City of Port Colborne
Water and Stormwater Master Servicing Plan
Volume 4 – Stormwater

November 2026



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Water and Stormwater Master Servicing Plan
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1 Introduction

1.1 Background

The City of Port Colborne (City) is located in southern Ontario along the north shore of Lake Erie and is bisected by the Welland Canal. It is part of the Niagara Region (Region) and is adjacent to the Town of Wainfleet, Town of Fort Erie, and City of Welland.

Water servicing within the City operates under a two-tier system. The Region is responsible for water treatment, storage facilities, pumping stations, and major trunk infrastructure, while the City owns and operates the local water distribution system, including trunk and distribution watermains. The system is supplied by the Port Colborne Water Treatment Plant (WTP), which is a conventional surface water treatment facility that draws raw water from Lake Erie via the Welland Canal. Treated water is distributed through a network of watermains and storage facilities within a single pressure zone.

The City owns, maintains and operates the majority of the stormwater collection and management infrastructure, including catch basins, storm sewers, ditches, culverts, stormwater management facilities, and other related structures. Stormwater runoff is conveyed through a combination of minor and major systems and ultimately discharges to local receiving watercourses and Lake Erie.

Reliable and accessible public infrastructure is critical to supporting existing and future communities. Coordinated infrastructure planning, land use planning, and investment are required to deliver efficient, safe, and cost-effective water and stormwater services.

The Master Servicing Plan (MSP) provides a comprehensive review of existing systems and identifies growth-related servicing strategies, with consideration for long-term sustainability and optimization of existing infrastructure.

1.2 Master Servicing Plan

The City is undertaking a Water and Stormwater Master Servicing Plan to develop a comprehensive strategy and vision for the City's short- and long-term water and stormwater infrastructure needs. The MSP reviews existing system conditions and performance, considers the impacts of growth, and identifies strategies to meet current and future servicing requirements.

The Study establishes a long-term management strategy to guide water and stormwater infrastructure planning through 2051 and beyond and includes an actionable Capital Program and Implementation Plan to support the strategy. The MSP will provide the framework for system capacity allocations, infrastructure upgrades, and financial planning, supporting the City's continued growth and sustainable management of its water and stormwater systems.

1.3 Master Servicing Plan Objectives

The MSP is designed to deliver a strategic, integrated framework for the management, enhancement, and expansion of the City's water distribution and stormwater management systems through 2051 and beyond. This MSP addresses the needs of both systems to ensure reliable service delivery, environmental protection, and support for the City's growth aspirations. The key objectives of the MSP are as follows:

- **Provide Safe and Reliable Services**: Ensure a consistent supply of potable water that complies with the Safe Drinking Water Act, 2002, and effective stormwater management to safeguard public health, property, and infrastructure under current and future conditions.
- **Accommodate Growth**: Evaluate and plan infrastructure capacity to support projected population increases, seasonal tourism demands, and potential industrial development, particularly along the Welland Canal, in accordance with the City's Official Plan.
- **Enhance System Resilience**: Develop adaptive strategies to mitigate the impacts of climate change, including increased storm intensity and fluctuations in Lake Erie water levels, ensuring the longevity and reliability of water and stormwater systems.
- **Meet Regulatory Standards**: Adhere to provincial legislation, Ministry of the Environment, Conservation and Parks (MECP) guidelines, Niagara Region policies, and Niagara Peninsula Conservation Authority (NPCA) requirements, while fulfilling the Municipal Class Environmental Assessment (EA) process.
- **Optimize Infrastructure Performance**: Identify opportunities to reduce non-revenue water losses, improve stormwater conveyance efficiency, and leverage existing assets to deliver cost-effective, sustainable solutions.
- **Protect Environmental Quality**: Minimize impacts on Lake Erie and local watercourses by enhancing stormwater quality, controlling runoff volumes, and incorporating low-impact development (LID) practices where feasible.
- **Foster Collaboration**: Engage residents, businesses, Niagara Region, NPCA, and other stakeholders to align the MSP with community needs, regional priorities, and environmental goals.

These objectives underpin a holistic servicing strategy that ensures Port Colborne's water and stormwater systems are robust, sustainable, and capable of supporting the community's long-term prosperity.

1.4 Master Servicing Plan Documentation Layout

The MSP Report, including all supporting volumes, is the documentation placed on public record for the prescribed minimum 30-day review period. The documentation, in its entirety, describes all required phases of the planning process and incorporates the procedure considered essential for compliance with the Environmental Assessment Act.

The MSP Report is organized into 5 volumes as described below.

1.4.1 Volume 1 - Executive Summary

Volume 1 provides a brief overview of the MSP. It summarizes the information contained in Volume 2, 3, 4 and 5, including the problem statement, purpose of the study, significant planning, environmental and technical considerations, and description of the preferred water and stormwater servicing strategies including depiction of the projects and documentation of the capital programs.

1.4.2 Volume 2 – Plan & Policy

Volume 2 details the master planning process including the Master Plan Class EA process, related studies, legislative and policy planning context, water and stormwater servicing performance objectives, population, and employment growth forecasts, existing environmental and servicing conditions, and future considerations.

1.4.3 Volume 3 – Water Master Plan

Volume 3 consists of the principal document summarizing the study objectives, approach, methodologies, technical analyses, evaluation, and selection of the preferred water servicing strategy. This volume contains baseline water system data and performance information. This volume also documents the water servicing strategy development with detailed information on the projects and capital program associated with the preferred water servicing strategy and implementation plan.

1.4.4 Volume 4 – Stormwater Master Plan

Volume 4 consists of the principal document summarizing the study objectives, approach, methodologies, technical analyses, evaluation, and selection of the preferred stormwater servicing strategy. This volume contains baseline stormwater system data and performance information. This volume also documents the stormwater servicing strategy development with detailed information on the projects and capital program associated with the preferred stormwater servicing strategy and implementation plan.

1.4.5 Volume 5 – Indigenous, Public, and Agency Consultation

Volume 5 contains all relevant documentation of the public consultation process including notifications, comments and responses, and distribution information. Presentation material from the Public Information Centre (PIC) held during the process is included. Other presentation material and discussion information from workshops held with relevant agencies, approval bodies and other stakeholders are also included.

2 Stormwater System Policy and Criteria

To ensure the City's stormwater system operates effectively and that its performance can be assessed under existing and future conditions, clear system performance criteria were established. As part of this MSP, the relevant design guidelines and historic studies were reviewed to confirm that projected runoff, infrastructure capacity, and system performance are accurately represented, supporting the identification and timing of future stormwater infrastructure improvements and the planning of upgrades to address existing deficiencies.

This MSP's Level of Service and Performance Criteria recommendations are based on the following:

- Port Colborne Design and Development Manual 2024
- City of Welland Stormwater and Wastewater Infrastructure Assessment - Technical Report February 2012
- Niagara Region – Stormwater Management Guidelines December 2022
- Niagara Peninsula Conservation Authority Stormwater Management Guidelines 2010
- Stormwater Management Planning and Design Manual - Ministry of the Environment, 2003

Through this review, it was determined that the MSP's stormwater Level of Service objectives will largely rely on the City's Design and Development Manual and the Niagara Peninsula Conservation Authority (NPCA) Guidelines performance criteria.

2.1 Stormwater Design Criteria

2.1.1 Design Storms

The City's Design Guidelines do not specify a particular design storm distribution; however, the Niagara Peninsula Conservation Authority Stormwater Management Guidelines recommend that, at a minimum, the 3-hour Chicago, 12-hour AES, and 24-hour SCS storm events be evaluated to ensure a comprehensive assessment of potential storm impacts.

For the purposes of this Master Servicing Plan, the initial system assessment was completed using all three storm events. The future conditions and infrastructure upgrade analysis were subsequently based on the design storm that produced the highest average peak flows within the system.

2.1.2 IDF Curves

Rainfall intensity for stormwater management design is determined using Intensity-Duration-Frequency (IDF) curves, which are derived from historical rainfall data recorded at a nearby rain gauge.

2.1.2.1 Existing IDF Curve

Table 2-1 below summarizes the City's existing IDF Curve Coefficients, as identified in its Design Guidelines and NPCA Stormwater Management Manual.

