates is presented herein.

The ADFs presented in the MSP are significantly greater than those which could be expected based on population increases. Population increases forecast by the RMON Planning Department were summarized in HMM's memorandum of June 7, 2007, and have been discussed with appropriate staff at the Cities of Niagara Falls, St. Catharines and Thorold, and the Town of Niagara-on-the-Lake. The reason for these discrepancies in the forecast ADFs is unknown but possible reasons are

i) use of various unit flow rate criteria
ii) changes in the proportion of land use.

There may also be other reasons, but these are not known at the present time.

Item i) is examined in Table 1 which presents a comparison of the unit flow rates shown in the relevant MSP Working Papers, the Region's Project Design and Technical Specifications Manual, and MOE Guidelines. It can be seen that there is a significant range in many of the criteria.

Item ii) is illustrated conceptually in Figure 1. Due to the different unit flow rates for the various land use types, it is to be expected that a change in the ratios of individual land use types, within an overall increase in land use, would cause some variation in the forecast ADF.

An estimate of the ADFs is required for the NE Area Wastewater Servicing Study to proceed. The following methodology is proposed to arrive at an **approximate** estimate of future ADFs.

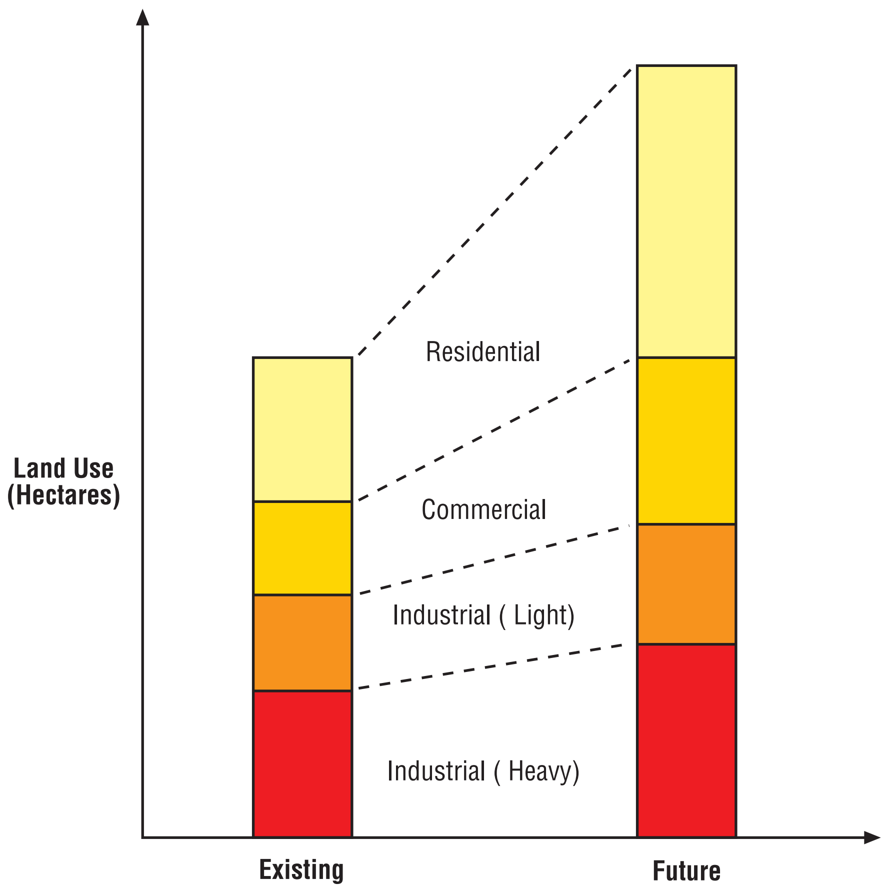


Figure 1
Land Use Comparison

1. The existing (2001-2005) ADF is prorated, based on the increase in population, to arrive at the future ADF.
2. The increase in overall land use is calculated (based on the respective MSP Working Paper).
3. The changes in ratio of individual land use types, within the overall land use increase, is identified (based on the respective MSP Working Paper).
4. The future ADF calculated in 1) above is adjusted to reflect increases or decreases in the ratios of land use types during that period.

The methodology noted above is presented in Tables 2, 3 and 4 attached, along with the results. Tables 2a), 3a) and 4a) use the RMON unit flow rate criteria in step 4, and Tables 2b), 3b) and 4b) use the MSP Working Paper criteria. After discussion with the Region, it was felt that it would be more appropriate to use the MSP Working Paper criteria, as these were likely to be derived from calibration of the models used at that time.

Table 5 summarizes the existing and forecast ADFs. Given the approximate nature of the estimate, the forecast ADFs should be rounded and therefore the ADFs recommended to be used in the future phases of this study are as follows:

Niagara Falls WWTP

2001 to 2005	54,577 m^3/day
2026	72,400 m^3/day
Build-out	79,900 m^3/day

Port Weller WWTP

2001 to 2005	42,286 m^3/day
2026	49,300 m^3/day
Build-out	54,300 m^3/day

Port Dalhousie WWTP

2001 to 2005	43,351 m^3/day
2026	48,300 m^3/day
Build-out	51,300 m^3/day

It is emphasized that the forecast future ADFs are approximate and appropriate only for use in a planning level study such as the NE Area Wastewater Servicing Study. We understand that the models which the Region is developing in anticipation of their next MSP Update will incorporate a more accurate means of estimating such flows.

CB/eam
Attach

Table 1 - Comparison of Unit Flow Rate Criteria

	Unit	MSP	RMON[1]	MOE[2]	Comments
Unit flow rate for residential use	L/cap/day	280	275	225 to 450	Both MSP and the RMON criteria are in the lower range of the recommended MOE values
Unit flow rate for commercial use	L/ha/day	20,000	24,750	25,000 to 50,000	The RMON criteria equals the lower limit recommended by MOE. MSP criteria is below the lower limit.
Unit flow rate for heavy industrial use	L/ha/day	150003[3] 20,000[4,5]	-	55,000	MSP criteria is well below the typical criteria recommended by MOE. The RMON criteria does not include sewage flow from heavy industry.
Unit flow rate for light industrial use	L/ha/day	7,500[3] 10,000[4,5]	34,375	35,000	MSP criteria is well below the typical criteria recommended by MOE. The RMON criteria used the same value as MOE recommends.
Unit flow rate for base infiltration	L/ha/day	7,000[3] 5,000[4] 8,000[5]	24,710	- 8,640 to 24,192 for sewer design - 3,715 to 9,245 for SPS and WWTP design	The criteria used by MSP is characteristic for the design of sewage pumping station and wastewater treatment plant, and it fits in the upper range of the values recommended by MOE. The criteria used by the RMON is characteristic for the design of sanitary sewer, and it fits in the upper range of the values recommended by MOE.
Peaking factor	-	1.5 to 3	M = 1 + (14/(4+P^0.5)	M = 1 + (14/(4+P^0.5)	MSP uses a range of characteristic values (based on historical data) and the RMON uses the recommended MOE formula to calculate the peaking factor.

Legend

SPS - sewage pumping station
WWTP - wastewater treatment plant
M - peaking factor
P - design population in thousands

Notes:

1 - Project Design and Technical Specificatons Manual, February 2005.
2 - Guidelines for the Design of Sanitary Sewage Works, MInistry of the Environment, Ontario, 1984.
3 - Niagara Falls WWTP Working Paper.
4 - Port Weller WWTP Working Paper.
5 - Port Dalhousie WWTP Working Paper.

Table 2a)
NE Area Wastewater Servicing Study
Niagara Falls WWTP Average Day Flows

Existing Rated Capacity 68,200 m^3/d
Existing Peak Flow Capacity 136,400 m^3/d

Population & Land Use	Existing		2026			Build-out		
					Increase from Existing (%)			Increase from Existing (%)
Population (from HMM memo)	82,392		104,068		26%	109,782		33%
Total Land Use (ha)	5,020		6,067		21%	7,112		42%
		Proportion of Total Land Use (%)		Proportion of Total Land Use (%)			Proportion of Total Land Use (%)	
Urban residential	2,685	53%	2,997	49%	12%	3,308	47%	23%
Rural residential	0	0%	0	0%		0	0%	
Commercial	881	18%	1,048	17%	19%	1,216	17%	38%
Institutional	0	0%	0	0%		0	0%	
Industrial (light)	49	1%	49	1%	0%	49	1%	0%
Industrial (heavy)	1,405	28%	1,973	33%	40%	2,539	36%	81%
Wastewater Flows								
Average Day Flow (based on population increases only) m^3/d	54577 (2001-2005)		**68,767**			**72,587**		
Average Day Flow (adjusted to reflect land use ratios) m^3/d	**RMON Criteria[2]**		**2026 Area (ha) @ 21%**	**Difference (ha)**	**Flow (m3/d)**	**Build-out Area (ha) @ 42%**	**Difference**	**Flow (m3/d)**
Commercial	24,750 L/ha/d		1,066	-18	-446	1,251	-35	-867
Industrial (light)	34,375 L/ha/d		59	-10	-354	70	-21	-707
Industrial (heavy)	34,375 L/ha/d		1,700	273	9,383	1,995	544	18,697
				Total Flow Difference (m^3/d)	**8,583**		**Total Flow Difference (m^3/d)**	**17,122**
			77,350			**89,709**		
Average DWF reported in MSP[1]	**65,536**		**93,666**			**120,412**		

1 - Excludes Queenston WWTP flows, but includes allowances for tourism (5,590 m^3/day) and St. Davids.
2 - Project Design and Technical Specifications Manual, February 2005.

Table 2b)
NE Area Wastewater Servicing Study
Niagara Falls WWTP Average Day Flows

Existing Rated Capacity 68,200 m^3/d
Existing Peak Flow Capacity 136,400 m^3/d

Population & Land Use	Existing		2026			Build-out		
					Increase from Existing (%)			Increase from Existing (%)
Population (from HMM memo)	82,392		104,068		26%	109,782		33%
Total Land Use (ha)	5,020		6,067		21%	7,112		42%
		Proportion of Total Land Use (%)		Proportion of Total Land Use (%)			Proportion of Total Land Use (%)	
Urban residential	2,685	53%	2,997	49%	12%	3,308	47%	23%
Rural residential	0	0%	0	0%		0	0%	
Commercial	881	18%	1,048	17%	19%	1,216	17%	38%
Institutional	0	0%	0	0%		0	0%	
Industrial (light)	49	1%	49	1%	0%	49	1%	0%
Industrial (heavy)	1,405	28%	1,973	33%	40%	2,539	36%	81%
Wastewater Flows								
Average Day Flow (based on population increases only) m^3/d	54577 (2001-2005)		68,767			72,587		
Average Day Flow (adjusted to reflect land use ratios) m^3/d	MSP Working Paper Criteria		**2026 Area (ha) @ 21%**	Difference (ha)	Flow (m3/d)	**Build-out Area (ha) @ 42%**	Difference	Flow (m3/d)
Commercial	20,000 L/ha/d		1,066	-18	-360	1,251	-35	-700
Industrial (light)	7,500 L/ha/d		59	-10	-77	70	-21	-154
Industrial (heavy)	15,000 L/ha/d		1,700	273	4,094	1,995	544	8,159
				Total Flow Difference (m^3/d)	3,657		Total Flow Difference (m^3/d)	7,304
			72,424			79,891		
Average DWF reported in MSP[1]	65,536		93,666			120,412		

1- Excludes Queenston WWTP flows, but includes allowances for tourism (5,590 m^3/day) and St. Davids

4. Population & Land Use Projections

Based on the information provided by the Regional Planning Department, traffic zones 191 to 256 are associated with the City of Niagara Falls. The population projections from the Regional Planning and Land Use information from the Official Zoning Plan are summarized in Table 3 and shown Figure 3.

Table 3 – Population and Land Use Projections for Niagara Falls

Population & Land Use	Existing	2026	Built-Out
Population (Persons)	**78,509**	**97,887**	**107,214**
Land Use (Hectares)			
Urban Residential	2,701.6	3,036.5	3,371.5
Rural Residential	65.0	77.7	90.4
Commercial	928.1	1,099.7	1,271.2
Industrial (Light)	90.4	130.1	169.7
Industrial (Heavy)	1,027.6	1,597.8	2,168.0
Institutional	-	-	-
Total	**4,817.7**	**5,914.8**	**7,070.8**

Wastewater from the construction of the future casino (in traffic zone 239) and the Grand Niagara resort hotel/golf course (in traffic zone 246) will be serviced by the High Lift Pumping Station. Effluent from new developments in St. Davids (in traffic zone 195) was also included.

It can be noted that all land use located outside the urban boundary was treated as contributing to the Niagara Falls network (see Figure 4). In the future, it is intended to extend the west urban boundary to service the areas located in this boundary. However, the traffic zones located outside of the urban boundary and south of Niagara Falls may be routed towards Fort Erie's Anger Avenue WPCP as an alternative to free up the High Lift Pumping Station, however this scenario was not modeled.

Table 4 shows a breakdown of population and land use projections by service areas of the pumping stations.

Table 4 – Population and Land Use Projections by Pumping Stations

Serviced Population & Land Use	Existing	2026	Built-Out
Low Lift Pumping Station			
Population (Persons)	**5,253**	**10,261**	**11,870**
Land Use (Hectares)			
Urban Residential	211	385	385
Rural Residential	0	0	0
Commercial	345	350	350
Industrial (Light)	0	0	0
Industrial (Heavy)	110	224	224
Institutional	0	0	0
Total:	**666**	**959**	**959**
High Lift Pumping Station			
Population (Persons)	**24,363**	**36,857**	**42,317**
Land Use (Hectares)			
Urban Residential	773	1,142	1,142
Rural Residential	26	31	31
Commercial	145	458	458

Table 4 – Population and Land Use Projections by Pumping Stations

Serviced Population & Land Use	Existing	2026	Built-Out
Institutional	0	0	0
Total:	**828**	**828**	**828**

5. Wastewater Flow Projections

Based on the information provided in the Wastewater Master Servicing Plan 1997, the following design parameters were used in the calculations of dry and wet weather flows for future development areas after 2002:

- Unit flow rate for future residential use = 280 Litres/capita/day
- Unit flow rate for commercial use = 20,000 Litres/hectare/day
- Unit flow rate for heavy industrial use = 15,000 Litres/hectare/day
- Unit flow rate for light industrial use = 7,500 Litres/hectare/day
- Unit flow rate for base infiltration = 7,000 Litres/hectare/day
- Peaking Factor = 1.5 to 3.0

For existing urban areas, the dry and wet weather flows established in the 1996 City of Niagara Falls Sewer System Analysis and CSO Abatement Study were used. They were determined from flow monitoring data collected by the Region in 1995-1996. More flow data were available from recent studies such as the Muddy Run CSO High Rate Treatment Feasibility Study and Taro North Pumping Station Decommissioning Study in 1999, and Chippawa Pollution Control Study in 1998. The flow data from these studies were used as the dry and wet weather flows in these areas.

Future developments will have completely separated storm and sanitary sewer, and they are not expected to contribute wet weather flow to existing combined/sanitary sewer systems. The volume of wet weather inflow/infiltration entering the sanitary sewer system is should be minimal. However, for conservative design of new sewer systems, wet weather inflow/infiltration has been included for future developments based on recommended design values from the Wastewater Master Servicing Plan.

The wastewater flow projections for the Niagara Falls WPCP system are summarized in Table 5.

Table 5 - Wastewater Flow Projections for Niagara Falls WPCP System

Wastewater Facility	Existing	2026	Built-Out (2051)
	Ave DWF (L/s)	Ave DWF (L/s)	Ave DWF (L/s)
Internal Urban boundary	665.57	831.48	985.65
Area extend to the urban boundary	113.31	273.84	418.40
Tourism (Casino, hotel)	107.75	107.75	107.75
St. David's	28.13	36.11	44.33
Queenston WPCP	---	2.35	2.72
Total Flow	914.8[1]	1251.53	1556.85

Table 3a)
NE Wastewater Servicing Study
Port Weller WWTP Average Day Flows

Existing Rated Capacity	56,180 m^3/day
Existing Peak Secondary Flow Capacity	112,360 m^3/day
Existing Peak Primary Flow Capacity	136,200 m3/day

Population & Land Use	Existing		2026			Build-out		
					Increase from Existing (%)			Increase from Existing (%)
Population (from HMM memo)	83,297		91,593		10%	95,835		15%
Total Land Use (ha)	3,542		4,496		27%	5,450		54%
		Proportion of Total Land Use (%)		Proportion of Total Land Use (%)			Proportion of Total Land Use (%)	
Urban residential	2,344	66%	2,623	58%	12%	2,901	53%	24%
Rural residential	41	1%	61	1%	50%	82	1%	100%
Commercial	285	8%	394	9%	38%	503	9%	76%
Institutional	48	1%	68	2%	43%	89	2%	85%
Industrial (light)	412	12%	917	20%	122%	1,421	26%	245%
Industrial (heavy)	408	12%	428	10%	5%	447	8%	10%
Wastewater Flows								
Average Day Flow (based on population increases only) m^3/d	42286 (2001-2005)		46,515			48,629		
Average Day Flow (adjusted to reflect land use ratios) m^3/d	RMON Criteria[2]		2026 Area (ha) @ 27%	Difference (ha)	Flow (m3/d)	Build-out Area (ha) @ 54%	Difference	Flow (m3/d)
Commercial	24,750 L/ha/d		362	32	788	440	64	1,576
Institutional	10,000 L/ha/d		61	7	74	74	15	148
Industrial (light)	34,375 L/ha/d		523	393	13,524	635	787	27,042
Industrial (heavy)	34,375 L/ha/d		519	-91	-3,116	629	-181	-6,235
				Total Flow Difference (m^3/d)	11,271		Total Flow Difference (m3/d)	22,531
			57,786			71,160		
Average DWF reported in MSP[1]	39,730[3] - 44,9813[4]		56,640			64,400		

1 - Includes contributions from both inside and outside urban boundary.
2 - Project Design and Technical Specifications Manual, February 2005.
3 - "Existing".
4 - 2002.