Table 2-1 Port Colborne Existing IDF Curve Coefficients

Return Period (Years)	a	b	c
2	755	8	0.789
5	830	7.3	0.777
10	860	6.5	0.763
25	900	5.2	0.745
50	960	5.1	0.736
100	1020	4.7	0.731

The existing IDF curve was utilized to assess the performance of the existing stormwater infrastructure.

2.1.2.2 Future IDF Curve

To review the potential effects of climate change on system performance, the MSP will also consider a future IDF curve that considers how the changing climate may impact local precipitation and temperature patterns, the frequency and intensity of storm events (leading to larger design storms), the impacts on lake levels, and the potential and magnitude of seiche events.

The neighbouring City of Welland had previously reviewed its IDF curve and the projected future changes due to climate change impact through two reports that were part of the National Engineering Vulnerability Assessment of Public Infrastructure to Climate Change program. The City's review is based on the City of Port Colborne's historic climate data, as such, the resulting data is directly applicable to the City. Two reports were prepared:

- The first report, ***Development of Projected Intensity-Duration-Frequency Curves for Welland, Ontario, Canada (AMEC 2011),*** developed potential future 2020 and 2050 IDF curves based on 16 different climate models, resulting in mean, 90th percentile, and maximum IDF curves for the Future 2020 and 2050 climate conditions. The future IDF curve projections were based on an existing Environment Canada IDF curve for the City of Port Colborne, which was developed using precipitation data from 1965 to 2000.
- The second report, ***Cost Benefit Assessment of an Updated Storm Drainage Standard (AMEC 2014),*** reviewed the projected IDF curves based on the updated 2012 Environment Canada IDF curve, completed a review of the rate of change of the

IDF curves, and undertook a cost-benefit assessment of changing the City's stormwater design standards. The report recommended that the city use the projected Mean 2050 IDF curve for the stormwater system design.

Table 2-2 summarizes the future IDF curve coefficients used as a part of this study, based on previous climate change assessments, while **Figure 2-1** presents the City's existing and future IDF curves. The future IDF curves account for projected changes in precipitation intensity and storm frequency due to climate change and were utilized to evaluate system performance under future conditions.

Table 2-2: Projected Future IDF Curve Coefficients

Return Period (Years)	a	b	c
2	696.1	0.79	6.134
5	848	0.771	7.249
10	975.4	0.768	7.956
25	1187.5	0.772	9.072
50	1345.3	0.775	9.709
100	1536	0.781	10.503

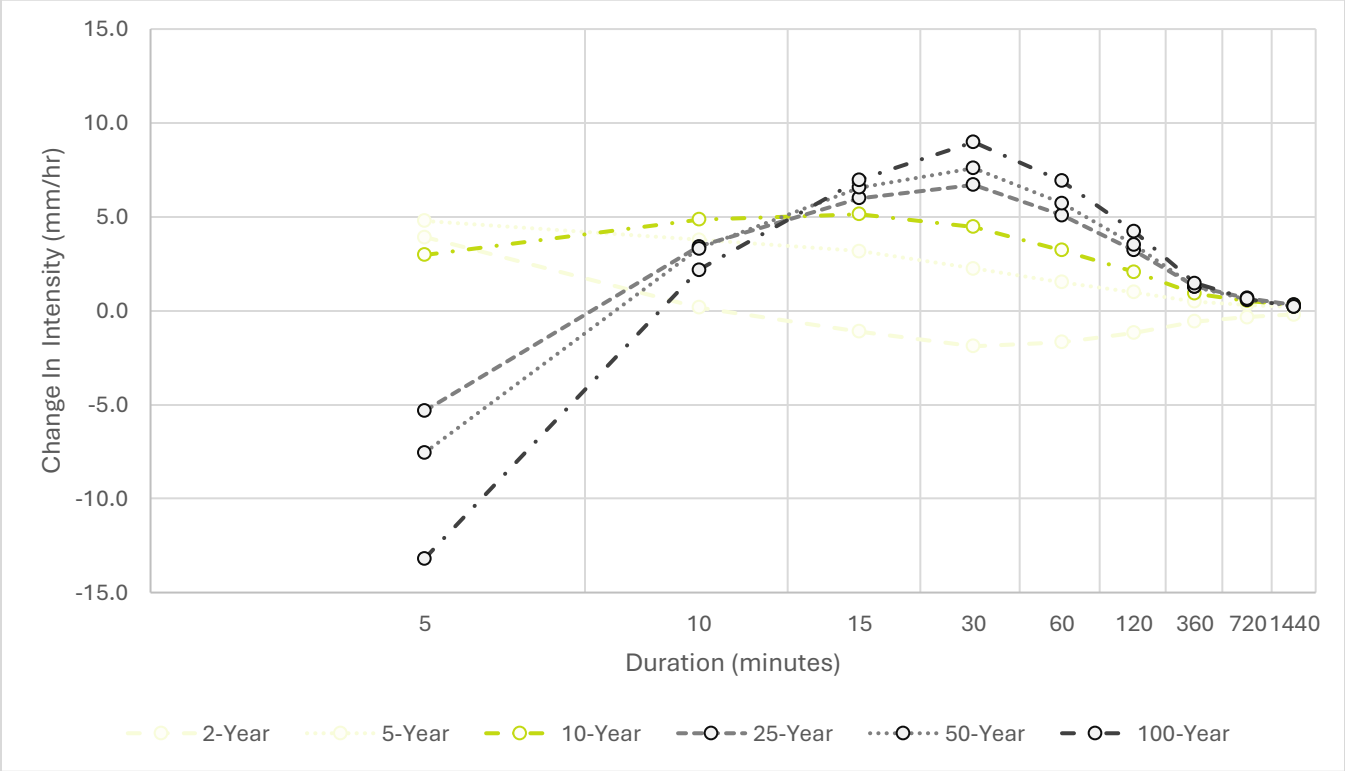


Figure 2-1: Increase in Rainfall Intensity – 2051 IDF vs. Existing IDF

2.1.3 Lake Erie Water Levels

The following data sources were reviewed to obtain historical water level data for Lake Erie.

- The U.S. Army Corps of Engineers – Great Lakes and Ohio River Division
- The NOAA Great Lakes Environmental Research Laboratory

Table 2-3 summarizes the Lake Erie levels at Port Colborne based on the 1918 to 2023 data set.

Table 2-3: Lake Erie Water Level Statistics (1918 - 2023)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	174.0	174.0	174.1	174.2	174.3	174.3	174.3	174.2	174.2	174.1	174.0	174.0	174.02
Max	174.8	174.9	174.9	175.0	175.0	175.1	175.1	175.0	174.8	174.9	174.8	174.8	174.89
Min	173.2	173.1	173.2	173.3	173.4	173.4	173.4	173.	173.3	173.3	173.2	173.1	173.19

As per Fisheries and Oceans Canada, Lake Erie exhibits both seasonal and short-period water level fluctuations. Seasonally, average water levels typically peak in June and reach their lowest in February. The average seasonal fluctuation is approximately 0.5 metres, with historical variations ranging from less than 0.3 to over 0.8 metres in a single season. Water level fluctuations in Lake Erie are summarized in **Table 2-4**.

Table 2-4: Lake Erie Water Level Fluctuations

Fluctuation Type	Characteristic	Details
Seasonal	Maximum Level	Typically occurs in June
	Minimum Level	Typically occurs in February
	Average Seasonal Range	Approximately 0.5 metres
	Observed Range	<0.3 metres to >0.8 metres in a single season
Short-Period	Duration	Ranges from <1 hour to several days
	Cause	Meteorological conditions (e.g., wind, barometric pressure differences)
	Observed Difference	Up to 5 metres across the lake due to the wind setup
	Impact on Volume	Minimal change in total lake volume despite large fluctuations

As a longer-term seasonal trend generally governs Lake Erie's water levels, there is not a strong correlation between peak lake levels coinciding with major precipitation events. However, the Port Colborne area is subject to seiche events, where high winds can raise lake levels. Furthermore, seiche events are more strongly correlated with major precipitation events.