Table 3b)
NE Wastewater Servicing Study
Port Weller WWTP Average Day Flows

Existing Rated Capacity 56,180 m^3/day
Existing Peak Secondary Flow Capacity 112,360 m^3/day
Existing Peak Primary Flow Capacity 136,200 m3/day

Population & Land Use	Existing		2026			Build-out		
					Increase from Existing (%)			Increase from Existing (%)
Population (from HMM memo)	83,297		91,593		10%	95,835		15%
Total Land Use (ha)	3,542		4,496		27%	5,450		54%
		Proportion of Total Land Use (%)		Proportion of Total Land Use (%)			Proportion of Total Land Use (%)	
Urban residential	2,344	66%	2,623	58%	12%	2,901	53%	24%
Rural residential	41	1%	61	1%	50%	82	1%	100%
Commercial	285	8%	394	9%	38%	503	9%	76%
Institutional	48	1%	68	2%	43%	89	2%	85%
Industrial (light)	412	12%	917	20%	122%	1,421	26%	245%
Industrial (heavy)	408	12%	428	10%	5%	447	8%	10%
Wastewater Flows								
Average Day Flow (based on population increases only) m^3/d	**42286** (2001-2005)		**46,515**			**48,629**		
Average Day Flow (adjusted to reflect land use ratios) m^3/d	**MSP Working Paper Criteria**		**2026 Area (ha) @ 27%**	**Difference (ha)**	**Flow (m3/d)**	**Build-out Area (ha) @ 54%**	**Difference**	**Flow (m3/d)**
Commercial	20,000 L/ha/d		362	32	637	440	64	1,274
Institutional	10,000 L/ha/d		61	7	74	74	15	148
Industrial (light)	10,000 L/ha/d		523	393	3,934	635	787	7,867
Industrial (heavy)	20,000 L/ha/d		519	-91	-1,813	629	-181	-3,628
				Total Flow Difference (m^3/d)	**2,833**		**Total Flow Difference (m3/d)**	**5,661**
			49,348			**54,290**		
Average DWF reported in MSP[1]	**39,730[2] - 44,981[3]**		**56,640**			**64,400**		

1 - Includes contributions from both inside and outside urban boundary.
2 - "Existing".
3 - 2002.

which is located east side of the Welland Ship Canal on the Niagara-on-the-Lake land use plan. This area is serviced via a siphon located under the canal. The effluent contributing to this area is associated with node 9300 in the model and includes traffic zones 48, 49 and 52.

In accordance with the Port Robinson long-term plan, traffic zone 190 was excluded from the traffic zones serviced by Port Weller. Except for traffic zone 190, the total land use located outside the urban boundary, south of St. Catharines, was considered as contributing to the Port Weller network and had been included in the urban boundary of the model for future conditions.

The population projections from the Regional Planning and remaining Land Use information from the Official Zoning Plan are summarized in Table 3. Although the population breakdown shows only a slight decrease, it can be seen that there will be considerable increases in new Land Uses in Thorold, which will cause the projected dry weather flow to increase in the system in future.

Table 3 - Population and Land Use Projections for Port Weller WPCP System

Population & Land Use	Existing	2026	Built-Out
Port Weller			
Population (Persons)	**78,279**	**74,443**	**74,620**
Port Weller Land Use (ha)			
Urban Residential	2,324.7	2,548.4	2,772.1
Rural Residential	8.7	13.1	17.4
Commercial	267.5	342.4	417.4
Institutional	48.0	68.4	88.7
Industrial (Light)	337.3	748.9	1160.4
Industrial (Heavy)	408.3	427.9	447.4
Sub-Total	**3,394.5**	**4,149.0**	**4,903.5**
Glendale			
Population (Persons)	**1,251**	**4,727**	**4,727**
Glendale Land Use (Hectares)			
Urban Residential	19.2	74.1	128.9
Rural Residential	32.1	48.2	64.2
Commercial	17.9	51.9	85.8
	---	---	---
Industrial (Light)	74.8	167.9	260.9
Industrial (Heavy)	---	---	---
Sub-Total	**144**	**341.9**	**539.8**
Total	**3,542.0**	**4,496.2**	**5,450.2**

Table 4 shows a breakdown of population and land use projections by service areas of pumping stations.

Table 4 – Population and Land Use Projections by Pumping Stations

Serviced Population & Land Use	Existing	2026	Built-Out
Beaver Dams Pumping Station			
Population (Persons)	**236**	**205**	**205**
Land Use (Hectares)			
Urban Residential	10	10	10
Rural Residential	0	0	0
Commercial	0	0	0
Industrial (Light)	27	49	49
Industrial (Heavy)	0	0	0
Institutional	0	0	0
Total:	**37**	**59**	**59**
Peel Street Pumping Station			
Population (Persons)	**2,101**	**2,029**	**2,029**
Land Use (Hectares)			
Urban Residential	69	93	93
Rural Residential	0	0	0
Commercial	12	27	27
Industrial (Light)	89	441	441
Industrial (Heavy)	0	0	0
Institutional	24	24	24
Total:	**194**	**585**	**585**
Black Horse Pumping Station			
Population (Persons)	**503**	**768**	**889**
Land Use (Hectares)			
Urban Residential	45	71	71
Rural Residential	0	0	0
Commercial	34	46	46
Industrial (Light)	39	175	175
Industrial (Heavy)	0	0	0
Institutional	0	0	0
Total:	**118**	**292**	**292**

5. Wastewater Flow Projections

Based on the information provided in the 1997 Wastewater Master Servicing Plan, the following design parameters were used in the calculations of dry and wet weather flows for future development areas after 2002:

- Unit flow rate for future residential use = 270 Litres/capita/day
- Unit flow rate for commercial use = 20,000 Litres/hectare/day
- Unit Flow rate for institutional use = 10,000 Litres/hectare/day
- Unit flow rate for heavy industrial use = 20,000 Litres/hectare/day
- Unit flow rate for light industrial use = 10,000 Litres/hectare/day
- Unit flow rate for base infiltration = 5,000 Litres/hectare/day
- Peaking factor for dry weather flow = 1.5 to 3.0

For existing urban areas, the dry and wet weather flows established in the 1999 City of St. Catharines and the Regional Municipality of Niagara Port Weller Sanitary Trunk Sewer Analysis were used. They were determined from flow monitoring data collected by the City.

Table 4a)
NE Wastewater Servicing Study
Port Dalhousie WWTP Average Day Flows

Existing Rated Capacity 61,350 m^3/day
Existing Peak Flow Capacity 100,000 m^3/day

Population & Land Use	Existing		2026			Build-out		
					Increase from Existing (%)			Increase from Existing (%)
Population (from HMM memo)	83,205		89,580		8%	93,512		12%
Total Land Use (ha)	2,766		3,357		21%	3,947		43%
		Proportion of Total Land Use (%)		Proportion of Total Land Use (%)			Proportion of Total Land Use (%)	
Urban residential	2,018	73%	2,355	70%	17%	2,692	68%	33%
Rural residential	0	0%	0	0%	0%	0	0%	0%
Commercial	343	12%	437	13%	27%	531	13%	55%
Institutional	135	5%	153	5%	14%	172	4%	27%
Industrial (light)	123	4%	208	6%	69%	292	7%	137%
Industrial (heavy)	147	5%	204	6%	39%	261	7%	78%
Wastewater Flows								
Average Day Flow (based on population increases only) m^3/d	43,351 (2001-2005)		46,819			48,553		
Average Day Flow (adjusted to reflect land use ratios) m^3/d	RMON Criteria[2]		2026 Area (ha) @ 21%	Difference (ha)	Flow (m3/d)	Build-out Area (ha) @ 43%	Difference	Flow (m3/d)
Commercial	24,750 L/ha/d		415	22	545	490	41	1,003
Institutional	10,000 L/ha/d		163	-10	-101	193	-21	-215
Industrial (light)	34,375 L/ha/d		149	59	2,019	176	116	3,993
Industrial (heavy)	34,375 L/ha/d		178	26	898	210	51	1,746
				Total Flow Difference (m3/d)	3,362		Total Flow Difference (m3/d)	6,528
			50,181			55,081		
Average DWF reported in MSP[1]	43,291		62,350			75,700		

1 - Includes contributions from both inside and outside urban boundary
2 - Project Design and Technical Specifications Manual, February 2005.

Table 4b)
NE Wastewater Servicing Study
Port Dalhousie WWTP Average Day Flows

Existing Rated Capacity 61,350 m^3/day
Existing Peak Flow Capacity 100,000 m^3/day

Population & Land Use	Existing		2026			Build-out		
					Increase from Existing (%)			Increase from Existing (%)
Population (from HMM memo)	83,205		89,580		8%	93,512		12%
Total Land Use (ha)	2,766		3,357		21%	3,947		43%
		Proportion of Total Land Use (%)		Proportion of Total Land Use (%)			Proportion of Total Land Use (%)	
Urban residential	2,018	73%	2,355	70%	17%	2,692	68%	33%
Rural residential	0	0%	0	0%	0%	0	0%	0%
Commercial	343	12%	437	13%	27%	531	13%	55%
Institutional	135	5%	153	5%	14%	172	4%	27%
Industrial (light)	123	4%	208	6%	69%	292	7%	137%
Industrial (heavy)	147	5%	204	6%	39%	261	7%	78%
Wastewater Flows								
Average Day Flow (based on population increases only) m^3/d	**43,351** (2001-2005)		**46,819**			**48,553**		
Average Day Flow (adjusted to reflect land use ratios) m^3/d	**MSP Working Paper Criteria**		**2026 Area (ha) @ 21%**	**Difference (ha)**	**Flow (m3/d)**	**Build-out Area (ha) @ 43%**	**Difference**	**Flow (m3/d)**
Commercial	20,000 L/ha/d		415	22	441	490	41	811
Institutional	10,000 L/ha/d		163	-10	-101	193	-21	-215
Industrial (light)	10,000 L/ha/d		149	59	587	176	116	1,162
Industrial (heavy)	20,000 L/ha/d		178	26	523	210	51	1,016
				Total Flow Difference (m3/d)	**1,450**		**Total Flow Difference (m3/d)**	**2,773**
			48,269			**51,326**		
Average DWF reported in MSP[1]	**43,291**		**62,350**			**75,700**		

1-Includes contributions from both inside and outside urban boundary

the population breakdown shows a slight increase, it can be seen that the land use increases are more considerable.

Table 3 - Population and Land Use Projections for Port Dalhousie WPCP System

Population & Land Use	Existing	2026	Built-Out
Population (Persons)	**74,406**	**88,024**	**99,539**
Land Use (Hectares)			
Urban Residential	2,017.9	2,354.7	2,691.5
Rural Residential	0	0	0
Commercial	342.7	436.7	530.6
Institutional	135.1	153.4	171.7
Industrial (Light)	123.1	207.7	292.2
Industrial (Heavy)	147.0	204.0	261.0
Total	**2765.8**	**3,356.5**	**3.947.0**

Traffic zones, 169, 170, and 171, located outside the urban boundary, south of St. Catharines, were considered as contributing to the Port Dalhousie network and were included in the computer model for future conditions. Traffic zones 184, 185 and 186 are located outside the Urban Area Boundary and will not be serviced, while traffic zones 188 and 189 will be serviced by the Welland System. Table 4 shows a breakdown of population and land use projections by service areas of the pumping stations.

Table 4 – Population and Land Use Projections By Pumping Stations

Serviced Population & Land Use	Existing	2026	Built-Out
October Village Pumping Station			
Population (Persons)	**2,133**	**1,985**	**1,985**
Land Use (Hectares)			
Urban Residential	53	---	54
Rural Residential	0	0	0
Commercial	5.4	---	5.4
Institutional	0	0	0
Industrial (Light)	0	0	0
Industrial (Heavy)	0	0	0
Total:	**58.4**	**0.0**	**59.4**
Cole Farm Pumping Station			
Population (Persons)	**2,005**	**1,774**	**1,774**
Land Use (Hectares)			
Urban Residential	58	59	59
Rural Residential	0	0	0
Commercial	0.55	0.55	0.55
Industrial (Light)	0	0	0
Industrial (Heavy)	0	0	0
Institutional	0	0	0
Total:	**58.55**	**59.55**	**59.55**

Table 4 – Population and Land Use Projections By Pumping Stations

Serviced Population & Land Use	Existing	2026	Built-Out
Renown Road Pumping Station			
Population (Persons)	18,264	21,616	21,616
Land Use (Hectares)			
Urban Residential	609	718	718
Rural Residential	0	0	0
Commercial	19	34	34
Industrial (Light)	73	106	106
Industrial (Heavy)	0	0	0
Institutional	94	119	119
Total:	795	977	977

5. Wastewater Flow Projections

Based on the information provided in the 1997 Wastewater Master Servicing Plan, the following design parameters were used in the calculations of dry and wet weather flows for future development areas after 2002:

- Unit flow rate for future residential use = 320 Litres/capita/day
- Unit flow rate for commercial use = 20,000 Litres/hectare/day
- Unit Flow rate for institutional use = 10,000 Litres/hectare/day
- Unit flow rate for heavy industrial use = 20,000 Litres/hectare/day
- Unit flow rate for light industrial use = 10,000 Litres/hectare/day
- Unit flow rate for base infiltration = 8,000 Litres/hectare/day
- Peaking factor for dry weather flow = 1.5 to 3.0

For existing urban areas, the dry and wet weather flows established with flow monitoring data collected in 2000 and 2001 were used for the analysis. These flow monitoring data were collected by the City of St. Catharines and the Region of Niagara.

It is assumed that future developments will have completely separated storm and sanitary sewer, and will not contribute wet weather flow to existing combined/sanitary sewer systems. There will be an increase in storm water runoff, but the volume of wet weather inflow/infiltration entering the sanitary is expected to be minimal. However, for conservative design of new sewers, infiltration for future developments has been included based on recommended design values from the Wastewater Master Servicing Plan.

Table 5 summarizes the dry weather flows applied in the model for areas inside and outside of the urban boundary limits respectively. The breakdown of the land use contribution outside the Port Dalhousie WPCP system urban boundary can be found on Figure 5.

Table 5 – Wastewater Flow Projections for Port Dalhousie WPCP System

Wastewater Facility	Existing	2026	Built-Out (2051)
	Ave DWF (L/s)	Ave DWF (L/s)	Ave DWF (L/s)
Internal Urban Boundary	422.69	516.20	564.93
Land Use Contribution Outside Urban Boundary	78.36	205.44	311.23
Total Flow	501.05	721.64	876.16

Table 5
NE Wastewater Servicing Study
WWTP Average Day Flows

	Average Day Flow (m^3/day)		
	Existing	**2026**	**Build-out**
Niagara Falls WWTP			
Existing rated capacity 68,200 m^3/day			
Existing peak flow capacity 136,400 m^3/day			
2001 - 2005	54,577		
MSP Working Paper	65,536	93,666	120,412
Based on Population Increase only		68,767	72,587
Based on Population Increase Adjusted for Land Use Ratios			
RMON Criteria		77,350	89,709
MSP Working Paper Criteria		**72,424**	**79,891**
Port Weller WWTP			
Existing rated capacity 56,180 m^3/day			
Existing peak secondary flow capacity 112,360 m^3/day			
Existing peak primary flow capacity 136,200 m^3/day			
2001 - 2005	42,286		
MSP Working Paper	39,730 - 44,981	56,640	64,400
Based on Population Increase only		46,515	48,629
Based on Population Increase Adjusted for Land Use Ratios			
RMON Criteria		57,786	71,160
MSP Working Paper Criteria		**49,348**	**54,290**
Port Dalhousie WWTP			
Existing rated capacity 61,350 m^3/day			
Existing peak secondary flow capacity 100,000 m^3/day			
2001 - 2005	43,351		
MSP Working Paper	43,291	62,350	75,700
Based on Population Increase only		46,819	48,553
Based on Population Increase Adjusted for Land Use Ratios			
RMON Criteria		50,181	55,081
MSP Working Paper Criteria		**48,269**	**51,326**

Appendix I
NE Servicing Study Executive Summary

Executive Summary

The Regional Municipality of Niagara (the Region) has identified through a number of prior studies that wastewater flows in Niagara Falls, St. Catharines/Thorold and Niagara-on-the-Lake (NOTL) are approaching capacity of some Regional linear and facility infrastructure. In addition, there are wet weather flow issues and combined sewer overflows (CSOs) in the individual municipalities in the Region. The studies have been carried out over the last 30 years but the most recent overall assessment of the region's wastewater systems was contained in the Region's Master Servicing Plan (MSP) Update (2003). Collectively, the previous studies have identified a large number of options to meet present and future wastewater servicing needs.

Recognizing that some of the most pressing issues are in the Cities of Niagara Falls, St. Catharines and Thorold, and the Town of Niagara-on-the-Lake (collectively known as the Northeast Area [NE Area]), the Region engaged Hatch Mott MacDonald Ltd. (HMM), with its subconsultant XCG consultants (XCG), to carry out a wastewater servicing study for the NE Area. The objective of the study was to evaluate existing infrastructure, and address existing and future requirements for both dry weather and wet weather flows. It was also to follow the Municipal Class EA process for Master Plans and satisfy Phases 1 and 2 of that process.

The municipalities within the NE Area are presently serviced by the following wastewater treatment plants (WWTPs):

Niagara Falls WWTP	Niagara Falls, Chippawa and St. David's (NOTL)
Port Dalhousie WWTP	West St. Catharines and part of north Thorold
Port Weller WWTP	East St. Catharines, west NOTL and east Thorold
NOTL WWTP	NOTL and Virgil (NOTL)
Queenston WWTP	Queenston (NOTL)

The southernmost part of Thorold, including Port Robinson, will be serviced by the Welland WWTP and did not form part of the study area.

The populations of all the municipalities in the NE Area are forecast to increase during the next 20 years. In some municipalities, that growth will be relatively modest; for example, St. Catharines where development has largely reached the limits of the designated urban area. Under the requirements of the Province of Ontario's Greenbelt Plan, expansion of the present designated urban area will not be permitted, and any population growth will be due to intensification within the existing urban area. In other municipalities, significant growth will be occurring in certain parts of the municipality but not in others; for example, growth in Niagara Falls is anticipated to occur largely in the southern part of the city, with relatively little in the northern part. Some of the smaller municipalities (e.g., St. David's and NOTL/Virgil) will experience population increases which, although relatively small in absolute terms, represent substantial growth of the present population of those municipalities. Significant growth areas in the NE Area include southwest Niagara-on-the-Lake (Glendale), East and North Thorold, South Niagara Falls/Chippawa, St. David's and Virgil/NOTL:.

- In south Niagara Falls/Chippawa, the majority of the population increase is forecast to occur within the High Lift Pumping Station (HLPS) sewershed; within that area the serviced population is to increase by 70% (19,000 people). However, the relative population increase within the overall Niagara Falls WWTP service area is less (25% or 22,000 people).

- East Thorold and SW NOTL – Both these areas are within the Port Weller WWTP sewershed. The population serviced by this WWTP is forecast to increase by 10% (8,100 people).
- North Thorold lies within Port Dalhousie WWTP sewershed and the population serviced by that WWTP is forecast to increase by 7%.
- In St. Davids the population increase is forecast to be 150% (1,900 people)
- In Virgil/NOTL the population increase is forecast to be 40% (4,200 people).

Such growth will place additional demands on the present wastewater systems by

- increasing dry weather flows
- causing greater wet weather impacts due to a reduction in the available capacity in the collections system and WWTPs from the increased dry weather flows, and more infiltration due to an increased servicing area.

To recognize and incorporate the factors and considerations noted above, the following Problem/Opportunity Statement was developed in cooperation with Regional staff:

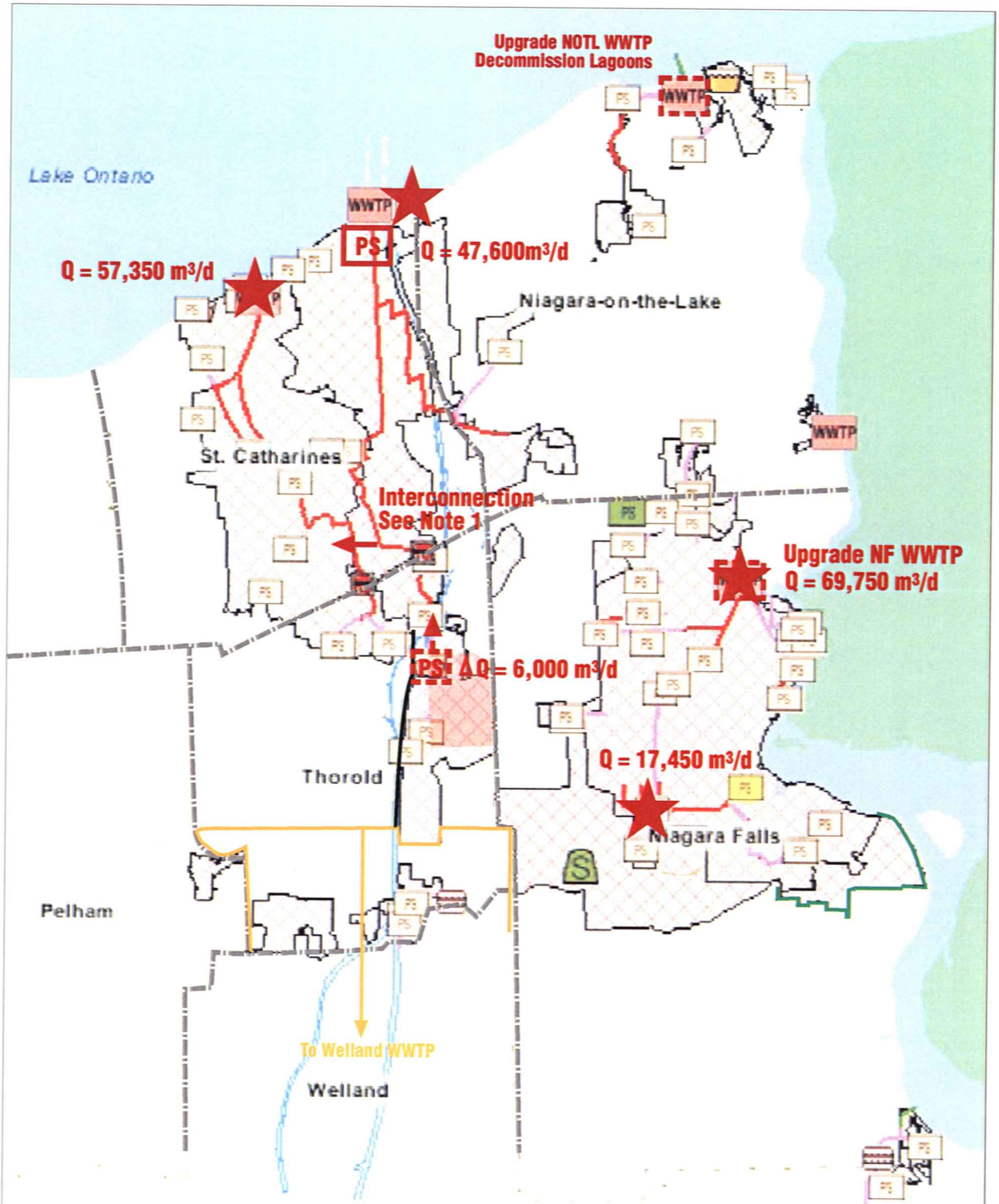
> "The NE Area Wastewater Servicing Study is to identify measures to:
> 1) Meet the wastewater servicing needs of NE Area to 2026
> 2) Treat both dry and wet weather flows to an acceptable level
> 3) Achieve 1) and 2) with least possible impacts to affected communities and the environment, and at the least possible cost."

During the course of the study, it became apparent that there is a wide difference in future average day flows (ADF) at the WWTPs as forecast in the MSP Update, compared to those which could be expected from likely population increases. A rationale to arrive at ADF estimates for use in this study was developed and reviewed with the Region. These estimates indicate that, at 2026, based on existing services areas for the WWTPs (i.e., no diversion of wastewater flow between sewersheds):

- the rated capacity of NF WWTP will have been exceeded (by approximately 2021)
- the rated capacity of NOTL WWTP will have been exceeded (by approximately 2013)
- there will be spare capacity remaining at Port Dalhousie WWTP (21%)
- there will be spare capacity remaining at Port Weller WWTP (12%)
- wet weather flows will continue to exceed peak capacities at all WWTPs except Queenston.

In the Request for Proposal (RFP) for the NE Area Wastewater Servicing Study, the Region presented fifteen concepts for servicing part or all of the NE Area. These concepts had been developed through either previous studies or internal assessment by the Region. Those 15 concepts noted in the RFP were taken as a starting point in developing a long list of alternatives for this study. As part of the study's initial activities, HMM/XCG identified a further nine concepts or subconcepts. Therefore, in total, a 'Long List' of 24 concepts and subconcepts were identified and evaluated. It should be noted that each concept in the Long List does not provide a complete solution to the future servicing needs of the NE Area. The majority just address a particular need or constraint within one area of the wastewater systems. Therefore, the various concepts have to be combined to provide complete servicing alternatives for the NE Area.

Final evaluation of the Long List of concepts and selection of the short list of alternatives was carried out in Workshop #1 with Regional staff.



< 500	New Infrastructure
500 - 1500	Upgraded Existing Infrastructure
1500 - 2500	Wet Weather Flow Facility
2500 - 3500	PS Pump Station
> 3500	

Note:
1. Interconnection from PW trunk to PD trunk systems for occasional maintenance or operational purposes

Figure ES1
NE Area Wastewater Servicing Study
Alternative D

XCG
Hatch Mott MacDonald

During the workshop, it became apparent that there were key choices in combining the concepts to form alternatives which would fully address the NE Area servicing needs. These are as follows:

- Expand existing Niagara Falls WWTP versus new South Niagara Falls WWTP.
- East Thorold servicing to either Port Weller or new South Niagara Falls WWTP.
- NOTL servicing via either an upgrade of the existing treatment system (including decommissioning of the lagoons) versus servicing to Port Weller WWTP.
- St. Catharines servicing via wet weather flow facilities (WWFFs) at existing plants, or new WWFF on east side of Welland Canal.

A Short List of three Alternatives (A, B and C) were selected in the workshop for further evaluation. Estimates of future wastewater flows and modeling of wastewater systems were then carried out to refine Alternatives A, B and C, by determining required WWTP capacity increases, sizing new WWTPs or WWFFs, and identifying constraints within the collection systems.

Each Alternative was evaluated with respect to:

- Satisfaction of objectives
- Surface and groundwater impacts
- Natural environment impacts
- Socio-economic impacts
- Technical considerations
- Site considerations
- Costs.

The evaluation of Alternatives A, B and C was then reviewed in Workshop #2 with the Region.

Evaluation of the short-listed Alternatives indicated a preference for Alternative B largely because it preserves and utilizes existing WWTP capacities, provides the maximum flexibility for St. Catharaines/Thorold growth, and has the least socio-economic impacts. Other conclusions from the evaluation included:

- The Glendale Siphon has sufficient capacity for at least 20 years.
- The Peel Street PS has just enough capacity for the next 20 years and it was therefore considered to require expansion within the planning period of the study.
- For operational flexibility, an interconnection between the Port Weller and Port Dalhousie trunks should be provided.

Using Alternative B as a starting point, means to improve upon it further were investigated. Consequently, Alternative D (Figure ES1) was developed in which the major elements are:

- Upgrade NOTL WWTP and replace the existing lagoons (6,900 m^3/day rated capacity with nitrification)
- WWFF at Port Weller East (47,600 m^3/day)
- WWFF at Port Dalhousie WWTP (57,350 m^3/day)
- WWFF at Niagara Falls HLPS (17,450 m^3/day)
- Upgrade Niagara Falls WWTP to 72,400 m^3/day ADF rated capacity with nitrification
- WWFF at Niagara Falls WWTP (69,750 m^3/day).

The estimated cost of Alternative D is $100M.

The anticipated commissioning date, Municipal Class EA Schedule and capital cost for each component of Alternative D are presented in Table ES.1. For the next 5-year period (2008 - 2012), these are presented on an annual basis. For the remaining periods (2013 - 2017, 2018 - 2022 and 2023 – 2026), overall costs for the entire time are presented. It is anticipated that future Master Planning studies or Municipal Class EAs will provide further details of requirements within those periods at the appropriate time.

Two items of particular note for consideration by the Region are as follows.

(a) Niagara-on-the-Lake Servicing Options

The present NOTL WWTP will reach its capacity by 2013, i.e., within the next 6 years. Also, Parks Canada and the Town of Niagara-on-the-Lake have approached the Region about using the present NOTL WWTP site for tourism events planned for 2012, which would require that the site (WWTP including lagoons) be decommissioned by that time. It is therefore important that a preferred servicing strategy for NOTL be identified as soon as possible. In an attempt to achieve this, a number of variants of Alternative D, applying different approaches to servicing NOTL, were developed, as follows:

- Alternative D – upgrading of the existing NOTL WWTP and decommissioning of the existing lagoons
- Alternative D1 – conveyance of peak dry weather flows from NOTL to the Port Weller WWTP. Storage tanks for wet weather flows would be provided at the Lakeshore Road and Garrison Village PSs, and an expanded tank at the William St. PS.
- Alternative D2 – conveyance of peak dry weather flows from NOTL to the Port Weller WWTP. A centrally located HRT facility would be provided for wet weather flows.
- Alternative D3 – conveyance of peak dry weather flows from NOTL to the Port Weller WWTP, and conveyance of wet weather flows to the Port Weller East WWFF.

Each of these Alternatives has respective advantages and disadvantages, in particular with regard to socio-economic impacts, decommissioning of the present NOTL WWTP and lagoon site, and operational issues and costs. All the Alternatives have approximately the same capital cost (within 5%). A definitive decision cannot be made at this time as to which of Alternatives D, D1, D2 or D3 is preferred. It is therefore recommended that the Terms of Reference for the Municipal Class EA for NOTL Wastewater Servicing include options for both an upgraded WWTP in NOTL and conveyance of at least part of NOTL wastewater flows to the Port Weller WWTP. The location of the new NOTL WWTP, should that be the option selected, will be determined as part of the Municipal Class EA process. Given the limited capacity remaining at the existing NOTL WWTP to service future development, and the recent interest by Parks Canada in redeveloping the present WWTP and lagoons site, the Municipal Class EA should be initiated as soon as possible in 2008.

(b) Wastewater Servicing Beyond 2026

It is prudent for the Region at this time to also consider likely growth in the NE Area beyond 2026 and what implications this may have for future servicing.

Growth below the Niagara Escarpment will likely continue to be constrained by the requirements of the Greenbelt Plan, which makes it less probable that urban boundary expansion in St. Catharines and NOTL will be permitted. Some population growth in St. Catharines due to intensification will occur but the increase in wastewater flows is anticipated to be relatively minor as the areal extent of the collection system will remain the same. Present population forecasts indicate that NOTL will have reached its

Build-Out population by 2026. Therefore, it is more likely that any significant growth will occur in Thorold and the southern part of Niagara Falls.

The conclusion of this study has been that maximizing the use of existing infrastructure and remaining capacity at the Region's existing WWTPs is the most effective, flexible and cost-effective means of providing wastewater servicing of the NE Area until 2026, and has the least socio-economic impacts. However, beyond that date, development patterns may favour reconsideration of a new WWTP to service South Niagara Falls and East Thorold. The Region may therefore wish to consider purchase of suitable land in that area in the near future before extensive development occurs, and it becomes more difficult to obtain such property. This would allow the Region to select a location appropriate for a WWTP now, rather than be forced into accepting a location which is less desirable and may have greater impacts on adjoining communities at some time in the future.

Table ES.1
Anticipated Implementation Schedule

Year	Project	Capital Cost ($M)	Average Capital Cost per Year ($M)	Class EA Schedule
2008	Initiate Class EA for NOTL WWTP Upgrade	0.4	0.4	C
2009	Initiate Final Design for NOTL WWTP Upgrade	1.0	1.0	
2010	Initiate Construction of NOTL WWTP Upgrade	1.6	1.6	
2011	Construction of NOTL WWTP	12.0	12.0	
2012	Construction and commissioning of NOTL WWTP	8.0	8.0	
	Subtotal	**23.0**		
2013 – 2017	WWFF at Port Dalhousie WWTP	15.8		B
	Port Weller East WWFF and WWTP PS Upgrade	9.1		C
	Interconnection between PW and PD Trunk Sewer Systems	1.3		A
	Initiate Class EA and Design of NF WWTP Upgrade and WWFF	6.2		C
	Subtotal	**32.4**	**6.5**	
2018 – 2022	Construction and Commissioning of Niagara Falls WWTP Upgrade and WWFF	35.2		
	Subtotal	**35.2**	**7.0**	
2022 – 2026	HRT at Niagara Falls HLPS	5.2		C
	Peel Street PS Upgrade	4.3		B
	Subtotal	**9.5**	**1.9**	
	TOTAL	**100.1**		