Given the wide variability in potential climate conditions, the stormwater infrastructure will be reviewed under both average annual lake levels of 174.0 m and the peak monthly lake level of 175.1 m.

2.1.4 Welland Canal Water Levels

The Great Lakes-St. Lawrence Seaway System controls and manages water levels within the Welland Canal between Lock 1 and Lock 8. **Table 2-5** summarizes the Welland Canal chart datum levels within the Municipal boundaries as provided on the Great Lakes-St. Lawrence Seaway System website.

Table 2-5: Chart Datum Water Levels at Welland Canal

Chart Datum at Water Level Stations - Welland Canal		
Gauge	**Location**	**Chart Datum (m)[1]**
L7NE	NORTHEAST WALL LOCK 7	158.36
L7SE	SOUTHEAST WALL LOCK 7	173.33
L8NE	NORTHEAST WALL LOCK 8	173.33
L8SE	SOUTHEAST WALL LOCK 8	173.50

1 – Chart datums are IGLD85.

2.1.5 Low Impact Development Best Management Practices (LID BMPs)

Port Colborne encourages the use of Low Impact Development Best Management Practices (LID BMPs) to meet stormwater quality, water balance, and erosion control objectives. As per the Port Colborne Design & Development Manual, potential LID BMPs include:

- Bioretention areas, bioswales;
- Vegetated filter strips, enhanced grassed swales;
- Inline or inground storage;
- Asphalt, concrete, paving stones;
- Prefabricated modules, soil retention cells, and tree pits; and,
- Green roofs.

Table 2-6 details the key site considerations for LID design as per the City's LID BMPs.

Table 2-6: Key Site Considerations for LID Design

Site Characteristic	Design Consideration
Subsurface soil type and permeability	MECP recommends **≥ 15 mm/hr** infiltration rate
Groundwater table (seasonal maximum) and depth to bedrock	1m separation from the bottom of the LID BMP to the seasonally high groundwater table or the top of the bedrock elevation.
Storage Volume	5mm

2.2 Hydraulic Performance Criteria

2.2.1 Minor (Storm Sewers)

Prior studies have identified broad area deficiencies within the City's stormwater sewer, as such, applying the City's design standards for new sewers may not be financially or technically feasible. **Table 2-7** summarizes the storm sewer design criteria for the Master Servicing Plan.

Table 2-7: Summary of Master Servicing Plan Stormwater Minor System Performance Objectives

Infrastructure		Capacity Requirements
New Sewers		5-Year Design Storm
Existing Sewer	Submerged Outlet - With Clear Major Flow Path	2-Year Design Storm – Under submerged conditions 5-Year Design Strom – Under Free Outlet
	Submerged Outlet - Without Major Flow Path	5-Year Design Storm – Under submerged conditions
	With Clear Major Flow Path	2-Year Design Storm
	Without Major Flow Path	5-Year Design Storm
Culverts	Driveway	5-Year Design Storm
	Road crossing	10-Year
Ditch	Local Road	10-Year
	Collector/Arterial	100-Year

Further, any sewers that do not meet the diameter or velocity requirements in the City's Design Guidelines were flagged.

2.2.2 Detention and Retention Requirements

The City of Port Colborne standards for wet and dry ponds are based on Ministry of Environment, Conservation and Parks (MECP) criteria. These characteristics are summarized in **Table 2-8**. The MSP assessed existing conditions relative to the minimum criteria, and new facilities will be designed to meet the preferred criteria.

Table 2-8: Design Criteria Summary for Wet Ponds and Dry Ponds

Design Element	Minimum Criteria	Preferred Criteria
Wet Pond		
Drainage Area	5 hectares (minimum, unless supplemented by groundwater or other water source)	≥ 10 hectares
Active Storage Detention Time	24 hours (12 hours if constrained by minimum orifice size)	24 hours
Forebay (Pre-treatment)	Minimum Depth: 1.0 m	Minimum Depth: 1.5 m
Permanent Pool – Maximum Depth	3.0 m	2.5 m
Permanent Pool – Mean Depth	1.0 – 2.0 m	1.0 – 2.0 m
Active Storage – Max Depth (incl. Quantity Control)	2.0 m	2.0 m
Active Storage – Max Depth (Water Quality / Erosion Control)	1.5 m	1.5 m
Freeboard Above High-Water Level	0.3 m	0.3 m
Dry Pond		
Drainage Area	5 hectares	10 hectares
Active Storage Detention Time	24 hours (12 hrs if constrained by minimum orifice size)	48 hours
Forebay (Pre-treatment)	Minimum Depth: 1.0 m	Minimum Depth: 1.5 m
Pond Depth – Maximum	3.0 m	2.0 m
Pond Depth – Mean	1.0 – 2.0 m	1.0 – 2.0 m

Retention targets will align with the City's Design Criteria as outlined in **Table 2-11**.

2.2.3 Water Quality

The water quality requirements for existing facilities and the design of new facilities will be based on the standards from Niagara Region and the City of Port Colborne, as summarized in **Table 2-9**.

Table 2-9: Water Quality Requirements – Niagara Region & City of Port Colborne

Design Element	Design Criteria / Requirements
Water Quality Target	80% average annual removal of Total Suspended Solids (TSS).
Quality Control Volume (New Facilities)	Based on the required permanent pool volume + retention of the first 25 mm of runoff over 48 hours.
Design Storm for Retention	Based on the 2-year or 5-year event, as governed by the storm sewer evaluation.

2.2.4 Growth and Land Use Assumptions

A review of the runoff Coefficient recommended by the City, NPCA, and Niagara Region was undertaken to identify typical coefficients to be applied to assess future growth areas. Typical C-values were converted to an equivalent impervious coverage based on an approximation of the formula:

$$I_a = \frac{(C - 0.15)}{0.9}$$

Impervious levels for existing conditions were established based on a review of aerial photography. The estimated impervious areas were used for future development. The estimated impervious coverages associated with each land type are summarized in **Table 2-10.**

Table 2-10: Percentage Impervious Areas

Surface Type / Land Use	Runoff Coefficient (C)	% Impervious Area (Estimated)
Parks	0.35	25%
Commercial/Industrial	0.9	85%
Institutional	0.75	67%
New Single Family Residential	0.65	55%
New Semi-Detached	0.7	62%
Townhouses	0.75	67%
Apartment/Condominium	0.85	78%

2.3 Stormwater Design Criteria and Level of Service Summary

The stormwater technical criteria used as part of this MSP are summarized in **Table 2-11** and **Table 2-12**.

Table 2-11: Summary of City's Stormwater System Design Manual Criteria

Category		Criteria
Flood Control (Development)	Discharge to a Watercourse	Post-development to pre-development peak flow control 2 through a 100-year design storm.
	Discharge to Storm Sewer – Known Capacity	100-year post-development controlled to storm sewer capacity.
	Discharge to a Storm Sewer – Unknown Capacity	100-year post-development to 5-year pre-development peak flow.
	Road Right of Way	Demonstrate no Negative Impact Meets Permissible Depth of Flooding as listed in **Table 2-12.**
	Municipal Drain	100-year post-development to 2-year pre-development peak flow.
Erosion Control	• Provide controls for receivers sensitive to erosion. • Target retention of 90th percentile storm (Runoff Volume Control Target).	
Water Budget	• Maintain pre-development infiltration/evapotranspiration - Where Feasible • Minimum Requirement - Retain/reuse/infiltrate the first 5 mm of rainfall	
Water Quality	Achieve 80% TSS removal ("Enhanced" level). Use oil-grit separators, inserts, filtration tech, or equivalent.	
Minor System	Capacity	• Sized to Convey 5-Year Design Storm • Minimum 300 mm size
	Slope / Velocity	• 300 mm @ 0.3% • Minimum Velocity 0.75 m/s • Maximum Velocity 6.0 m/s
Major System	Capacity	• Size to Convey 100-Year Design Storm • Where the Roadway provides the Major System Function. Ensure Design Meets Permissible Depth of Flooding as listed in **Table 2-12**

Table 2-12: Summary of City's Stormwater System Design Manual – Prescribed Flooding Levels

Location	Design Storm		
	5-Year	25-Year	100-Year
Walkways	Minor surface	As required	As required
Open Spaces	flow up to 25 mm on walkways	For overland flow outlets	For overland flow outlets
Local	No ponding	0.05m above the crown	0.15m above the crown
Collector	1.0 m wide in the gutter or 0.10m deep at the low point catchbasins	Up to crown	0.10 m above the crown, maximum depth of flooding of 0.3 m
Private Property	Minor ponding in swales	No structural damage, ponding in yard areas below building openings - no basement flooding	No structural damage from overland flow
Public Property	Minor ponding in swales or ditches	No structural damage, ponding in flat areas, no erosion	No structural damage, ponding in flat areas, some erosion

2.4 Capital Cost Projections

Cost estimates for all projects identified in this MSP have been developed in accordance with the cost classification framework outlined in the *Guide to Costing* (Treasury Board of Canada Secretariat, May 2023) and the classification system of the Association for the Advancement of Cost Engineering (AACE). These classification systems define the appropriate estimating methodology, expected level of accuracy, and associated risk at various stages of project planning and design. For the purposes of this MSP, the estimates have been prepared consistent with a Class 4 level estimate, reflecting the current stage of planning and establishing the range of accuracy that can be expected as projects advance toward detailed design.