Appendix J
AACE Cost Estimate Classification System

TABLE 8
AACE COST ESTIMATE CLASSIFICATION SYSTEM

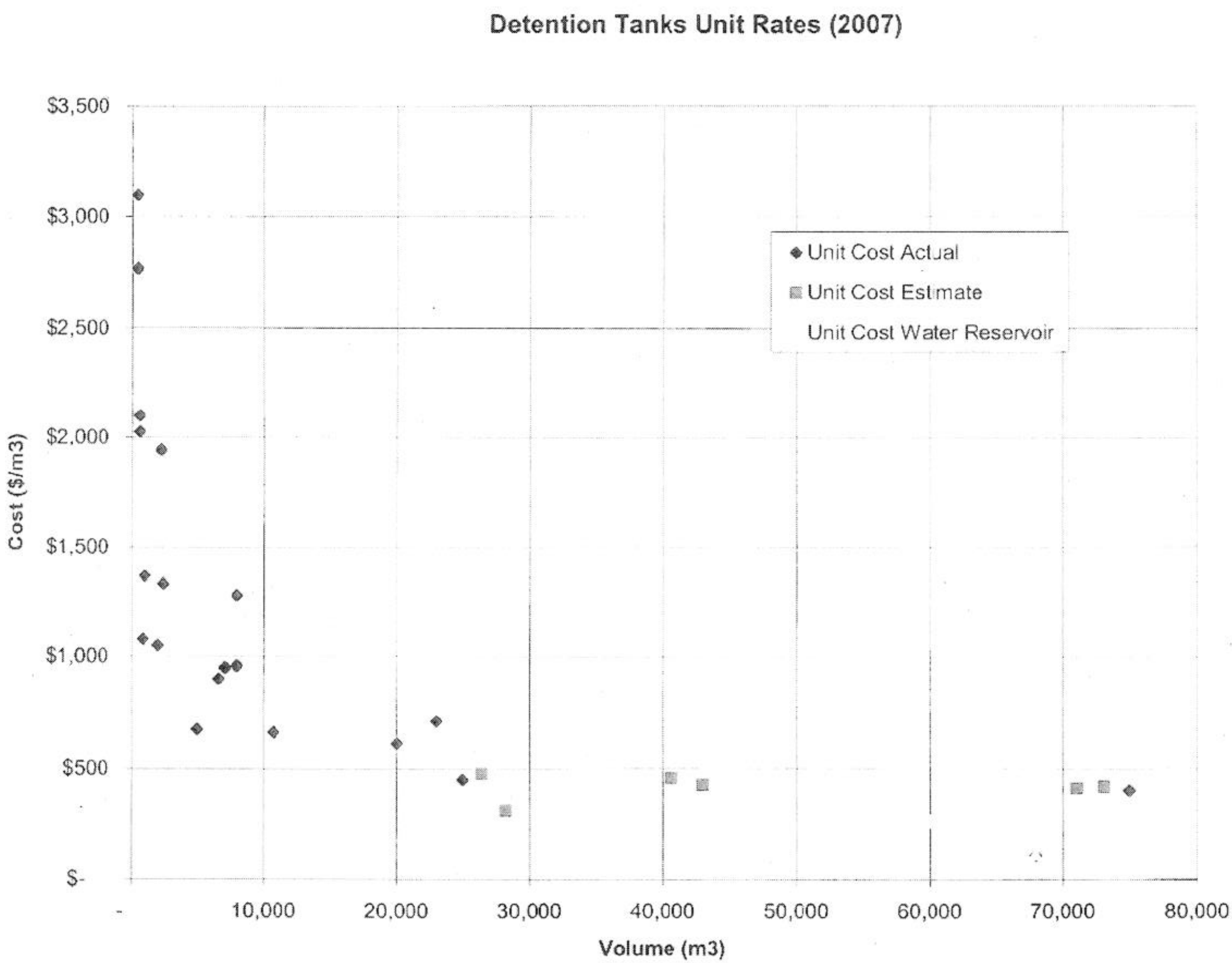
	Project Definition				AACE 17R & 18R Expected Accuracy		Suggested Contingency Range	
Estimate Class	Start	End	End Usage	Methodology	Low	High	Low	High
Class 5	0%	2%	Concept Screening	Capacity factor, Parametric Model, Judgment or Analogy	-50%	100%	30%	35%
Class 4	1%	15%	Study or Feasibility	Equipment Factored or Parametric Model	-30%	50%	25%	30%
Class 3	10%	40%	Budget, Authorization, or Control	Semi-Detailed Unit Cost with Assembly Level Line Items	-20%	30%	15%	25%
Class 2	30%	70%	Control or Bid/Tender	Detailed Unit Costs with Forced Detailed Take-off	-15%	20%	10%	15%
Class 1	50%	100%	Check Estimate or Bid/Tender	Detailed Unit Costs with Detailed Take-off	-10%	15%	5%	10%

DETENTION TANKS

	CONTRACT	VOLUME (m^3)	2007 Unit Cost Actual ($/$m^3$)	2007 Unit Cost Estimate ($/$m^3$)	2007 Unit Cost Water Reservoirs ($/$m^3$)	CONTRACT YEAR	Contract Value * (1996)	PRESENT VALUE (1997)	PRESENT VALUE (2005)	PRESENT VALUE (2007)	SOURCE	COMMENTS
1	Eastern Beaches Tank -CSO	2,250	$ 1,944			1989	$ 2,915,500	$ 2,945,000	$ 3,975,750	$ 4,373,325	CH2M Gore & Storrie	
2	Eastern Beaches II - CSO	8,000	$ 1,275			1994	$ 6,800,000	$ 6,868,000	$ 9,271,800	$ 10,198,980	CH2M Gore & Storrie	(Includes piles, cleaning sys)
3	Glendonwynne/Glen Lake -Storm	850	$ 1,080			1991	$ 612,000	$ 618,000	$ 834,300	$ 917,730	MacViro	
4	Don Trunk - Godfrey Fowler -CSO	40,660		$ 456			$ 12,375,000	$ 12,499,000	$ 16,873,650	$ 18,561,015	Est. Don Trunk Report	
5	Don Trunk - Victoria Park 1 -CSO	26,410		$ 478			$ 8,410,000	$ 8,494,000	$ 11,466,900	$ 12,613,590	Est. Don Trunk Report	
6	Don Trunk - Massey Creek -CSO	28,250		$ 312			$ 5,880,000	$ 5,939,000	$ 8,017,650	$ 8,819,415	Est. Don Trunk Report	
7	Don Trunk - North Toronto -CSO	71,080		$ 410			$ 19,425,000	$ 19,619,000	$ 26,485,650	$ 29,134,215	Est. Don Trunk Report	
8	Don Trunk - Cadorna -CSO	73,080		$ 418			$ 20,370,000	$ 20,574,000	$ 27,774,900	$ 30,552,390	Est. Don Trunk Report	
9	Keele Street Tank - CSO	43,000		$ 426			$ 12,212,000	$ 12,334,000	$ 16,650,900	$ 18,315,990	Paul Thiel & Assoc.	(Designed/Not Constructed)
10	RedHill Creek Tank -CSO	68,000	$ 110			1988	$ 5,000,000	$ 5,050,000	$ 6,817,500	$ 7,499,250	City of Hamilton	Cut & Fill as W Reservoir
11	Strachan Tank -CSO	20,000	$ 610			1992	$ 8,140,000	$ 8,221,000	$ 11,098,350	$ 12,208,185	City of Hamilton	(Excl.disposal,contingency)
12	James Tank -CSO	2,000	$ 1,050			1992	$ 1,400,000	$ 1,414,000	$ 1,908,900	$ 2,099,790	City of Hamilton	
13	Devine Street CSO Tank, Sarnia, Ont.	10,740	$ 661			1995	$ 4,731,700	$ 4,779,000	$ 6,451,650	$ 7,096,815	CH2M Gore & Storrie	
14	City of Kingston - CSO	5,000	$ 675			1995	$ 2,250,000	$ 2,273,000	$ 3,068,550	$ 3,375,405	MacViro	(On Rock)
15	Hamilton - CSO	25,000	$ 448			1996	$ 7,470,000	$ 7,545,000	$ 10,185,750	$ 11,204,325	Thorburn Penny	
16	King Street CSO Tank- Hamilton	75,000	$ 400			1995	$ 20,000,000	$ 20,200,000	$ 27,270,000	$ 29,997,000	R.V. Anderson	
17	North Maple Reservoir -water	11,365			$ 135	1979	$ 1,021,000	$ 1,031,000	$ 1,391,850	$ 1,531,035	MacViro	
18	North Richmond Hill -water	22,700			$ 150	1978	$ 2,275,700	$ 2,298,000	$ 3,102,300	$ 3,412,530	MacViro	
19	Richmond Hill Reservoir -water	31,800			$ 158	1977	$ 3,350,400	$ 3,384,000	$ 4,568,400	$ 5,025,240	MacViro	
20	Maple Reservoir -water	45,500			$ 188	1978	$ 5,690,900	$ 5,748,000	$ 7,759,800	$ 8,535,780	MacViro-precast struct.	
21	Markham Reservoir -water	68,000			$ 118	1978	$ 5,347,500	$ 5,401,000	$ 7,291,350	$ 8,020,485	MacViro	
22	Owen Sound Reservoir - water	22,700			$ 262	1988	$ 3,200,000	$ 4,000,000	$ 5,400,000	$ 5,940,000	CH2M Gore & Storrie	
23	Region of Halton Appleby Line Reservoir - water	32,000			$ 211	1992	$ 4,200,000	$ 4,550,000	$ 6,142,500	$ 6,756,750	CH2M Gore & Storrie	
24	Belleville Utilities Commission North Pa Street - water	9,000			$ 437	1995	$ 2,600,000	$ 2,650,000	$ 3,577,500	$ 3,935,250	CH2M Gore & Storrie	
25	Town of Sturgeon Falls WTP Reservior	4,500			$ 413	1988	$ 1,000,000	$ 1,250,000	$ 1,687,500	$ 1,856,250	CH2M Gore & Storrie	
26	Region of Halton Upper Middle Road Reservoir	14,000			$ 394	1997	$ 3,710,000	$ 3,710,000	$ 5,008,500	$ 5,509,350	CH2M Gore & Storrie	Cost of P.S. $1,590,000 removed
27	Region of Niagara - Nixon Street Reservoir	5,000			$ 342	1995	$ 1,127,000	$ 1,150,000	$ 1,552,500	$ 1,707,750	CH2M Gore & Storrie	
28	Region of Halton - Rebecca SSO Tank	6,600	$ 900			1998		$ 4,000,000	$ 5,400,000	$ 5,940,000	Halton	~double concrete req./in rock
29	Owen Sound SSO Tank	1000	$ 1,366			2000		$ 920,000	$ 1,242,000	$ 1,366,200	Henderson Paddon	
30	Kingston - Emma Martin Park	8000	$ 958			2004			$ 6,966,000	$ 7,662,600	CH2M/XCG	add on $921,000 for contam material
31	Kingston - Collingwood St CSO/STM Tank	2400	$ 1,329			2004			$ 2,900,000	$ 3,190,000	CH2M/XCG	
32	Truman Tank -New Haven	23000	$ 712			2004	$12,400,000 US		$ 14,890,000	$ 16,379,000	CH2M HILL	US $ very poor soils (secant piles)
33	St Catharines - Kernahan CSO Tank	600	$ 2,026			2005	$ -		$ 1,105,356	$ 1,215,892	CH2M HILL HILL	pre-cast or cast-in-place = cast-in-place; 40ft excavation
	St Catharines - Welland/Ontario CSO Tank	7080	$ 949			2006			$ 6,400,000	$ 6,720,000	CH2M HILL HILL	
34	Markham PD6 Reservoir	60000			$ 266	2005			$ 14,500,000	$ 15,950,000	CH2M HILL HILL	
35	Peel - Lakeview reservoir	25000			$ 293	2003			$ 6,650,000	$ 7,315,000		
36	Sydenham/Sullivan CSO tank - Thorold	400	$ 2,770			2007			$ 1,108,000	$ 1,108,000	Genivar	
37	Delaware/Sullivan CSO tank - Thorold	400	$ 3,100			2007			$ 1,240,000	$ 1,240,000	Genivar	
38	Lawrence/Collier CSO tank - Thorold	600	$ 2,102			2007			$ 1,261,000	$ 1,261,000	Genivar	

Water Reservoirs

11,365	$ 122
22,700	$ 137
31,800	$ 144
45,500	$ 171
68,000	$ 107
22,700	$ 238
32,000	$ 192
9,000	$ 398
4,500	$ 375
14,000	$ 358
5,000	$ 311
60000	$ 242
25000	$ 266



Detention Tanks Unit Rates (2007)
Unit Cost Actual
Unit Cost Estimate
Unit Cost Water Reservoir
Cost ($/m3)
$3,500
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$-
-
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
Volume (m3)

CITY OF S

ITEM	UNIT	PRICES	QUANT	COST	QUANT	COST	QUANT	COST	QUANT	COST	QUANT	COST	QUANT	COST	QUANT	COST	QUANT	COST
		UNIT	1 laterals every 10m200mm dia san	1 laterals every 10m250mm dia san	1 laterals every 10m300mm dia san	1 laterals every 10m375mm dia san	1 laterals every 10m450mm dia san	1 laterals every 10m525mm dia san	1 laterals every 10m600mm dia san	1 laterals every 10m750mm dia san										
DEPTH			2.5		2.5		2.5		2.5		2.5		2.5		2.5		2.5	
GRANULAR A		$16.00	12.6	$201.60	12.6	$201.60	12.6	$201.60	12.6	$201.60	12.6	$201.60	12.6	$201.60	12.6	$201.60	12.6	$201.60
				$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00
900mmD		$900.00																
825mmD		$830.00																
750mm D SANITARY	m	$900.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00	1	$900.00
675mm D SANITARY	m	$830.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00
600mm D SANITARY	m	$775.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00	1	$775.00		$0.00
525mm D SANITARY	m	$725.00		$0.00		$0.00		$0.00		$0.00		$0.00	1	$725.00		$0.00		$0.00
450mm D SANITARY	m	$675.00		$0.00		$0.00		$0.00		$0.00	1	$675.00		$0.00		$0.00		$0.00
375mm D SANITARY	m	$275.00		$0.00		$0.00		$0.00	1	$275.00		$0.00		$0.00		$0.00		$0.00
300mm D SANITARY	m	$220.00		$0.00		$0.00	1	$220.00		$0.00		$0.00		$0.00		$0.00		$0.00
250mm D SANITARY	m	$210.00		$0.00	1	$210.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00
200mm D SANITARY	m	$200.00	1	$200.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00
2400mm D MH	ea	$9,000.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00
1800mm D MH	ea	$7,000.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00
1500mm DMH	ea	$6,000.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00	0.013	$80.00
1200mm D MH	ea	$5,000.00	0.013	$66.67	0.013	$66.67	0.013	$66.67	0.013	$66.67	0.013	$66.67	0.013	$66.67	0.013	$66.67		$0.00
RECONNECT LATERALS	ea	$320.00	0.1	$32.00	0.1	$32.00	0.1	$32.00	0.1	$32.00	0.1	$32.00	0.1	$32.00	0.1	$32.00	0.1	$32.00
LATERALS	m	$125.00	0.5	$62.50	0.5	$62.50	0.5	$62.50	0.5	$62.50	0.5	$62.50	0.5	$62.50	0.5	$62.50	0.5	$62.50
CURB	m	$90.00	1	$90.00	1	$90.00	1	$90.00	1	$90.00	1	$90.00	1	$90.00	1	$90.00	1	$90.00
HL8 TRENCH (2m WIDTH)	sq m	$40.00	2	$80.00	2	$80.00	2	$80.00	2	$80.00	2	$80.00	2	$80.00	2	$80.00	2	$80.00
MILL AND OVERLAY HL3	sq m	$40.00	4	$160.00	4	$160.00	4	$160.00	4	$160.00	4	$160.00	4	$160.00	4	$160.00	4	$160.00

Sub-total
Budget

Outfall Location	System	Overall Rank	Outfall Node ID	Outfall Link ID	Storage Req'd (m^3)	2 Year Design Storm Rounded (m3)	Peak Flow* (L/s)	Rounded (L/s)	Planning Level Cost Estimate Storage 2007 Unit Cost ($/$m^3$)	2008 Unit Cost ($/$m^3$)	2008 with Contingencies	Capital Cost	Influent Works Cost Allowance	O&M
Carlton & Ontario	Port Dalhousie	1	1651	1651P	8681	8680	2683	2680	$1,000	$1,100	$1,320	$11,457,600	$1,145,760	$30,000
Westchester & O.W. Canal	Port Dalhousie	2	5057	5057P	2872	2870	760	760	$1,500	$1,650	$1,980	$5,682,600	$568,260	$30,000
Hartzel & CNR Line	Port Weller	3	OF3405	DP3405	4115	4110	1609	1610	$1,000	$1,100	$1,320	$5,425,200	$542,520	$30,000
Renown Rd PS	Port Dalhousie	4	2253	2253P	4299	4300	502	500	$1,000	$1,100	$1,320	$5,676,000	$567,600	$30,000
Eastchester PS	Port Dalhousie	5	5851	5851P	1345	1340	319	320	$2,000	$2,200	$2,640	$3,537,600	$353,760	$30,000
Wedsworth & Hastings	Port Weller	6	OF4302	PW4352	1788	1790	766	770	$2,000	$2,200	$2,640	$4,725,600	$472,560	$30,000
Thomas Street, Henry & Beech	Port Dalhousie	7	1670	1670P	4472	4470	2358	2360	$1,000	$1,100	$1,320	$5,900,400	$590,040	$30,000
Michigan Avenue	Port Dalhousie	8	150	150P	1617	1620	810	810	$2,000	$2,200	$2,640	$4,276,800	$427,680	$30,000
Forster & Linwell	Port Weller	9	OF457	pw456	91	90	41	40	$3,000	$3,300	$3,960	$356,400	$35,640	$30,000
Parkway & O.W. Canal	Port Dalhousie	10	5150	5150P	1886	1890	1551	1550	$2,000	$2,200	$2,640	$4,989,600	$498,960	$30,000
Oakdale & Marren	Port Weller	10	OF3498	HP3498	636	640	159	160	$2,500	$2,750	$3,300	$2,112,000	$211,200	$30,000
Burleigh Hill & Glendale	Port Weller	10	OF4202	PW4252	377	380	61	60	$3,000	$3,300	$3,960	$1,504,800	$150,480	$30,000

Unit Cost Breakdown

Storage	2007 Unit Cost (/m^3)
0 - 500	$3,000
500 -1000	$2,500
1000 - 2000	$2,000
2000 - 4000	$1,500
> 4000	$1,000

O&M Costs

- assumed $30,000 for each storage facility

* Peak flow was calculated to determine feasibility of HRT, which has been removed from list of alternatives.

2008 04 07

Appendix K
Public Consultation

CH2M HILL Canada Limited
255 Consumers Road
Toronto, Ontario M2J 5B6
Tel 416.499.9000
Fax 416.499.4687

Name
Address
Address

Re: **Class Environmental Assessment Master Plan**
St. Catharines and Thorold Pollution Control Plan Update

CH2M HILL Canada Limited has been retained to assist the Cities of St. Catharines and Thorold, together with the Regional Municipality of Niagara to complete a Class Environmental Assessment (EA) Master Plan Update for the urban areas of St. Catharines and Thorold. This study is being conducted in accordance with the requirements for Master Plan projects as described in the Municipal Engineers Association's Class EA document (June 2000).

The purpose of this Class EA Master Plan is to develop a roadmap for infrastructure projects that will address capacity constraints, receiving water pollution control and assist the municipalities with their goal of meeting the Ministry of the Environment guidelines for Combined Sewer Overflow management.

At this time, we wish to confirm the nature and extent of your interest in this study, and whether you are interested in reviewing information as it is made available, and/or the Master Plan Report, which will be available at the completion of the study. If you wish to continue your participation in this study, please contact the undersigned at the above address, by telephone at 416-499-0090, ext. 346, or via e-mail at Sabrina.Coletti@ch2m.com.

Sincerely,

CH2M HILL Canada Limited

Sabrina Coletti, MCIP, RPP
Environmental Planner

	Last Name	First Name	Title	Agency	Address		phone	fax
Ms.	Arthur	Jennifer	Environmental Assessment and Planning Coordinator	Ministry of the Environment	119 King Street West, 12th Floor, Hamilton ON L8P 4Y7		T (905) 52	F (905) 52
Mr.	Bentley	Kevin	Manager, Engineering Office	Ministry of Transportation	659 Exeter Road	London ON N6E 1L3		
Mr.	Bice	John	City Clerk	City of Thorold	P.O. Box 1044, 3540 Schmon Parkway	Thorold, ON L2V 4A7		
Mr.	Boswell	Don	Senior Claims Analyst, Specific Claims Branch	Department of Indian and Northern Affairs	10 Wellington St., Room 1310	Gatineau QC K1A 0H4		819-956-22
Mr.	D'Amario	Tony	General Manager/Secretary Treasurer	Niagara Conservation Authority	250 Thorold Road West, 3rd Floor, Welland, ON L3C 3W2			
Ms.	Cavanaugh	Ellie	Agriculture and Rural Rep.	Ministry of Agriculture, Food and Rural Affairs	Advisory Services Building, Vineland Station, ON L0R 2E0			
Mr.	Chrzan	Tom	Manager, Central Region	Ministry of Citizenship and Immigration, Culture, Tourism and Recreation	180 Dundas Stree West, Suite 502	Toronto Ontario, M7A 2R9		
Mr.	Conlon	John	District Trades Supervisor - Civil	Ontario Hydro, Decew District Office	Lockhart Drive	St. Catharines, ON L2R 7E3		
	Coplen	Larry	Fire Chief	City of Thorold	P.O. Box 1044, 3540 Schmon Parkway	Thorold, ON L2V 4A7		
Mr.	Crawford	R.E.	Manager, Planning and Transportation	District School Board of Niagara	191 Carlton Street	St. Catharines, ON L2R 7P4		
Ms.	Dirks	Tija	Director Growth Policy, Planning and Analysis	Ontario Growth Secretariat	777 Bay Street, 16th Floor,	Toronto, Ontario M5G 2E5		
Mr.	Dobos	Rob	Head, EA Section	Environment Canada – Ontario Region	P.O. Box 5050 867 Lakeshore Road, Burlington, ON M7R 4A6			
Mr.	Douglas	Jeremy	Environmental Assessment Coordinator	Ontario Realty Corporation	11th Floor, Ferguson Block, 77 Wellesley Street West, Toronto, ON M7A 1N3			
Mr.	Durst	Joe	Area Manager	Ministry of Natural Resources - Niagara Office	P.O. Box 5000 4890 Victoria Avenue North, Vineland Station ON L0R 2E0			
Mr.	Durward	Andrew	Distribution Engineer	St. Catharines Hydro	Box 3038 - 340 Vansickle Road	St. Catharines, ON L2R 6P7		
Mr.	Farrow	Bob	Manager	Ministry of Tourism, Culture and Recreation	530 Temblay Road, 1st Floor, Ottawa, ON K1G 6B7			
Mr.	Ferris	Neal	Regional Archaeologist/Heritage Planner	Ministry of Citizenship Culture and Recreation	55 Centre Street, London ON N6J 1T4			
Mr.	Frawley	Mark	Director	Niagara Escarpment Commission	232 Guelph Street	Georgetown, ON L7G 4B1		
	Goldsworthy, I	Vince	Planner	Regional Niagara Planning and Development Department	2201 St. Davids Rd., P.O. Box 1042	Thorold, ON L2V 4T7	905-984-3630 ext. 338	
	Green	Shawn	Environmental Officer	Department of Indian and Northern Affairs	25 St. Clair Avenue East, 5th Floor	Toronto ON M4T 1M2		
Mr.	Hewitt	Tom	Sr. Project Manager, Niagara	Ministry of Transportation	6th Floor Atrium Tower, 1201 Wilson Avenue, Downsview ON M3M 1J8			
Mr.	Hollick	Thomas	Regional Clerk	Regional Municipality of Niagara	2201 St. Davids Road, PO Box 1042, Thorold ON L2V 4T7			
Mr.	Jones	Al	Fire Chief	City of St. Catharines	PO Box 3012 - 50 Church Street	St. Catharines, ON L2R 7C2		
Ms.	Knox	Louise	Regional Director, Ontario Region	Canadian Environmental Assessment Agency	55 St. Clair Avenue East, 9th Floor	Toronto ON M4T 1M2		
Ms.	Kok	Sandra	Senior Project Engineer	Great Lakes 2000 Sustainability Fund, Environmental Conservation Branch, E	867 Lakeshore Road, Burlington, ON L7R 4A6			
Mr.	Lambert	Bryan	Planning Project Coordinator	COGEDO Cable Systems Inc.	7170 MacLeod Road, Niagara Falls, ON L2G 3H2			
Mr.	Laviolette	Leo	General Manager	Hamilton and District Heavy Construction Association	104 - 370 York Boulevard,	Hamilton, ON L8R 3L1		
Ms.	Lerette	Kathy	Director, Design and Construction	Horizon Utilities Corporation	P.O. Box 2249,. Station LCD 1 - 450 Nebo Road	Hamilton, ON L8N 3E4		
Mr.	Maniccia	Domenic	Acting Manager of Operations	Niagara Catholic District School Board	427 Rice Road	Welland, ON L3C 7C1		
Mr.	Mattson	Mark	President	Lake Ontario Waterkeepers	245 Queens Quay West, Toronto Ontario	M5J 2K9		
Mr.	McCarthy	Terry	Area Manager	Ministry of Community and Social Services	PO Box 2112, 6th Floor, 119 King Street West, Hamilton, ON L8N 3Z9			
Ms.	McClymont-Pe	Diane	Director Environmental Health Assessment Services	Health Canada	Tupper Building 2720 Riverside Drive	Ottawa ON K1A 0K9		
Ms.	McCready	Linda	Corporate Policy Unit	Ministry of Tourism and Recreation	Ferguson Block 9th Floor 77 Welsley Ave. W	Toronto ON M7A 1N3		
Ms.	McInnes	Suzanne	Coordinator, Watershed Management	Niagara Peninsula Conservation Authority	250 Thorold Road West, 3rd Floor, Welland, ON L3C 3W2			
Mr.	McKinnon	Wes	Sr. Project Manager	Enbridge Consumers Gas	3401 Schmon Parkway, PO Box 1051, Thorold, ON L2B 4Y6			
Mr.	Mitchell, O.A./	Steven	Business Services Branch	Ministry of Education	21st Floor, Mowat Block, 900 Bay Street	Toronto ON M7A 1L2		
	Moretti	Michelle	Planner, Municipal Services Office - Central Region	Ministry of Municipal Affairs and Housing	777 Bay Street, 2nd Floor	Toronto, ON. M5G 2E5	(416) 585-	(416) 585-6
Mr.	Nesbitt	R.J.	Sr. Business/Tourism	Ministry of Economic Development Trade and Tourism	9th Floor, 301 St. Paul Street, St. Catharines, ON L2R 7R4			
Mr.	Nicholls	Gary	Deputy Chief	Niagara Regional Police	68 Church Street	St. Catharines, ON L2R 3C6		
Mr.	Paolasini	Tony	Real-Estate Co-ordinator, Real Estate Services	Hydro One Networks Inc.	483 Bay Street	Toronto, ON M5G 2P5		
Ms.	Richardson	Cathy	Planner	Ministry of Natural Resources	Box 5000, 4890 Victoria Ave., Vineland Station, ON L0R 2E0			
Mr.	Roy	Franklin	Director, Litigation Management and Resolution Branch	Department of Indian and Northern Affairs	10 Wellington Street	Gatineau QC K1A 0H4		819-997-16
	Ruf	Fred	Acting Head of Food and Safety, Safe Water and Environmental Healt	Public Health Branch	8th Floor, 5700 Yonge St	Toronto ON M2M 4K5		
Mr.	Savoie	Paul	Fish Habitat Management	Fisheries and Oceans Canada	District Office, 3027 Harvester Road, Unit 304	Burlington ON L7R 4K3		
	Secretariat	Environment Canada	Environment Protection Service	Regional Screening and Coordination Committee	4905 Dufferin Street, Downsview, ON M3H 5T4			
Mr.	Singbush	Bruce	Manager, Community Planning and Development	Ministry of Municipal Affairs and Housing	2nd Floor, 777 Bay Street	Toronto ON M5G 2E5		
Mr.	Tardif	Jean-Francois	Director, Financial Issues and Cost-Sharing	Ontario Ministry of Aboriginal Affairs	10 Wellington Street	Gatineau, QC K1A 0H4	819-953-1	819-997-98
Mr.	Todd	Kenneth	City Clerk and Director of Corporate Services	City of St. Catharines	PO Box 3012 - 50 Church Street	St. Catharines ON L2R 7C2		
Ms.	Trepanier	Louise	Director, Claims East of Manitoba, Comprehensive Claims Branch	Department of Indian and Northern Affairs	10 Wellington St., Room 1310	Gatineau QC K1A 0H4	819-953-3109	
Ms.	Tzimas	Ria	Crown Law Office, Aboriginal Legal Issues Office	Ministry of the Attorney General	720 Bay Street, 8th Floor	Toronto ON M5G 2K1	416-326-4	416-326-41
Mr.	Wedge	Grant	Counsel, Crown Law Office-Civil	Ministry of the Attorney General	8th Floor, 720 Bay Street	Toronto ON M5G 2K1		
Ms.	Wheaton	Pat	Project Manager	Bell Canada	63 King Street 3rd Floor, PO Box 190, St. Catharines, ON L2R 6S9			
Ms.	Wheaton	Pam	Director, Policy and Relationships Branch	Ontario Secretary of Aboriginal Affairs	720 Bay St., 4th FL	Toronto ON M5G 2K1		
Dr.	Williams	Robin	Medical Office of Health	Niagara Regional Area Health Unit	573 Glenridge Avenue, St. Catharines, ON M2T 4C2			


Lake Ontario
N
Read Road
Gregory Road
St. Catharines
Fourth Avenue
Fifth Avenue Louth
Seaway Haulage Road
Fifth Street Louth
Third Street Louth
First Street Louth
Decew Road
Highway 406
Thorold
Highway 58
Cataract Road
Hansler Road
Kottmeier Road
Highway 20
Holland Road
Barron Road
Highway 20
Barron Road
Study Area
Municipal Boundaries

Lake Ontario
Martindale Pond
Welland Canal
Niagara-on-the-Lake
Youngstown
Virgil
Vineland Sta.
Jordan Sta.
Vineland
St Catharines
St Davids
Lewiston
Queenston
Tuscarora Indian Reservation
Power Reservoir
Niagara Univ.
Thorold
Niagara
Niagara Falls
Niagara Falls
Davis Rd
Allanburg
Robert Moses State Pky
Port Robinson
Grand Island
Welland
Caledon
Markham
Oshawa
Erin
Brampton
Toronto
Mississauga
Milton
Oakville
Lake Ontario
Hamilton
Grimsby
St Catharines
West Lincoln
Niagara Falls
Haldimand
Welland

CH2M HILL
255 Consumers Road
Toronto, ON M2J 5B6
Tel 416.499.9000
Fax 416.499.4687

CH2MHILL

September 4, 2007

Mr. Surinder Singh Gill
Ontario Secretariat of Aboriginal Affairs
Policy and Relationships Branch
720 Bay Street
Toronto, ON
M5G 2K1

Subject: **Pollution Control Master Plan for the Cities of St. Catharines and Thorold First Nations' Interest in Lands**

Dear Mr. Singh Gill:

As a part of the Class Environmental Assessment Master Plan Study for the Cities of St. Catharines and Thorold, we would like to request a list of the First Nations groups that may have an interest, as well as land claims and any on-going legal proceedings in the area under study.

The City of St. Catharines, the City of Thorold and the Regional Municipality of Niagara have initiated a Class Environmental Assessment (EA) Master Plan to update and expand the existing St. Catharines Pollution Control Plan (PCP). The purpose of this Class EA Master Plan is to develop a roadmap for infrastructure projects that will address capacity constraints, receiving water pollution control, and assist the municipalities with their goal of meeting the Ministry of the Environment (MOE) guidelines for combined sewer overflow management.

Through the EA process, a framework for future municipal works and development will be outlined and recommendations will be made for a set of prioritized works throughout the study area to be implemented over an extended period of time. For this reason, it is important that public consultation occurs early in the process to resolve potential future conflicts.

Please see the attached map of the area covered by the EA study.

If you require additional information, please do not hesitate to contact the undersigned at 416-499-0090 Ext. 346. Thank-you for your assistance in this matter.

Sincerely,

CH2M HILL Limited

Sabrina Coletti, MCIP, RPP
Environmental Planner

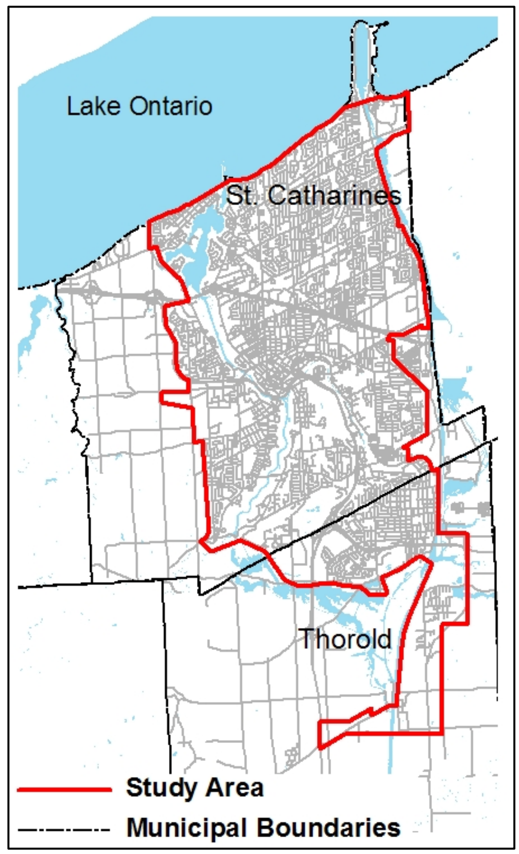
c: Mark Green, City of St. Catharines
Philip Lambert, City of Thorold
Ryan Creamer, Region of Niagara

Encl.

CLASS ENVIRONMENTAL ASSESSMENT FOR THE ST. CATHARINES AND THOROLD POLLUTION CONTROL PLAN UPDATE

NOTICE OF STUDY COMMENCEMENT

The City of St. Catharines, the City of Thorold and the Regional Municipality of Niagara have initiated a Class Environmental Assessment (EA) Master Plan to update and expand the existing St. Catharines Area Pollution Control Plan (PCP). The purpose of this Class EA Master Plan is to develop a roadmap for infrastructure projects that will address capacity constraints, receiving water pollution control and assist the municipalities with their goal of meeting the Ministry of the Environment (MOE) guidelines for Combined Sewer Overflow (CSO) management.



This study is being conducted in accordance with the requirements for Master Plan projects as described in the Municipal Engineers Association's *Municipal Class Environmental Assessment* (EA) document (June 2000). As such, it requires that the following two phases are undertaken:

- Phase I: Establish the problem or opportunity. For example, identify opportunities for decreasing CSOs.
- Phase II: Identify and assess alternative solutions to the problem or opportunity, and select a preferred alternative.

Through this process, opportunities and requirements for infrastructure updates and opportunities to reduce CSOs will be established by an analysis of the wastewater system and receiving stream environments. This will outline a framework for future works and development. Alternative solutions for these works will then be identified and assessed, and preferred alternatives will be selected. The Master Plan will outline a recommendation for a set of works throughout the study area to be implemented over an extended period of time.

Consultation with the public and government review agencies is a vital component of the study. Notices will be distributed to interested members of the public at key stages in the project, and a public information session will be held. We will be preparing a mailing list of interested public and agencies. If you wish to be placed on the mailing list to receive project information, or if you have any questions regarding the study, please contact:

Mark Green
Manager of Environmental Services
City of St. Catharines
383 Lake Street,
St. Catharines, ON, L2N 4H5
Email: mgreen@stcatharines.ca
Phone: 905-688-5601 Ext. 2193

Sabrina Coletti
Environmental Planner
CH2M HILL Canada
255 Consumers Road
Toronto, ON M2J 5B6
Email: sabrina.coletti@ch2m.com
Phone: 416-499-0090 Ext. 346

Ministry of Aboriginal Affairs

720 Bay Street
4th Floor
Toronto, ON M5G 2K1

Tel: (416) 326-4741
Fax: (416) 326-4017

Ministère des Affaires autochtones

720, rue Bay
4e étage
Toronto, ON M5G 2K1

Tél: (416) 326-4741
Téléc: (416) 326-4017

Ontario

website: www.aborginalaffairs.gov.on.ca

Reference: PAR 303
0708-151

SEP 2 6 2007

Sabrina Coletti
Environmental Planner
CH2M Hill
255 Consumers Road
Toronto, ON M2J 5B6

Re: Pollution Control Master Plan – St. Catharines & Thorold

Dear Ms. Coletti:

Thank you for your letter dated August 29, 2007, regarding the above noted project. We would like to apologize for the delay in responding to your request.