The cost estimating strategy was developed to provide a consistent, transparent, and reliable basis for project budgeting and prioritization. The approach includes the development of a standardized estimating algorithm and benchmarking against recent project costs to provide perspective on estimate accuracy.

The cost estimating methodology consists of four key steps:

- **Step 1 – Unit Costs and Baseline Construction Costs:** Establishment of unit costs for linear infrastructure (watermains and storm sewers) using a first-principles analysis, lump sum costing for stormwater management ponds based on size, and volumetric unit costs for LID infrastructure. Baseline construction costs are derived by applying these unit costs to the planned infrastructure quantities.
- **Step 2 – Adjustments for Scope and Complexity:** Modification of baseline construction costs to reflect project-specific factors and current market conditions, including road restoration, construction overhead, site complexity, special conditions, market and inflation adjustments, and unique project elements.
- **Step 3 – Inclusion of Non-Construction (Soft) Costs:** Addition of allowances for land acquisition, supporting studies and investigations, design and contract administration services, and City-related project management and permitting costs.
- **Step 4 – Overall Project Contingency:** Application of a contingency allowance to account for uncertainty, scope refinement, and unforeseen conditions at this stage of planning.

Detailed costing sheets were developed to support the financial analysis and provide transparency with respect to quantities, assumptions, and adjustment factors applied to each project. **Appendix A** in **Volume 2** provides a memo outlining the detailed costing methodology and associated assumptions.

3 Planning, Land Use, & Growth Projections

Section 7 in **Volume 2** summarizes the various historical and current growth forecasts that have been prepared over the past decade, providing context for the growth assumptions adopted in this MSP. These forecasts inform the future system modelling and the development of infrastructure improvement strategies intended to address the long-term servicing needs of the City. Key background documents reviewed include the 2013 Official Plan (growth to 2031), the 2023 Growth Analysis Review (Dillon Consulting), the 2024 Development Charges Background Study (Watson & Associates), the 2024 East Side Employment Lands Servicing Review (GEI), and the ongoing Pollution Prevention Control Plan project.

3.1 Growth Stormwater Servicing

The stormwater servicing concepts and strategies presented in the following sections consider both improvements within the City's existing infrastructure system, as well as new infrastructure and upgrades required to support the expansion areas. **Figure 3-1** presents the proposed growth land use type.

An increase in stormwater runoff volume, peak flow rates, and a potential reduction in water quality are expected due to the conversion of previously pervious areas. Future development will be required to manage runoff volume, peak flows, and water quality to meet pre-development conditions or better. Stormwater controls within the expansion areas will be determined on a site-specific basis. As such, in most instances, new development areas that incorporate the onside management requirements are anticipated to have a negligible increase to existing system peak flows and are not anticipated to trigger system upgrades, with the following exceptions:

- Outlets with existing deficiencies in the downstream conveyance systems.
- Development discharging to system outlets not requiring detention control, where there is sufficient downstream conveyance capacity to support the increase in system runoff.



Figure 3-1 Growth Land Use Type

4 Existing Stormwater System

4.1 Existing Stormwater Infrastructure

The City's stormwater system is primarily managed by the City of Port Colborne, with responsibility for the operation and maintenance of stormwater conveyance systems and associated infrastructure. Unlike the water system, there is no regional oversight of stormwater servicing; however, system performance is influenced by downstream receiving systems, including the Welland Canal and Lake Erie.

Figure 4-1 illustrates the City's stormwater system. The system includes a combination of urban storm sewer infrastructure and rural drainage systems that convey runoff to local watercourses and receiving bodies.

In newer areas of development (post 1980s), stormwater infrastructure has generally been designed in accordance with modern standards, including provisions for attenuation and water quality treatment. However, due to the City's historic development patterns, a significant portion of the system was constructed prior to current design requirements. As a result, many areas do not meet current levels of service and would require upgrades to meet the City's desired levels of service for new stormwater infrastructure. Additionally, there are neighbourhoods where stormwater infrastructure evolved through incremental infilling of roadside ditches, resulting in non-standard system configurations.

A key focus of this Master Servicing Plan is to identify and prioritize improvements to address the configuration, condition, and performance limitations of these legacy stormwater systems.

4.1.1 Minor Stormwater System

Within the urban boundary, the stormwater system is predominantly comprised of a conventional storm sewer network; the City's CLI-ECA lists the system length as 108 km of sewers and 40 km of ditches and swales. However, subsequent sewer investigation and inventory updates have identified additional sewer elements. The MSP assessment is based on the inventory as of January 2025, as well as a number of assumed sewers incorporated to address system connectivity issues present in the January 2025 inventory, comprising approximately 121 km of storm sewers and 4 km of culverts, ranging in diameter from 100 mm to 2,200 mm. Since January 2025, the City has undertaken additional investigation to further confirm the system inventory, geometry, and condition. It is anticipated that as the City continues to complete storm sewer investigations and system improvements the actual system length will be further updated.

These sewers convey runoff from streets, catchments, and local drainage areas to downstream outlets and detention facilities. Some areas continue to rely on roadside drainage systems or a combination of storm sewers and ditches.

Outside the urban boundary, stormwater is primarily conveyed through roadside ditches and culverts to nearby creeks and rivers prior to discharging to receiving water bodies.

Due to the age and evolution of the system, portions of the storm sewer network reflect legacy design approaches, including direct conveyance to outlets and non-standard configurations resulting from historic ditch infilling.

Table 4-1 summarizes the total length of the Minor System, located within the City's existing urban boundary as listed within the City's CLI-ECA.

Table 4-1: Minor Stormwater Sewer Length

Diameter	Length (km)
<=250 mm	26
>250 mm - <=500 mm	58
>500 mm - <=1050 mm	19
>1050 mm	5



Figure 4-1 Existing Stormwater System

4.1.2 Outfalls

Stormwater is discharged through a network of outfalls to local watercourses and receiving bodies, including Lake Erie, the Welland Canal, Quarry Ponds, and their local tributaries. **Figure 4-2** highlights the outlet locations, while **Table 4-2** summarizes the system outfalls by outlet system.

Table 4-2: System Outfalls

Outfall Location	Number of Outfalls
Welland Canal	31*
Lake Erie	26
Quary Pond	2
Eagle Marsh	10
Local tributaries	8

*Includes Johnston Street Stormwater Management Facility with pumped discharge

The performance of these outlets is influenced by downstream water levels and available hydraulic capacity.

Key constraints affecting outlet performance include:

- Lake Erie Water Level:
    - Influenced by long-term seasonal trends
    - Additional impacts from seiche (storm) events
- Welland Canal Levels:
    - Downstream of Lock 8
        - Water levels regulated by the Seaway
        - Analysis based on reported operational levels
    - Upstream of Lock 8
        - Governed by Lake Erie Water Levels
- Limited formal overland flow routes in some areas
- Outlet capacity restrictions during elevated lake or canal water levels
- Quarry Ponds: No natural outlet, subject to seasonal variability and is dependent on evaporation and infiltration to manage water levels.
- Eagle Marsh: Area drains to Lake Erie, high water levels are managed through a flood control structure at Lakeshore Road West.