The responsibilities of the Ministry of Aboriginal Affairs (MAA) include conducting land claim and related negotiations on behalf of the Province. In light of this mandate, MAA has reviewed the materials and notes that this project appears to be located within an area where the Six Nations of the Grand River have existing or asserted rights. We recommend that you contact Chief Allen McNaughton and Chief David General of the Six Nations about the project. They can be reached at the following addresses:

Chief D. M. General
1695 Chiefswood Road
PO Box 5000
Ohsweken, ON, NOA 1MO
PH: (519) 445-2201

- and -

Chief A. MacNaughton
RR 2
Ohsweken, ON, NOA 1M0
PH: (519) 755-2769

.../2

You should be aware as well that many First Nations either have or assert rights to hunt and fish in their traditional territories. These territories often include lands and waters outside of a First Nation's reserve. As well, in some instances project work may impact archaeological and burial sites. First Nations with an interest in such archaeological sites may extend beyond those First Nations in the nearest vicinity of the proposed project.

As well, the Government of Canada sometimes receives claims that Ontario does not receive, or with which Ontario does not become involved. For information about possible claims in the area, MAA recommends the proponent contact the following federal contacts:

Mr. Don Boswell
A/Sr Claims Analyst
Ontario Research Team
Indian and Northern Affairs Canada
10 Wellington St.
Gatineau, QC K1A 0H4
Tel: (819) 953-1940
Fax: (819) 997-9873

Mr. Jean-Francois Tardif
Director,
Financial Issues and Cost-Sharing
10 Wellington St. 8th Floor
Gatineau, QC K1A 0H4
Tel: (819) 953-5830
Fax:(819) 953-3812

MAA requests that we remain on your contact list and that we continue to receive any updates about the project. MAA would also request that you continue to keep the Aboriginal communities interested in the above-noted project appraised of any new developments.

Yours truly,

Alan Kary
Deputy Director
Policy and Relationships Branch

Law, Pam/KWO

From: Yacob, Iris (PIR) [Iris.Yacob2@ontario.ca]
Sent: Tuesday, February 20, 2007 12:30 PM
To: Coletti, Sabrina/TOR
Cc: Bingler, Trevor (PIR)
Subject: Class Envioronmental Assessment Master Plan

Dear Ms. Sabrina Coletti,

I am writing to you on behalf of Trevor Bingler, Manager at the Ontario Growth Secretariat. Trevor has conveyed to me that the Ontario Growth Secretariat will be observing during the process. However, if you have any questions or comments they can be directed to:

Trevor Bingler, Manager-Growth Policy
tel:416-325-5794
fax:416-325-7405
email: Trevor.Bingler@ontario.ca

Sincerely,

Iris Yacob
Administrative Assistant, GPPA
Ministry of Infrastructure Renewal,
Ontario Growth Secretariat
4th Floor, 777 Bay Street
Phone:(416)325-7390
Fax:(416) 325-7403

Horizon Utilities Corporation

FAX → Sabrina Colletti
CH2M
Mark Green
905-646-6570
2
DATE: Mar 7/07

March 2, 2007

City of St Catharines
383 Lake Street
St Catharines, On
L2N 4H5

Attention: Mark Green, manager of Environmental Services

File# ______

HAMILTON HYDRO
55 John Street N.
Hamilton, ON
Tel: (905) 522-6611

St. Catharines Hydro
340 Vansickle Road
St. Catharines, ON
Tel: (905) 684-8111

Re: St. Catharines and Thorold Pollution Control Plan

In response to your correspondence(s) dated February 15, 2007, please be advised that our Engineering Design Department have reviewed the information concerning the above noted Consent Application and our comments are as follows:

Please send Horizon Utilities information as it is made available and the Master Plan Report at the completion of the study, so we have an opportunity to examine your findings to identify any potential conflicts with our existing plant.

We would also like to stipulate the following:

- Do not excavate within two metres of hydro poles and anchors.
- Excavation within one metre of underground hydro plant is not permitted unless approval is granted by a Horizon Utilities representative and is present to provide direct supervision. Cost associated with this task shall be at the owner's expense.
- Horizon Utilities must be contacted if the removal, isolation or relocation of existing plant is required, all cost associated with this work will be at the owners expense.
- CALL BEFORE YOU DIG, arrange for underground hydro cable locate(s) before beginning construction by contacting Ontario One Call @ 1-800-400-2255.
- Clearances from Overhead and Underground existing electrical distribution system must be maintained in according to:
    - Ontario Building Code (1997) Section 3.1 (3.1.18.1)
    - Electrical Safety Code Rule 75-312
    - Occupational Health and Safety Act (OH&SA) - Construction Projects (Electrical Hazards)
    - CAN/CSA-C22.3 No. 1-01, Overhead System
    - C22.3 No. 7- 94 Underground Systems

Mail to: P.O. Box 2249 Station LCD 1 Hamilton, ON L8N 3E4
www.horizonutilities.com

From: Hudgin, Glen [mailto:glen.hudgin@regional.niagara.on.ca]
Sent: Thursday, March 15, 2007 9:05 AM
To: Coletti, Sabrina/TOR
Subject: St. Catharines and Thorold Pollution Control Plan Update

Hell Sabrina
Your letter regarding the above sent to our Medical Officer of Health Dr. Robin Williams, has been passed to me. Please add me to your mailing list to receive information and updates on this project.
Thanks, Glen

Glen Hudgin, Manager, Health Protection & Promotion
Niagara Region Public Health Department
2201 St. David's Rd., Campbell East
Thorold, Ontario L2T 4T7
Tel: 905-688-3762 ext. 7596
Toll Free: 1-800-263-7248
Fax: 905-641-4994
E-mail: Glen.Hudgin@regional.niagara.on.ca
Website:www.regional.niagara.on.ca

March 13, 2007

Your file Votre référence

Our file Notre référence
5010-1
#154711

Sabrina Coletti
Environmental Planner
CH2M Hill Canada Ltd.
255 Consumers Road
Toronto, ON
M2J 5B6

Dear Ms. Coletti:

RE: Class Environmental Assessment Master Plan St. Catherines and Thorold Pollution Control Plan Update

Thank you for your notice of February 15, 2007 regarding the above project.

For all provincial and/or municipal undertakings, Indian and Northern Affairs Canada requests that the proponent of such projects make efforts directly from the initiation of a project to identify and notify all potentially interested First Nation communities. It is recommended that this identification and notification occur at the earliest planning stages of the undertaking and if requested by any First Nation(s), maintain communication with such communities. To assist with identifying First Nations and other Aboriginal groups within the vicinity of a specific proposed project, Indian and Northern Affairs Canada can provide the following information sources:

- The Chiefs of Ontario website (http://www.chiefs-of-ontario.org) provides a directory of contact information for all First Nations and Chiefs, as well as a map of the locations of all Ontario First Nations.
- Natural Resources Canada, Legal Surveys Division, produces a 1:2 000 000 map entitled "Canada - Indian Communities, Ontario", showing all First Nation reserve lands and communities in Ontario.
- Natural Resources Canada's online *Historical Indian Treaties* map, showing historical First Nation treaties across Canada, is available at: http://atlas.nrcan.gc.ca/site/english/maps/historical/indiantreaties/historicaltreaties

- A search by place name at the Canadian Geographical Names database (http://geonames.nrcan.gc.ca/search/search_e.php) will generate a map which shows any nearby Indian reserve lands in grey.

- The Métis Nation of Ontario (http://www.metisnation.org/) may be able to provide information regarding Métis interests with respect to a particular project.

- The Ontario Federation of Indian Friendship Centres website provides a list of all friendship centres in Ontario, at: http://www.ofifc.org/Centres/OfficeList.asp?Region='ON'

- For enquiries regarding land claims in Ontario, please contact the Director General of the Comprehensive Claims Branch at (819) 994-7521, the Director General of Specific Claims Branch at (819) 994-2323 and the Director General of Litigation Management and Resolution Branch at (819) 997-3582.

If, however, the proponent believes that the proposed project is likely to also trigger a requirement for a federal environmental assessment under the *Canadian Environmental Assessment Act* (CEAA), we advise that the proponent contact the Canadian Environmental Assessment Agency early in the planning process, and provide a project description to them. The Agency will notify federal agencies, including INAC, of the proposed project as appropriate, in accordance with the requirements of the *Regulations Respecting the Coordination b y Federal Authorities of Environmental Assessment Procedures and Requirements*. INAC will, in turn, provide input to the Agency regarding our interest in the project and/or First Nation contact information wherever warranted.

Thank you for your time and consideration.

Miranda Lesperance
Environment Officer
Environment Unit
INAC - Ontario Region
25 St. Clair Avenue E. 8th Floor
Toronto, Ontario M4T 1M2
lesperancem@inac.gc.ca

cc: Mark Green, City of St. Catherines

This letter has been distributed electronically. If you require a signed copy, please contact the author at the address provided above.

Canada

Ministry of the Environment
119 King Street West
12th Floor
Hamilton, Ontario L8P 4Y7
Tel.: 905 521-7640
Fax: 905 521-7820

Ministère de l'Environnement
119 rue King ouest
12e étage
Hamilton (Ontario) L8P 4Y7
Tél. : 905 521-7640
Téléc. : 905 521-7820

Ontario

April 18, 2007

Sabrina Coletti
CH2M HILL Canada
255 Consumers Road
Toronto, ON M2J 5B6

Dear Sabrina:

RE: MEA Class Environmental Assessment – Master Plan
Proponents: City of St. Catharines, City of Thorold and Regional Municipality of Niagara
Undertaking: St. Catharines and Thorold Pollution Control Plan Update

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Further to the e-mail I sent to you March 7, 2007 I would like to thank you for your letter regarding the proposed Master Plan undertaking for the above noted project. Projects resulting from this type of study often require approval under the *Environmental Assessment Act* (EAA). To obtain the authority for the individual projects to proceed the municipality noted above must plan the projects in accordance with the *Municipal Engineers Association Municipal Class Environmental Assessment, June 2000* (Class EA).

In accordance with the Class EA, Master Plans are required to address a Minimum of Phases 1 and 2 of the Class EA process. The work undertaken in the preparation of Master Plans should recognize the Planning and Design Process of the MEA Class EA, and should incorporate the key principles of successful environmental assessment planning identified in Section A.1.1. It is also important that public and agency consultation take place during each phase of the study process, specifically, at the initiation of the Master Plan and at the selection of the preferred set of alternatives stage.

The key features of Master Plans include:

- Addresses the key principles of successful environmental planning (see Section A.1.1);
- Addressed at least the first two phases of the MEA and can also cover other phases;
- Allows for an integrated process with other planning initiatives;
- Provides a strategic level assessment of various options to better address overall system needs and potential impacts and mitigation;
- Is generally long term;
- Takes a system-wide approach to planning which relates infrastructure either geographically or by a particular function;
- Recommends an infrastructure master plan which can be implemented through the implementation of separate projects;
- Includes a description of the specific projects.

Regardless of the Master Plan approach followed, the onus is on the proponent to ensure that the requirements of the MEA Class EA are met. **It is therefore recommended that the proponent contact the Environmental Assessment and Approvals Branch of the Ministry of the Environment to discuss the proposed approach.**

MOE recommends that proponents contact the following agencies to determine potentially affected Aboriginal communities in the project area:

CLASS ENVIRONMENTAL ASSESSMENT FOR THE ST. CATHARINES AND THOROLD POLLUTION CONTROL PLAN UPDATE

NOTICE OF PUBLIC INFORMATION CENTRE

The City of St. Catharines, the City of Thorold and the Regional Municipality of Niagara are in the process of undertaking a Class Environmental Assessment (EA) Master Plan to update the existing St. Catharines Area Pollution Control Plan (PCP). The purpose of this Class EA Master Plan is to develop a roadmap for infrastructure projects that will address capacity constraints, receiving water pollution control and assist the municipalities with their goal of meeting the Ministry of the Environment (MOE) guidelines for Combined Sewer Overflow (CSO) management.

This study is being conducted in accordance with the requirements for Master Plan projects as described in the Municipal Engineers Association's *Municipal Class Environmental Assessment* (EA) document (Oct. 2000, amended 2007). As such, it requires that the following two phases are undertaken:

- Phase I: Establish the problem or opportunity. For example, identify opportunities for decreasing CSOs.
- Phase II: Identify and assess alternative solutions to the problem or opportunity, and select a preferred alternative.

Through this process, opportunities and requirements for infrastructure updates and opportunities to reduce CSOs have been established by an analysis of the wastewater system and receiving stream environments. Alternative solutions for these works have been identified and assessed, and preferred alternatives have been selected.

A Public Information Centre is planned for June 5, 2008 from 6 p.m. to 8 p.m. at Thorold City Hall (3540 Schmon Parkway, Thorold). The purpose of this Open House is to provide the community with an outline of the study process including the study purpose, description of existing conditions, overview of the evaluation process and a summary of the recommended preferred alternatives. A display of information on the project will be available for visitors. City and Regional staff along with the consultant team will be on hand to answer questions and to discuss the project. Consultation with the public and government review agencies is a vital component of the study.

If you are unable to attend the Public Information Centre and wish to comment on this project or receive information, please contact:

Mark Green
Manager of Environmental Services
City of St. Catharines
383 Lake Street,
St. Catharines, ON, L2N 4H5
Email: mgreen@stcatharines.ca
Phone: 905-688-5601 Ext. 2193

Phill Lambert
Assistant Director of Operations
City of Thorold, PO Box 1044
3540 Schmon Parkway
Thorold, On, L2V 4A7
Email: pubworks@thorold.com
Phone: 905-227-3535

Tom Mahood
Project Manager
CH2M HILL Canada
300-72 Victoria St. S.
Kitchener, ON, N2G 4Y9
Email: tom.mahood@ch2m.com
Phone: 519-579-3501 ext 3241

1. **The Ontario Secretariat for Aboriginal Affairs**
   (Contact: Ms. Pam Wheaton, Director, Policy and Relationships Branch, Ontario Secretariat of Aboriginal Affairs, 720 Bay St., 4th Floor, Toronto ON M5G 2K1; fax: 416-326-4017; pam.wheaton@ontario.ca)

2. **Indian and Northern Affairs of Canada – Specific Claims Branch**
   (Contact: Mr. Don Boswell, Senior Claims Analyst, Specific Claims Branch, Department of Indian and Northern Affairs, 10 Wellington St., Room 1310, Gatineau QC K1A 0H4; fax: 819-956-2258; boswelld@inac.gc.ca);

3. **Indian and Northern Affairs of Canada - Litigation Management and Resolution Branch**
   (Contact: Mr. Franklin Roy, Director, Litigation Management and Resolution Branch, Department of Indian and Northern Affairs, 10 Wellington Street, Gatineau QC K1A 0H4; fax: 819-997-1679; royf@inac.gc.ca);

4. **Indian and Northern Affairs of Canada - Comprehensive Claims Branch**
   (Contact: Ms. Louise Trepanier, Director, Claims East of Manitoba, Comprehensive Claims Branch, Department of Indian and Northern Affairs, 10 Wellington St., Room 1310, Gatineau QC K1A 0H4; 819-953-3109; trepanierl@inac.gc.ca)

5. **Ministry of the Attorney General – Aboriginal Legal Issues Office**
   (Contact: Ms. Ria Tzimas, Crown Law Office, Ministry of the Attorney General, 720 Bay Street, 8th Floor, Toronto ON M5G 2K1; tel: 416-326-4930 fax: 416-326-4181; ria.tzimas@ontario.ca)

Once identified, it is recommended that you provide notification directly to the Aboriginal communities who may be affected by the project and provide them with an opportunity to participate in the planning of the project.

Once the Master Plan is finalized, a final public notice is issued allowing the public an opportunity to review and provide input to the municipality. Depending on the Master Plan Approach selected, the final public notice may also become the Notice of Completion for any Schedule B or C projects identified within the study. You are reminded that when concerns are raised during the public comment period, the concerned party should be consulted in an attempt to resolve the concerns. Discussions to this end should proceed for an appropriate period of time, even if this means the 30-day review period is exceeded. The concerned party must be advised that if such discussions are unsuccessful at resolving the concerns, they can submit a Part II Order request if they have not already done so to the Minister within a further seven calendar days following the end of discussions.

We request that the proponent forward one copy of the Notice of Completion with the complete Master Plan Document to this Office for our review, filing and potential comments as well as any information that is available in the interim such as PIC packages.

Should you have any questions regarding the Class EA process or need to schedule meetings with District or Technical Ministry staff, please feel free to contact Barb Ryter at (905) 521-7864.

Thank you,

Original signed by Jennifer Arthur, April 18, 2007.

Jennifer Arthur
Environmental Assessment & Planning Coordinator
West Central Regional Office

Law, Pam/KWO

From: Bell, Rebecca (MOH) [Rebecca.Bell@moh.gov.on.ca]
Sent: Wednesday, February 21, 2007 4:15 PM
To: Coletti, Sabrina/TOR
Subject: St. Catharines Class EA

Hello Sandra,

Please include the Ministry of Health and Long-Term Care, Environmental Health Branch in future mailings related to the Class EA for St. Catharines and Thorold Pollution Control Plan Update. Please direct mailings to Fred Ruf at the mailing address in the signature below.

Please also include Niagara Health Unit in future mailings related to the Class EA as Niagara HU has jurisdiction in this matter. Information can be directed to Bjorn Christensen, Director, Health Protection and Promotion -
email: bjorn.christensen@regional.niagara.on.ca / Ph: 905-688-3762, Ext 7226.