These conditions can reduce discharge capacity during peak events and contribute to localized flooding or system surcharging.



Figure 4-2 Stormwater Outlets

4.1.3 Detention Facilities

The City CLI-ECA lists a single detention facility, the Johnston Street Stormwater Management Facility (SWMF), which is designed to capture and retain system runoff. The Johnston Street SWMF includes a pumping station that can, if the storage capacity is exceeded, pump flows, via forcemain, to the Canal Bank Road ditch, which ultimately discharges to the Welland Canal via the Bell Street Outfall.

Across much of the existing urban area, stormwater management infrastructure does not include consistent detention or treatment, reflecting historic design practices. As a result, there are opportunities to enhance system performance by implementing additional storage, detention, and treatment measures.

It is noted that the City has several large ditches, such as the Canal Bank Road ditch, that serve as informal detention facilities, attenuating peak flows and reducing downstream impacts.

It is noted that recent development applications for new greenfield developments include on-site stormwater management and retention facilities to reduce post-development runoff rates to pre-development conditions.

Future improvements identified through this Master Servicing Plan will consider system capacity, risk, cost, and interactions between the stormwater and wastewater systems, particularly regarding wet-weather flow management.

4.1.4 Water Quality Management Facilities

The City's CLI-ECA lists 2 oil/grit separators to support the Westwood Estates development but lists no other dedicated stormwater quality management facilities. The City's Johnston Street SWMF and future greenfield detention facilities are assumed to provide standard stormwater quality treatment. However, all remaining areas are assumed to receive no stormwater quality treatment.

4.2 Summary of Stormwater System Configurations

Due to the age and evolution of the City's stormwater system, including resident-led enclosures of drainage networks, significant portions of the City's stormwater conveyance system were not officially designed. These non-design systems were not constructed to a specific standard in terms of sewer geometry, sewer depth, minimum sewer slope, inlet locations and capacity, or size to convey a specific design storm.

As such, the stormwater collection system has been categorized into the following grouping, and as highlighted in **Figure 4-3**:

- **Designed System:** These represent newer portions of the stormwater sewer systems where the City has clear documentation of the system design, and/or systems where the sizing and configuration of the existing stormwater system generally meet existing City design standards. Areas where a new stormwater sewer system has been retrofitted to capture and convey stormwater runoff, but where portions of the historic non-design stormwater system remain to support local drainage and inlet capacity, are, for the purposes of the MSP, considered Designed Systems.
- **Semi-Designed and Non-Designed System:** These represent older portions of the stormwater system where the City does not have clear documentation of the system design and where the system configuration and capacity do not meet the City's existing design standards. These areas are legacy design approaches, including direct conveyance to outlets and non-standard configurations resulting from historic ditch infilling and are generally characterized by undersized sewers, shallow sewers, the presence of parallel sewers, the use of corrugated steel sewers, the absence of manholes, the absence of a curb and gutter system, and inconsistent catch basin placement.



Figure 4-3 Stormwater System Configuration

4.3 Hydraulic Stormwater Model

A hydraulic stormwater model was developed as part of this Master Servicing Plan, as no existing comprehensive stormwater model was available for the City. Based on a review of available modelling platforms and the City's long-term needs, PCSWMM was selected for stormwater modelling.

The model provides a representation of the City's primary stormwater conveyance system and supports the evaluation of system performance under existing and future conditions. The goals of the stormwater modelling under this Master Servicing Plan include:

- Quantifying system performance under various existing and future design storm scenarios.
- Identifying areas of deficiency and distinguishing whether issues are existing, growth-related, or exacerbated by growth.
- Assessing outfall capacity, major flow system performance, and stormwater management facility coverage, including detention and treatment.
- Evaluating system sensitivity to climate change, lake levels, and seiche events.
- Reviewing non-standard or legacy systems to determine current levels of service and the need for upgrades or reconfiguration.
- Identifying servicing requirements for greenfield areas, including drainage boundaries, outlet locations, and preliminary storage and treatment needs.
- Evaluating the effectiveness of proposed system upgrades and supporting infrastructure sizing.

The model development was completed using the following approach:

- Review of available GIS data, record drawings, and background studies.
- Development of an all-pipe network including storm sewers, culverts, and key drainage channels.
- Completion of network topology checks to identify inconsistencies (e.g., orphan pipes, negative slopes, and non-standard configurations).
- Delineation of drainage catchments using topography, road and drainage features, and available GIS data.
- Assignment of hydrologic parameters based on land use, soil conditions, and available mapping.
- Development of model scenarios representing existing and future (buildout) conditions.

4.3.1 Network Development

The stormwater model was developed based on the City's available (January 2025) GIS stormwater infrastructure data, including storm sewers, culverts, and select drainage channels.

A review of the available GIS data identified gaps and inconsistencies in the stormwater dataset, including missing attributes (e.g., pipe size, material, and invert elevations) and instances where available information did not align with expected system configurations. As a result, additional interpretation and assumptions were required to develop a hydraulically functional model.

Standard network topology checks were completed to identify and address inconsistencies within the dataset, including disconnected elements, overlapping pipes, negative slopes, and other non-standard conditions. Where discrepancies could not be resolved using available data, they were flagged for review and confirmation by the City.

4.3.2 Subcatchment Delineation

Lidar-derived classified point could (available through Ontario GeoHub) were used to develop a 2D surface model covering the City extents. The combination of surface model, building footprints, ditch and channel lines, and sewer network inlet points was utilized to develop the model surface drainage and catchment delineations.

4.3.3 Model Validation

The City commissioned a stormwater system flow monitoring program. The flow monitoring program consisted of 31 flow monitors covering a 5 month period from June 2024 to October 2024. **Figure 4-4** highlights the Flow Monitoring locations and their respective upstream stormwater collection network.

Table 4-3 summarizes the 3 major precipitation events that were used to help validate the model's performance.

Table 4-3: Major Precipitation Events

Date	Peak 1 Hour Intensity (mm/hr)	Total Depth (mm)
June 29, 2024	10.2	36.6
July 10, 2024	5.4	35.8
August 16, 2024	13.0	21.9



Figure 4-4 Flow Monitoring Locations

4.3.4 System Evaluation and Model Scenarios

The developed hydraulic model was used to evaluate the performance of the stormwater system under existing and buildout conditions.

The assessment included:

- Identification of system deficiencies and their relationship to existing conditions and future growth.
- Evaluation of outfall capacity, major flow conveyance systems, and downstream outlet constraints.
- Assessment of detention, storage, and treatment facility capacity and coverage.
- Review of system sensitivity to climate change, lake levels, and seiche events.
- Evaluation of non-standard or legacy systems and their ability to meet current levels of service.
- Identification of servicing requirements for greenfield development areas.
- Assessment of stormwater system interaction with the wastewater system, including wet weather flow impacts and opportunities for mitigation.

4.3.5 Model Limitations and Future Enhancements

The model drainage network developed extensive topology connectivity assumptions and interpolation of geometry. It is recommended that, prior to undertaking major analysis and or design activities, localized network geometry verification and model updates be undertaken.

5 Assessment of Existing Stormwater Infrastructure

A key step in the Master Servicing Plan process is assessing the existing stormwater infrastructure to establish baseline system conditions, which form the foundation for the MSP recommendations. This assessment was completed through a detailed review of both designed and semi- or non-designed portions of the system, including minor and major conveyance elements. Once baseline conditions were determined, the potential impacts of future growth, expansion, and intensification were evaluated to inform recommended stormwater servicing strategies.

The analysis approach included:

- Reviewing designed systems and applying established performance criteria.
- Focusing on localized upgrades and investigations where required.
- Assessing semi-designed and non-designed systems to identify gaps and deficiencies.
- Undertaking a modelled capacity review to support infrastructure planning.
- Completing "desktop" trunk sewer design, with emphasis on conveyance to downstream outlets.
- Categorizing system performance:
    - Major deficiencies – requiring rebuild or redesign, often with limited existing system information.
    - Moderate deficiencies – targeted trunk upgrades and identification of key investigation areas.

Per the City's stormwater management policy and design criteria, all infill and future development areas are required to maintain or improve pre-development stormwater peak flowrates. Stormwater servicing concepts focus on addressing existing deficiencies, supporting growth areas, and maintaining or enhancing overall system performance.

The following sections outline current opportunities and constraints within the stormwater system and assess its ability to accommodate projected runoff and drainage demands through the 2051 planning horizon and beyond.

5.1 System Performance

The City's stormwater model was used to support the assessment of the stormwater system's capacity and performance under existing and projected conditions.

5.1.1 Stormwater System Capacity

Figure 5-1 and **Figure 5-2** present the sewer surcharging levels under the 2-year and 5-year design storm, assuming typical outlet conditions.

The performance of the stormwater system varies depending on the level of design and location within the City:

- **Designed Systems:** Most of the modern stormwater infrastructure meets the City's 5-year level of service.
- **Semi-Designed and Non-Designed Systems:** Legacy and ad hoc systems generally do not meet the 2-year level of service, with localized deficiencies observed throughout older neighbourhoods.

5.1.2 Impact of Lake Levels

System performance is influenced by downstream water levels in Lake Erie and the Welland Canal. Areas with ground elevations below 177 m are sensitive:

- Average lake level (174.0 m) generally allows for adequate drainage.
- Peak monthly levels (175.1 m) can reduce outlet capacity, causing localized surcharging or ponding.

Figure 5-3 showcases the lake level impact boundary on the stormwater system.



Figure 5-1: 2-Year Stormwater Sewer Capacity



Figure 5-2: 5-Year Stormwater Sewer Capacity



Figure 5-3 Lake Level Impact

5.2 Opportunities and Constraints

Existing and future stormwater opportunities and constraints were identified through discussions with City staff, review of available GIS and infrastructure data, and preliminary hydraulic analyses. **Figure 5-4** highlights the opportunities and constraints within the system.

System Understanding and Capacity

- The stormwater system is primarily managed by the City, with designed portions generally conveying flows effectively to outlets.
- Non-designed and semi-designed systems, particularly in older neighbourhoods, contribute to localized flooding during higher-intensity rainfall events.
- System configuration and condition are uncertain in some areas, with a mix of design standards and incomplete documentation.
- Outlet capacity is influenced by downstream water levels in Lake Erie and the Welland Canal, particularly in low-lying areas (<177 m).

Constraints

- Non-designed systems with limited formal overland flow routes.
- Constrained outlet capacity due to lake and canal water levels.
- Localized flooding in older neighbourhoods with inadequate conveyance.
- Uncertainty in system configuration and condition across much of the network.
- High cost and complexity associated with system upgrades, making full system replacement infeasible.
- Prioritization required based on risk and history of flooding issues.

Opportunities

- Targeted upgrades in older and non-designed areas to improve conveyance and reduce reliance on overland flow.
- Focus on trunk conveyance improvements to outlets, where practical, to maximize system performance.
- Develop a long-term rehabilitation and replacement strategy to manage improvements over time.
- Coordinate stormwater improvements with broader City infrastructure initiatives to optimize investment.
- Apply consistent design criteria and performance standards in new development and infill areas to maintain or improve current service levels.



Figure 5-4 Opportunities and Constraints

5.3 High-Level Servicing Concepts

The stormwater servicing concepts presented in **Table 5-1** were evaluated at a high level to determine their ability to address the City of Port Colborne's stormwater management objectives. Each concept was assessed for its potential to meet key system performance criteria, considering factors such as conveyance, quantity control, and localized improvements.

Given the variety of strategies included—ranging from status quo operations and localized sewer upgrades to LID measures, major system improvements, outlet upgrades, pumping, and full system reconstruction—the effectiveness of each concept in addressing specific objectives may vary depending on the technologies and strategies ultimately selected.

Table 5-1 also identifies which concepts were recommended to be carried forward for further consideration.

Table 5-1 High Level Servicing Concepts

	Description	Carried Forward
Status Quo	• Keep the existing system as is • Address small issues gradually as part of system rehab and renewal	**Carried forward**: • Designed system with no major deficiencies
Localized Sewer Upgrades	• Targeted improvements to address local problem areas or bottlenecks	**Carried forward**: • Designed system with minor deficiencies • Semi-designed system with sufficient outlet capacities
Quantity Control	• Storage system to manage peak stormwater flows	**Carried forward**: • Greenfield growth areas • Larger site plan developments
Low Impact Development (LID)	• Decentralized stormwater solutions to help manage peak flows and reduce runoff	**Not carried forward** due to groundwater levels and soil conditions **To be considered** on site-by-site case during design stage
Major System Improvements	• Increase the system's capacity to handle runoff that exceeds current sewer system • Improve surface drainage pathways	**Carried forward:** • All system • To be incorporated into design standard practices
Outlet Upgrades	• Upgrade outlet capacity • Protect outlets from high water levels	**Carried forward:** • All system

		• To be incorporated into design standard practices
Pumping	• Pumping conveyance to move water and manage risk from high water levels	**Carried forward:** • Areas impacted by high lake levels
Major System Reconstruction	• Significant redesign and upgrading of the local drainage network	**Carried forward:** • Semi-designed system with major system deficiencies • Non-designed system with major system deficiencies

6 Stormwater Servicing Alternatives and Evaluation

Stormwater servicing alternatives were developed under the context of identifying servicing alternatives to address both broader drainage areas and local opportunities and constraints. These alternatives focus on the existing stormwater system while still accommodating growth.

6.1 Servicing Strategy Development

As part of this MSP, stormwater concepts were evaluated for existing and future growth areas to guide the selection of servicing strategies that:

- Optimize the use of existing infrastructure to reduce the need for new construction where possible.
- Minimize costs associated with new infrastructure.
- Account for operation and maintenance costs to support long-term financial sustainability.
- Ensure the long-term reliability and security of the water system.
- Enhance system resilience to climate change.
- Avoid or minimize environmental disruptions, including watercourse and habitat crossings, wherever feasible.
- Reduce the production of greenhouse gas emissions.
- Limit impacts in areas where disturbances could pose a significant drinking water threat.
- The following sections summarize the development and evaluation of alternative servicing strategies for the City's stormwater system.

6.2 Growth Servicing

Provisional planning for stormwater upgrades identifies general system needs, potential improvement areas, and suitable outlets to connect new developments to the existing stormwater network. These preliminary plans provide guidance for future growth but require refinement through more detailed studies. Key considerations include:

- **Provisional Planning for Upgrades:** Growth planning identifies general system needs, potential improvement areas, and suitable outlets to tie into the existing stormwater network.
- **Need for Site-Specific Designs:** Individual developments must complete detailed stormwater management (SWM) studies to confirm appropriate solutions and ensure compatibility with the local system.

- **Increase in Impervious Area:** New growth introduces additional hard surfaces such as roads, rooftops, and driveways, increasing stormwater runoff and reducing natural infiltration.
- **On-Site Stormwater Management:** Developments are generally required to manage runoff on-site so post-development peak flows match pre-development conditions.
- **Existing Built-Up Areas:** In established neighbourhoods, future growth is assumed not to increase peak flows but may still require targeted improvements or controls.

The following sections present the preliminary servicing strategy and stormwater management requirements for greenfield growth areas, including flow direction, initial drainage boundaries, proposed new SWM ponds, and new outlets. The strategy is based on existing topology, drainage boundaries, and the phased buildout of areas based on existing property boundaries. It is anticipated that detailed functional servicing and stormwater management plans will be completed for each new greenfield development, and that individual proponents may adjust the final servicing approach provided the overall management requirements are achieved.

6.2.1 Roadway Urbanization

The servicing of new growth areas may also trigger improvements and urbanization of existing stormwater drainage along rural cross-section roadways. These improvements and their costs are assumed to be captured within the development's and/or City's roadway improvement projects and have not been identified as specific stormwater upgrade projects.

Further, it is assumed that any additional runoff resulting from roadway urbanization will be incorporated into the onsite stormwater management requirements and strategies for the fronting development, and will not contribute additional peak runoff to the existing stormwater collection and conveyance system.