Thank you,
Rebecca

Rebecca Bell, B. Sc., M.E.S.
Policy Analyst
Infectious Diseases Branch
Public Health Division
Ministry of Health and Long-Term Care
5700 Yonge Street,
Toronto, ON, M2M 4K5

Email: rebecca.bell@moh.gov.on.ca
Phone: (416) 212-7258
Fax: (416) 327-0984

Law, Pam/KWO

From: Fyffe, Hugh (MTO) [Hugh.Fyffe@ontario.ca]
Sent: Monday, March 05, 2007 11:52 AM
To: Coletti, Sabrina/TOR
Subject: Class EA Master Plan - St. Catharines and Thorold Pollution Control Plan Update

Sabrina:

Please keep the Ministry of Transportation in your circulation as we are interested in reveiwing information as it becomes available.

Also be advised that ministry permit(s) are required prior to any work/construction being done, within a provincial highway right-of-way, within 46m of a provincial highway right-of-way or within a 395m radius of the intersection of the centre-lines of a provincial highway and a municipal / regional road.

Thanks.

Hugh Fyffe
Project Manager - Corridor Management Section Ministry of Transportation 7th Floor Building 'D'
1201 Wilson Avenue
Downsview ON M3M 1J8

February 26, 2007

Ms. Sabrina Coletti
Environmental Planner
CH2M Hill Canada
255 Consumers Road
Toronto, ON M2J 5B6

Mr. Mark Green
Manager of Environmental Services
City of St. Catharines
383 Lake Street
St. Catharines, ON L2N 4H5

Dear Ms. Coletti/Mr. Mark Green:

RE: Notice of Study Commencement
Class Environmental Assessment (CEA) Master Plan
St. Catharines Area Pollution Control Plan (PCP)
City of St. Catharines, City of Thorold and the Regional Municipality of Niagara

With regard to the above noted Study, please be advised that the Niagara Escarpment Commission (NEC) is interested in reviewing the information as it is made available and the Master Plan Report which will be available at the end of the study.

Further, it would assist us in our review of the Study if the consultants could identify works within the Niagara Escarpment Plan Area.

Please direct further correspondence on this Study to myself. I can be contacted directly at 905 877-8363.

Yours truly,

Kathryn Pounder, MA, MCIP, RPP
Senior Planner

Law, Pam/KWO

From: Michaud, Annie [annie.michaud@conservation-niagara.on.ca]
Sent: Monday, March 19, 2007 9:27 AM
To: Coletti, Sabrina/TOR
Subject: RE: Class EA St. Catharines & Thorold PCP Update

Hi Sabrina,

I received the information letter you sent to the NPCA on February 15, 2007 re: the Class EA for the St. Catharines and Thorold Pollution Control Plan Update. Please include me on the mailing list for this project.

Thank you,
Annie

Annie Michaud
Water Quality Specialist
Niagara Peninsula Conservation Authority
250 Thorold Road West, 3rd Floor
Welland, ON L3C 3W2
Phone: 1-905-788-3135, Ext. 245
Fax: 1-905-788-1121
Email: amichaud@conservation-niagara.on.ca

Website: www.conservation-niagara.on.ca

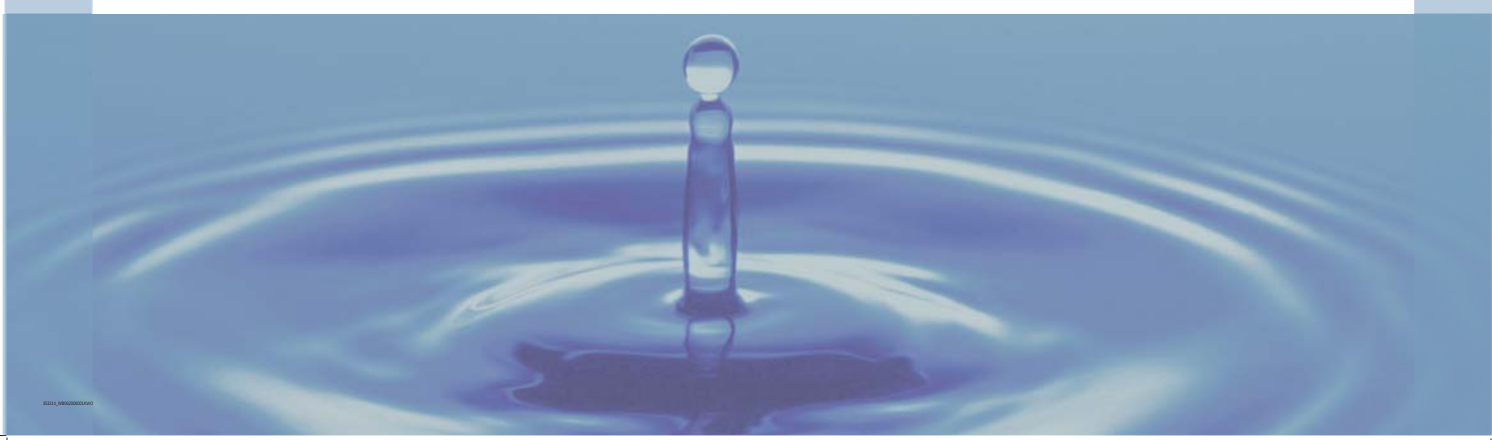
Welcome to the

City of St. Catharines and City of Thorold Pollution Control Plan Class Environmental Assessment Master Plan Public Information Centre

June 5, 2008

Please Sign In and take an Information Bulletin and Comment Sheet.
Staff from the Cities of St. Catharines and Thorold, and their consultants, CH2M HILL, are on hand to answer your questions.

CH2MHILL



Study Background

Background

In Ontario, Pollution Control Planning has long been a fundamental practice exercised by municipalities to meet their objectives for successful wastewater management. The Pollution Control Plan (PCP) that the City of St. Catharines and the City of Thorold follow is a comprehensive planning tool that, when it was initially developed in the early 1990s, served many essential purposes. It provided the Cities of St. Catharines and Thorold (Cities) with a roadmap for the development of infrastructure projects that would help to alleviate the problems associated with infrastructure capacity, help address receiving water pollution and assist the municipalities with their goal of meeting the Ontario Ministry of the Environment (MOE) guidelines for Combined Sewer Overflow (CSO) management.

The PCP has also provided the Cities with support and justification for funding applications to the Federal government, the Province, and the Regional Municipality of Niagara (Region). This has allowed the City to garner monetary support for the long-term implementation of the PCP recommendations over the last 16 years. Following the recommended implementation plan, the Cities, the Region, and the Province have put forth a great deal of effort to reduce the impact of infrastructure on the environment.

Purpose of the Current Undertaking

The Cities of St. Catharines and Thorold, along with the Region, have asked for an update to the 1990 St. Catharines Area PCP because many of the original recommendations for infrastructure renewal and CSO abatement have been implemented and the remaining recommendations need to be revisited. The update also allows new opportunities to be examined in the development of a new PCP strategy. The work carried out to-date, which addresses the original recommendations, also needs to be evaluated based on the current MOE requirements. Port Dalhousie and Port Weller sewershed studies, which were intended as updates to the original 1990 PCP, were carried out to examine these two areas specifically in regard to infrastructure capacities and CSO abatement requirements. The new PCP document also combines information from these two studies into the updated strategy.

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Class Environmental Assessment Process

Master Plans are long range plans which examine the current and future requirements of a given infrastructure system using environmental assessment planning principles. The Master Plans at a minimum must address Phases 1 and 2 of the Class EA process described in the previous section. Master plans develop a framework for planning a group of related projects required to accommodate demands on a system over a long period of time.

The Master Planning process allows a municipality to develop the need and justification for specific projects under a broad planning framework. A Master Plan should be reviewed every five years to determine the need for detailed review and updates. Specific projects identified in the Master Plan may require additional Class EA planning and approvals prior

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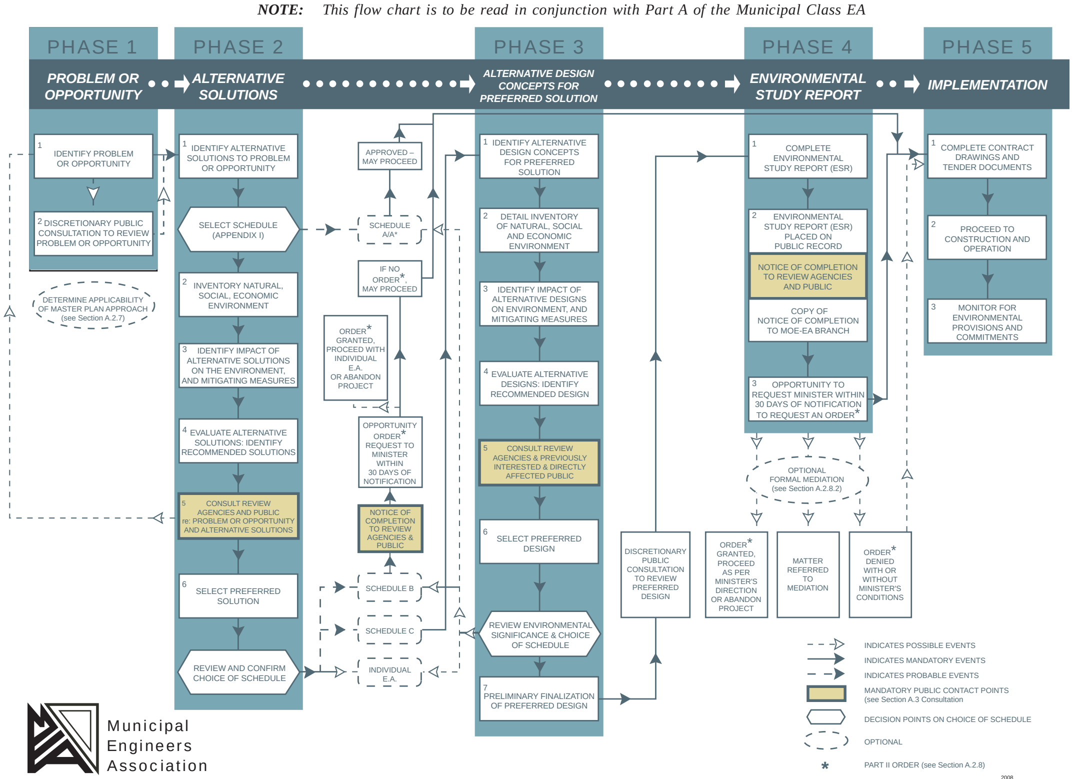
Municipal Class Environmental Assessment Planning and Design Process

NOTE: *This flow chart is to be read in conjunction with Part A of the Municipal Class EA*



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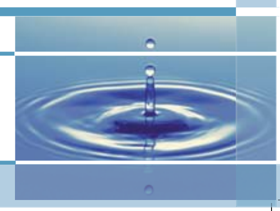

Study Objectives

Problem Statement

The Port Weller and Port Dalhousie sewersheds currently exhibit overflows and basement flooding during intense wet weather periods. The Cities of St. Catharines and Thorold have identified the need to undertake a system-wide plan to determine the level of infrastructure required to service the two sewersheds, currently and in the future.

Study Objectives

The objective of the PCP is to develop a strategy to address current system constraints and issues related to CSO, and to plan for future system requirements in the Cities of St. Catharines and Thorold. The PCP recommendations will conform with the MOE's Procedure F-5-5 and assess the relative impact of CSO discharges to local receiving stream environments.

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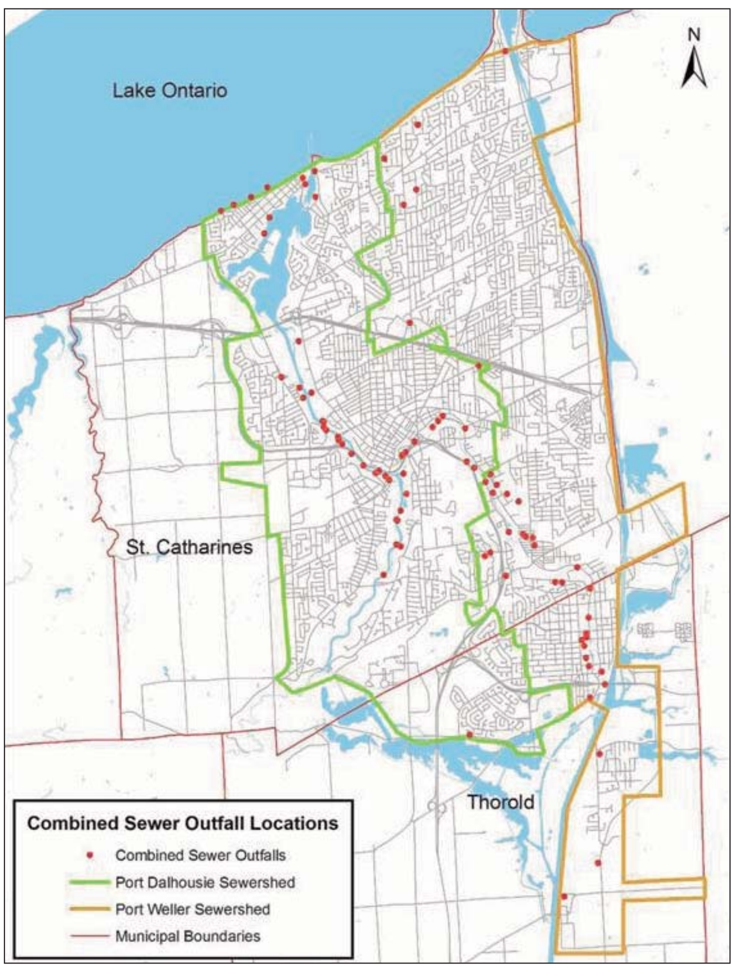
Study Area Description

The Study Area for the Pollution Control Plan encompasses the urban areas of St. Catharines and Thorold, as shown in the figure below. The locations of the CSOs that are being examined as part of the study are also indicated in the figure below.

Combined Swer Outfall Locations – Port Dalhousie and Port Weller Sewrsheds



Sewer System Performance and Recommended System Upgrades

Conformance with MOE Guidelines

CSO Volume Reduction for Approved Capital Works

Sewershed	CSO Location	Existing Conditions Typical Year Analysis			Approved Capital Works Typical Year Analysis		
		Frequency	Volume	% Capture	Frequency	Volume	% Capture
Port Dalhousie	Welland / Ontario	16	24786	82.5	1	590	99.6
	Page Street	34	31709	82.2	6	20090	88.7
	Capner / Oakdale	42	14063	43.4	4	2260	90.9
Port Weller	Guy Road	3	4609	72.7	1	1170	93.1
	Pine Plaza (Thorold)	33	56193	32.5	N/A	83201	90

1 Based on 90% design capture

Recommended Projects

Implementation Schedule

	CSO Location	Recommended Alternative	Estimated Capital Cost	Recommended EA	Recommended Implementation Period
PCP Update					**Complete**
1 to 5 years	Capner & Oakdale	Storage	$1,200,000	Complete	2008
	Westchester/OWC	Storage	$5,683,000	2009	2010
	Parkway & OWC	Storage	$4,990,000		
	Burleigh Hill & Glendale	Storage	$1,505,000	2010	2011
	Hartzel/CNR	Storage	$5,425,000	2011	2012
	Wedsworth & Hastings	Storage	$4,726,000		2013
	Michigan Avenue	Sewer Replacement	$150,000	2012	2013
PCP Update					**2012**
5 to 10 years	Carlton & Ontario	Storage	$11,458,000	2013	2014
	Thomas St., Hennry & Beech, George & Beech	Storage	$5,900,000		2015
	Page Street	Storage	$1,500,000		2016
	Oakdale & Marren	Storage	$2,112,000	2016	2017
	Renown Rd. PS	Storage	$5,676,000	2017	2018
PCP Update					**2017**
	Eastchester	Storage	$3,538,000	2018	2019
	Forester & Linwell	–	–	2019	2020

22-May-08

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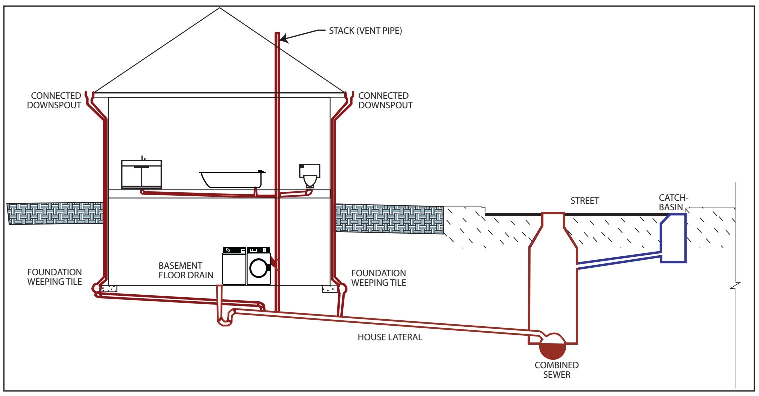
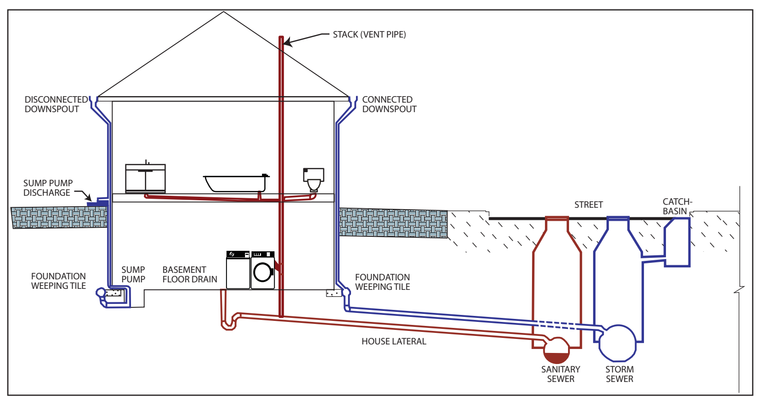
Types of CSOs

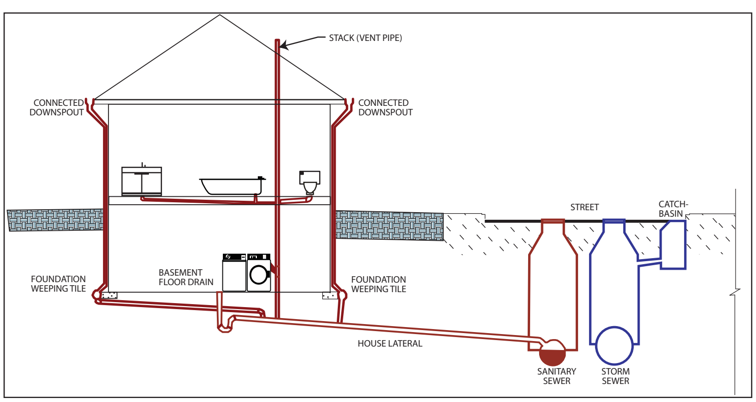
CSO 1



CSO 2



CSO 3



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Pollution Control Plan for the Cities of St. Catharines and Thorold

Public Information Centre – June 5, 2008

Attendance Register

Please print clearly.

NAME	ADDRESS	POSTAL CODE	TELEPHONE

Thank you for your participation in this study!

Niagara Region CH2MHILL Responsible Solutions for a Sustainable Future® The City of Niagara Falls Canada

Pollution Control Plan for the Cities of St. Catharines and Thorold

Comment Sheet – June 5, 2008

The Cities of St. Catharines and Thorold and Region of Niagara are interested in receiving the community's comments, questions and concerns regarding the Pollution Control Plan. Please take a few minutes to complete this brief comment sheet.

If you have comments on the Pollution Control Plan, please provide them below.

If you have questions on the Pollution Control Plan, please provide them below.

Please include your name, address, and telephone number (**OPTIONAL – this information will be included in the Master Plan unless specified otherwise**).

Kindly return this completed Comment Sheet to the Study team here at the Open House or you may fax or mail it, by **July 5, 2008**, to:

City of St. Catharines
Manager of Environmental Services
City of St. Catharines
383 Lake Street
St. Catharines, Ontario L2N 4H5
Ph (905) 688-5601 extension 2193
Fax (905) 646-6570

Phill Lambert, P. Eng.
Assistant Director of Operations
City of Thorold
3540 Schmon Parkway, P.O. Box 1044
Thorold, Ontario L2V 4A7
905-227-3535 (phone)
905-227-3666 (fax)

CH2MHILL Responsible Solutions for a Sustainable Future®

City of Thorold
Where Ships Climb The Mountain...

Information Handout

Pollution Control Plan for the Cities of St. Catharines and Thorold

Port Dalhousie and Port Weller Sewersheds

Prepared for

City of St. Catharines
City of Thorold
Regional Municipality of Niagara

June 5, 2008

Prepared by

CH2MHILL

Background

In Ontario, Pollution Control Planning has long been a fundamental practice exercised by municipalities to meet their objectives for successful wastewater management. The Pollution Control Plan (PCP) that the City of St. Catharines and the City of Thorold follow is a comprehensive planning tool that, when it was initially developed in the early 1990s, served many essential purposes. It provided the Cities of St. Catharines and Thorold (Cities) with a roadmap for the development of infrastructure projects that would help to alleviate the problems associated with infrastructure capacity, help address receiving water pollution and assist the municipalities with their goal of meeting the Ministry of the Environment (MOE) guidelines for Combined Sewer Overflow (CSO) management.

The PCP has also provided the Cities with support and justification for funding applications to the Federal government, the Province and the Regional Municipality of Niagara (Region). This has allowed the City to garner monetary support for the long-term implementation of the PCP recommendations over the last 16 years. Following the recommended implementation plan, the Cities, the Region, and the Province have put forth a great deal of effort to reduce the impact of infrastructure on the environment.

Existing PCP

The City of St. Catharines, in partnership with the MOE, the Region and the City of Thorold completed the St. Catharines Area Pollution Control Plan (SCAPCP) in 1990. The purpose of the study was to develop a plan to improve water quality in the St. Catharines area. The objectives of the study were:

- To identify and quantify existing and potential sources of water pollution;
- To develop and evaluate a series of management options; and
- To select a preferred strategy with recommendations for implementation

Since that time, updates have been completed for each of the separate sewersheds. The Port Weller Sanitary Trunk Sewer Analysis was completed in 1998. The Port Dalhousie Trunk Sewer and CSO Study was completed in 2006.

Objectives of the Current Undertaking

To plan for an upgrade or expansion of the existing sewage infrastructure to address current issues associated with CSO discharges to local receiving environments and manage anticipated growth, the Cities and the Region, are undertaking the completion of a Pollution Control Plan (PCP) update for the study area.

The Cities of St. Catharines and Thorold, along with the Region, have asked for an update to the 1990 St. Catharines Area PCP because many of the original recommendations for infrastructure renewal and CSO abatement have been implemented and the remaining recommendations need to be revisited. The update also allows new opportunities to be examined in the development of a new PCP strategy. The work carried out to-date which addresses the original recommendations also needs to be evaluated based on the current MOE requirements. Port Dalhousie and Port Weller sewershed studies, which were intended as updates to the original

1990 PCP, were carried out to examine these two areas specifically in regard to infrastructure capacities and CSO abatement requirements. The new PCP document also combines information from these two studies into the updated strategy.

The Regional Master Servicing Plan, completed in 2003, addressed wastewater infrastructure and treatment requirements at the Regional level. The results and recommendations from the Master Service Plan have also been incorporated into this new PCP Strategy document.

Aside from the number of projects already completed as part of the original PCP implementation and the subsequent infrastructure studies, there are significant new undertakings already underway or planned for the study area. The Region is undertaking the Northeast Wastewater Servicing Study, which will examine the wastewater treatment and linear infrastructure capacity for the Northeast portion of the Region, including portions of St. Catharines and Thorold. Under the Niagara Water Strategy (NWS), the Region is also undertaking a comprehensive assessment of CSO locations and prioritization of abatement requirements for these CSOs across the region. The draft results of these studies have been incorporated into the new PCP. All of this past and current work will be incorporated into the new PCP Strategy and the performance of the relevant system components, including all of their infrastructure improvements, will be evaluated against the current MOE guidelines.

The MOE guidelines for the management of CSOs have been refined since the development of the City's original PCP. The projects implemented by the City since the mid-1990s have been designed to meet the MOE Procedure F-5-5 and F-5-1 objectives. One of the objectives of the PCP update is to examine the relevant portions of the current system configuration and determine the success of the projects that have been implemented over the last 16 years in relation to Procedure F-5-5. The MOE is also emphasizing project elements that include additional receiving stream impact assessments for PCP strategy alternatives in relation to potential impacts on the natural environment and municipal water supplies.

The ultimate objective of the study is to develop an updated PCP strategy for the Cities that will provide them with guidance on the implementation of future infrastructure and CSO abatement projects, as well as best management practices, that will provide for anticipated growth within the municipalities and improve receiving water quality conditions.

Draft Recommendations of the Study

System-Wide Policies and Programs Review

One method of decreasing the volume, frequency and impact of overflows is to control the volume and quality of extraneous flows entering the system at its source. Source control can be achieved through various program and policy initiatives.

St. Catharines

Under the original Pollution Control Plan, St. Catharines initiated a number of pollution control programs and policies in the early 1990s. These programs are implemented by City Staff. A review of the existing programs was carried out to determine which programs were working successfully and what, if any, changes were required. In addition, the review attempted to

identify any gaps where new programs could be recommended for implementation. The following are the recommended Policies and Programs:

- Downspout Disconnection Program
- Pet Litter Control Program
- Environmental Education Program
- Dry Weather Seepage Abatement
- Citizen's Reports
- Water Quality Monitoring Surveys
- Beach Water Quality Program
- Weeping Tile/Foundation Drain Disconnection
- Floatables Control Program
- CSO Regulator Inspections and Maintenance
- Closed Circuit Television (CCTV) Inspections
- Catchbasin Cleaning
- Street Sweeping Program
- Combined Sewer Separation
- Manhole Rehabilitation with Recommended Program Upgrades
- Sewer Rehabilitation with Recommended Program Upgrades
- Sewer Flushing/Reaming with Recommended Program Upgrades
- CSO Storage Facility Review

Thorold

Similar to St. Catharines, the City of Thorold has a number of pollution control programs and policies as part of their municipal programming. These programs are implemented by City Staff. A detailed review of the existing programs was carried out to determine which programs were working successfully and what if any changes were required. In addition, the review attempted to identify any gaps where new programs could be recommended for implementation. The following are the recommended Policies and Programs:

- Downspout Disconnection Program
- Water Conservation Program with Recommended Program Upgrades
- Weeping Tile/Foundation Drain Disconnection with Recommended Program Upgrades
- Citizens' Reports
- Catchbasin and Street Cleaning
- Operations and Maintenance Program
- Manhole Rehabilitation with Recommended Program Upgrades
- Sewer Rehabilitation with Recommended Program Upgrades
- Region of Niagara
- Household Hazardous Waste Collection

Capital Works

The capital works recommended in the study are in addition to those works which are currently in various design and construction phases.

1. **Carlton & Ontario**. Currently, an 8,680 m^3 storage facility is being recommended for Carlton & Ontario at a cost of $8,700,000. The size of this storage tank could be reduced if integration

of upstream sewer separation and/or storage is found to be suitable during a more detailed site investigation and Class EA. As noted, the proximity to the Thomas St. outfall could make an integrated abatement approach feasible.

2. **Thomas Street, Henry & Beech, George & Beech**. A 4,470 m^3 storage facility is being recommended for Thomas Street. The size of this storage tank could be reduced if integration of upstream sewer separation and/or storage is found to be suitable during a more detailed site investigation and Class EA. As noted, the proximity to the Carlton & Ontario outfall could make an integrated abatement approach feasible.

3. **Westchester & O.W. Canal**. A 3,000 m^3 storage tank had been previously recommended and designed for this overflow location. The estimated cost for this project was $5,306,000, based on submitted construction tenders. It is being recommended that this location be examined in further detail to determine if there are any upstream opportunities that would reduce the size of the required storage.

4. **Parkway & O.W. Canal**. A 1,890 storage volume would be required for the Parkway outfall location to capture the volume from a two-year storm event. The estimated cost for this storage would be $3,800,000. It is recommended that a joint project be examined for the Westchester and Parkway locations to develop an efficient means of abating overflows at the two locations.

5. **Hartzel & CNR Line.** A 4,110 storage tank would be required for this overflow location, at an estimated cost of $4,100,000. A previous study found that locating land for a storage facility of this size would be challenging in the vicinity of the Hartzel & CNR overflow. It is recommended that the upstream area be examined in further detail to determine if there are opportunities for source control and/or sewer separation. The Wedsworth & Hastings overflow is located near this overflow location and the feasibility of a joint abatement approach should be examined.

6. **Wedsworth & Hastings.** A 1,790 m^3 storage facility is being recommended for this location at an estimated cost of $3,600,000. As indicated this overflow is located near the Hartzel & CNR Line overflow locations. The feasibility of a joint abatement approach as well as opportunity for upstream source control should be examined

7. **Renown Road PS.** A 4,300 m^3 storage facility is being recommended for the Renown Road PS at an estimated cost of $4,300,000. The size of this storage tank could be reduced if integration of upstream sewer separation and/or storage is found to be suitable during a more detailed site investigation and Class EA.

8. **Eastchester PS.** It is recommended that the flows to Eastchester PS be monitored after the Capner & Oakdale works are completed to determine their effect. No capital works are currently recommended to the Eastchester PS. Flows to the pump station should be monitored once the upgrades at the Capner & Oakdale CSO are completed.

9. **Michigan Avenue.** Due to the proximity to the treatment plant, it is recommended that no capital works be constructed at the Michigan Avenue CSO. The Michigan Avenue CSO overflows at a much higher rate than the treatment plant (26 events vs. 6 events during the typical year). Therefore, increasing the flow through capacity to the plant will allow more CSO to be treated during moderate events. The pipe capacity to the plant should be

increased from the current 350mm pipe to 525mm pipe. The estimated cost for replacement of the sewer is $150,000.

10. **Forster & Linwell.** The feasibility of conveying flows to the new Guy Road storage facility should be examined on a site-specific level. This Forster & Linwell overflow is located adjacent to Guy Road Park.

11. **Oakdale & Marren.** A 640 m^3 tank is being recommended for this overflow location at an estimated cost of $1,300,000. There is limited opportunity for upstream source control as this overflow is located on the Regional trunk sewer.

12. **Burleigh Hill & Glendale.** A 380 m^3 storage facility is being recommended for this overflow location at an estimated cost of $760,000. The size of this storage tank could be reduced if integration of upstream sewer separation and/or storage is found to be suitable during a more detailed site investigation and Class EA.

System Upgrades

St. Catharines

It is recommended that flooding concerns within the City continue to be addressed as part of the FLAP program. Areas with multiple FLAP applications or complaints should be examined for targeting a reduction of wet weather in the system.

Thorold

The system constraints upstream and downstream of the Peel St. pump station should be examined. The upstream system should be examined to alleviate basement flooding, in addition to the constraints for conveying flows downstream of the station.

Data Management

St. Catharines

It is recommended that the following data management components be developed:

1. **Updated Combined Sewer Mapping.** The City of St. Catharines should continue to keep the combined sewer mapping database updated as system improvements are made.

2. **Capital Works Database.** A GIS based database should be developed to show system improvements which address problem areas and alleviate CSOs and basement flooding.

Thorold

1. **Infrastructure Data Update/Electronic Mapping and Modeling.** It is recommended that the existing sanitary and storm sewer mapping be converted into an electronic format. The preferred format for infrastructure is GIS.

Regional Municipality of Niagara

1. **Pump Station Records/Database.** A database should be developed and kept up to date with current pump station information. Pump station capacities should be confirmed through draw fill tests.

St. Catharines/Thorold/Regional Municipality of Niagara

1. **Integrated Flow Monitoring Program.** The two cities and the Region should examine the possibility of an integrated flow monitoring program. This program would ensure that the placement of regional and municipal flow monitors would compliment each other resulting in an effective use of each monitor to gain a better understanding of the sewersheds. Data management protocols should be developed to ensure that the data collected from each of the monitors can be easily integrated for model calibration and analysis of the sewer system.

2. **Annual Report**. It is recommended that an annual report be prepared that provides a comprehensive compilation and summary of the infrastructure management activities carried out The annual report should be a compilation of all system upgrades and updates on maintenance and management programs. The annual flow monitoring records should also be compiled in the report. Mapping upgrades for sewer improvements should also be a component of the report. The Cities and the Region should work together to develop this report. The report should determine and report on the success of the upgrades and improvements to programs as recommended in the PCP report as well as make recommendations based on improvements to programs and update the recommendations in the PCP report.

3. **PCP Updates**. It is recommended that the PCP be updated every five years to determine the implementation success of the PCP and the future needs.

CH2M HILL Canada Limited
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Toronto, Ontario M2J 5B6
Tel 416.499.9000
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Name
Address
Address

Re: **Class Environmental Assessment Master Plan**
St. Catharines and Thorold Pollution Control Plan Update

Please find enclosed the Notice of Study Completion for the above noted project. This study has fulfilled the requirements for a Schedule B Class Environmental Assessment. The project file has been placed on the public record as of August 11, 2008 for a 30-day review period. If you have comments or concerns or require further information, please contact the undersigned at (519) 579-3500 ext. 3241 or at tom.mahood@ch2m.com.

Sincerely,

CH2M HILL Canada Limited

Tom Mahood, P.Eng.
Vice President

Cities of St. Catharines and Thorold Pollution Control Plan Update Study
Class Environmental Assessment Master Plan

Notice of Study Completion

The Cities of St. Catharines and Thorold have completed a Pollution Control Plan and CSO (Combined Sewer Overflow) Abatement Study using the Master Plan process following Phases 1 and 2 of the Municipal Class Environmental Assessment.

The Pollution Control Plan identifies recommended infrastructure upgrades as well as operational programs to decrease the impacts of CSOs and reduce the potential for basement flooding. The Plan outlines areas for CSO storage and potential opportunities for operational modifications to decrease the potential for CSOs. In addition to the infrastructure upgrades, the Pollution Control Plan recommends the continued implementation of ongoing City programs and policies as well as the introduction of new programs focused on pollution prevention and infrastructure management.

The specific recommended infrastructure upgrades may require additional study, consultation and documentation to complete the Class EA requirements prior to implementation.

The Pollution Control Plan is available for review at the City of St. Catharines City Hall and the City of Thorold City Hall.

Please forward any comments to either of the study contacts by September 16th, 2008.

Mark Green Manager of Environmental Services City of St. Catharines 383 Lake Street, St. Catharines, ON, L2N 4H5 Email: mgreen@stcatharines.ca Phone: 905-688-5601 Ext. 2193	Phill Lambert Assistant Director of Operations City of Thorold, PO Box 1044 3540 Schmon Parkway Thorold, On, L2V 4A7 Email: plambert@thorold.com Phone: 905-227-3535	Tom Mahood Project Manager CH2M HILL Canada 300-72 Victoria St. S. Kitchener, ON, N2G 4Y9 Email: tom.mahood@ch2m.com Phone: 519-579-3501 ext 3241

Thereafter, the Master Plan will be reviewed and revised taking into account the comments which were received from the public. The recommended Master Plan will be presented to City Councils for final approval.