6.2.2 Eastern Growth Area

The Eastern Growth Area includes a combination of infill development and greenfield expansion. The stormwater servicing approach varies depending on the location and available outlet options, as shown on **Figure 6-1**. In general, the existing collection system in this area has limited capacity, and future development will require a combination of new outlets, local detention, and on-site stormwater management controls. All developments will require, at a minimum, water quality treatment prior to discharge.

- 1 – Outlet Unclear for Infill Development: On-site detention is not required to address downstream outlet control to the canal. However, the existing system in this area has no available capacity to support additional peak flows from the development. However, the proximity to the canal presents an opportunity for a potential new outlet, which would need to be confirmed through further detailed study.
- 2 – Greenfield Development to Existing Trunk Sewer: Discharge to the existing trunk system is possible; however, the trunk is currently at capacity. As a result, a local onside flow control is required to control peak flows prior to discharge.
- 3 – Greenfield to Existing Municipal Drain: Existing lands drain to an existing Municipal Drain. Development to maintain existing drainage patterns. The development will require full on-site stormwater management to manage post-development flows to pre-development levels. Area does not impact the City's existing stormwater collection system.

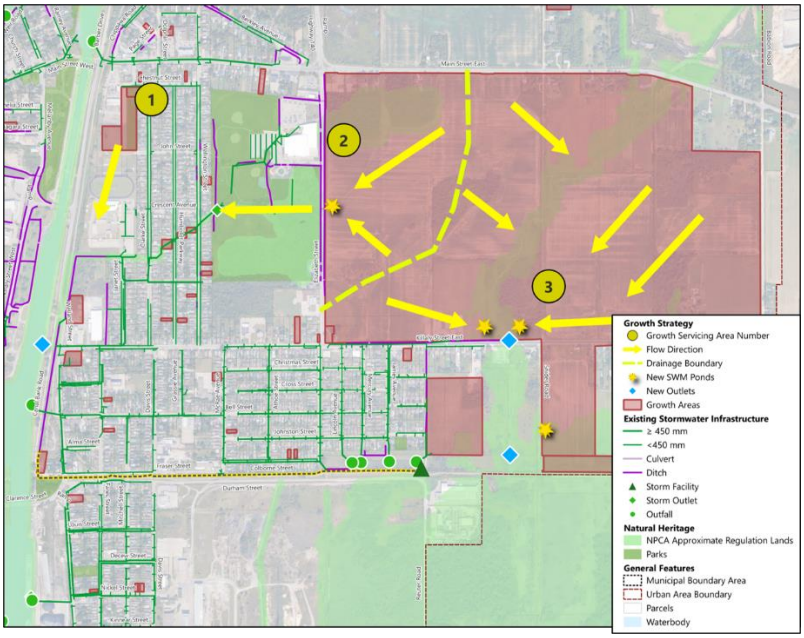


Figure 6-1: Eastern Growth Area

6.2.3 ESEL Growth Area

The ESEL Growth Area consists of lands currently identified for excess soil placement or removal, where future drainage patterns will be largely dependent on final site grading. At this stage, development within this area is not expected to impact the existing stormwater network. The preliminary servicing concepts are shown on **Figure 6-2** and focus on available downstream outlets and associated detention requirements. Individual development applications will be required to confirm the existing capacity of the downstream drainage network to accommodate the proposed development and identify any requirements for on-site stormwater management. All developments will require, at a minimum, water quality treatment prior to discharge.

- 1 – Discharge to Ditch and Existing Outlet: Drainage would be directed to an existing ditch system and downstream outlet. On-site detention is not required to address downstream outlet control to the canal. Detention requirements would be governed by the available capacity of both the ditch and the receiving outlet, and may be required to manage peak flows.
- 2 – Discharge to Existing Outlet: Drainage would connect directly to an existing outlet. On-site detention is not required to address downstream outlet control to the canal. An upgrade to the outlet may be required to reduce or minimize the need for on-site detention and improve overall conveyance capacity.

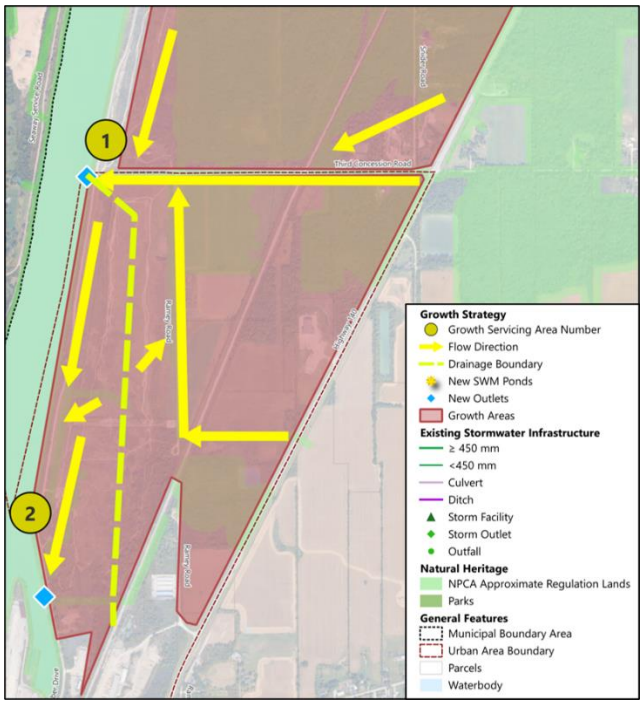


Figure 6-2: ESEL Growth Area

6.2.4 North Growth Area

The North Growth Area is predominantly a greenfield development area and is not expected to have any impact on the existing stormwater network. The preliminary servicing approach, shown on **Figure 6-3**, considers a combination of existing ditch outlets and direct discharge to the creek, with varying levels of stormwater management required depending on the selected outlet. All developments will require, at a minimum, water quality treatment prior to discharge.

- 1 – Discharge to Ditch and Existing Outlet: Drainage would be directed to an existing ditch system and downstream outlet. On-site detention is not required to address downstream outlet control to the canal. Detention requirements would be based on the available capacity of both the ditch and the receiving outlet.
- 2 – Discharge to Creek (Greenfield): Direct discharge to the creek and would require full stormwater management controls to be implemented.
- 3 – Discharge to Ditch and Existing Outlet: Similar to 1, drainage would be directed to an existing ditch system and downstream outlet. On-site detention is not required to address downstream outlet control to the canal. Detention requirements would be based on the available capacity of both the ditch and the receiving outlet.

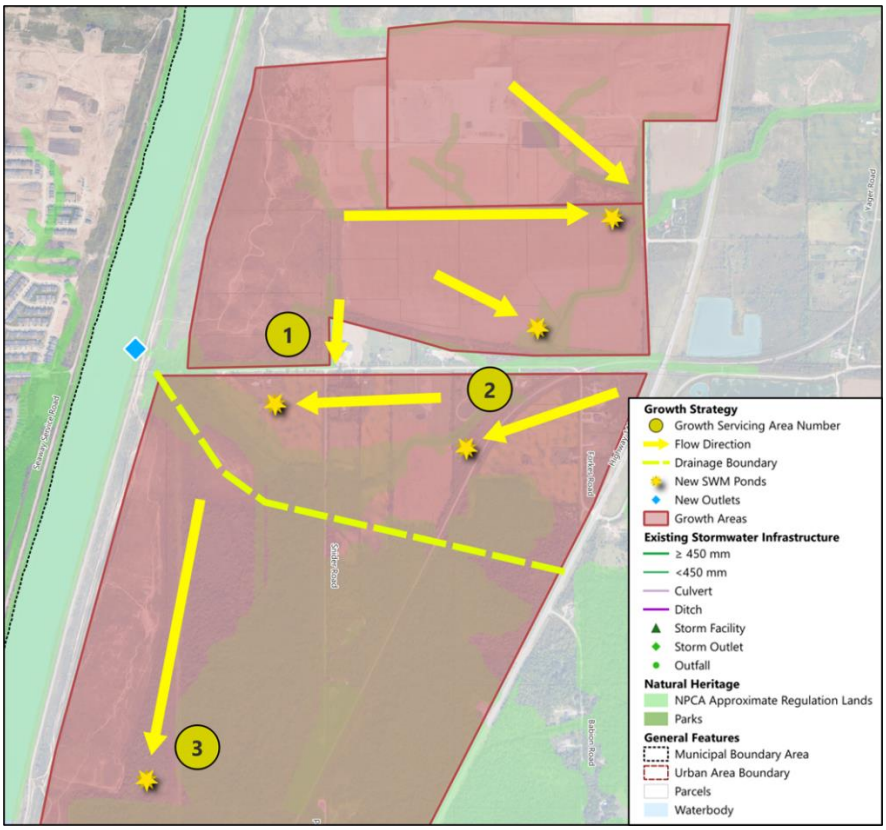


Figure 6-3: North Growth Area

6.2.5 Marina Growth Area

The Marina Growth Area is currently not serviced by stormwater sewers and is not expected to impact the existing stormwater network. As shown on **Figure 6-4,** a new outlet will be required to support future development in this area.

- 1 – New Outfall to Required Lake Erie (Marina): Development would require a new outfall to the canal Lake Erie (within the existing Marina area). Stormwater management in this area would focus primarily on water quality treatment prior to discharge, with appropriate measures to meet regulatory requirements.

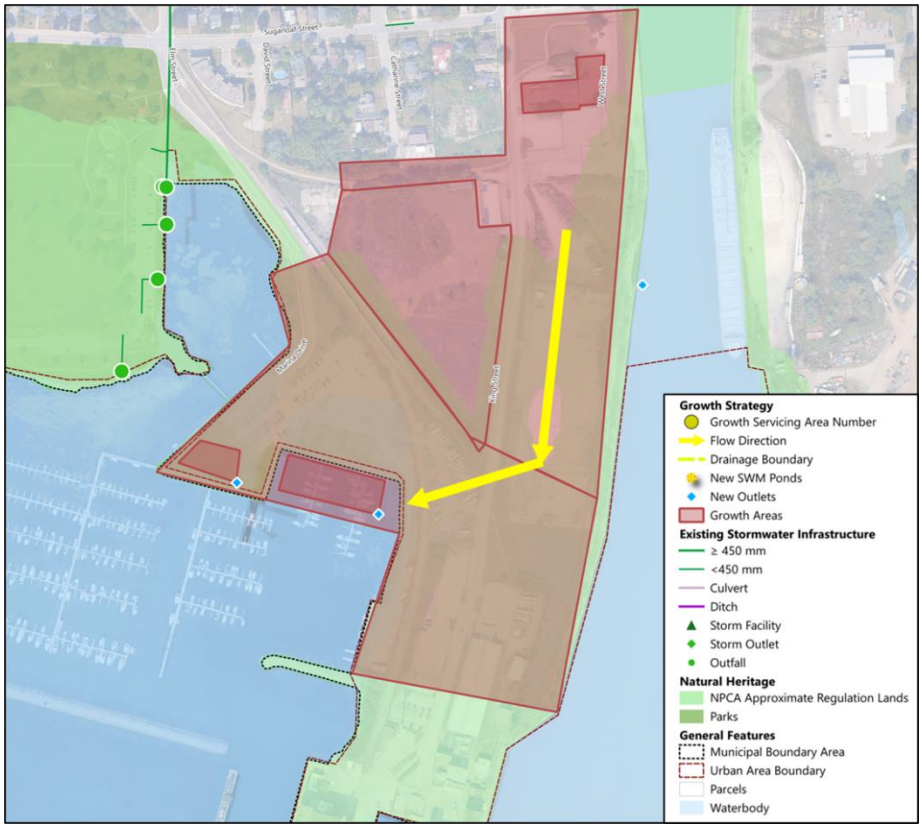


Figure 6-4: Marina Growth Area

6.2.6 Southwest Growth Area

The Southwest Growth Area is a new greenfield development area and is not expected to impact the existing stormwater network. As shown on **Figure 6-5**, there is an opportunity to establish a new outlet that could also intercept flows from the Sugarloaf area, supporting a more integrated drainage approach.

- Discharge to Existing Ditch and to Eagle Marsh: Drainage would be directed to the existing ditch system and downstream Eagle Marsh. Detention requirements would be based on the available capacity of the ditch, with controls implemented as needed to manage peak flows prior to discharge, at a minimum, the developments will require water quality treatment prior to discharge.

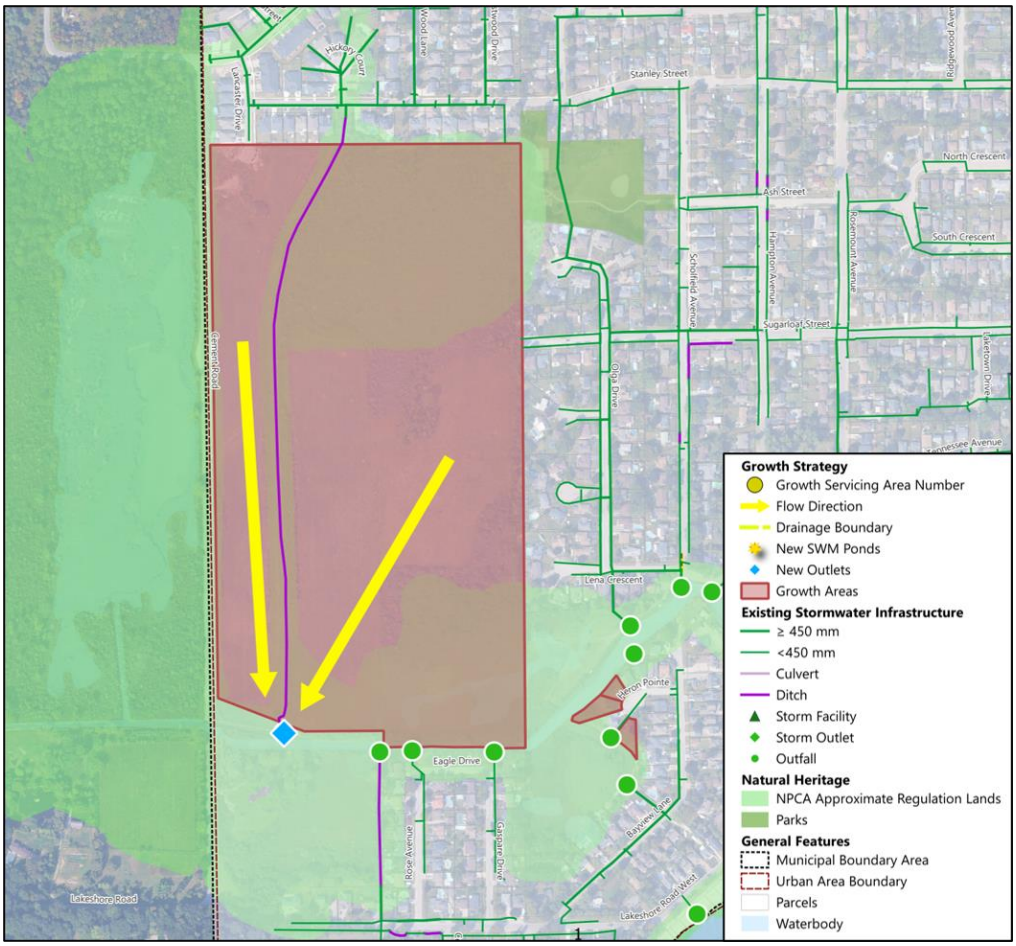


Figure 6-5: Southwest Growth Area

6.2.7 Western Growth Area

The Western Growth Area is a new greenfield development area and is not expected to impact the existing stormwater network. The preliminary servicing strategy, as shown on **Figure 6-6**, considers various discharge pathways to the existing ditch network, with varying levels of system constraints and required on-site controls.

- 1 – New Greenfield to Existing Ditch: Drainage would be directed to the existing ditch system, with potential ditch improvements required to support increased flows. SWM subject to available capacity within the Quarry Pond. The Quarry Pond does not have an existing outlet; the proposed development application will be required to demonstrate that there is sufficient detention and retention capacity to support the increased runoff volumes without causing flooding or overflows at the Quary pond. Provisions for an overflow from the Quarry Pond to the Rosemount Avenue sewer and outfall upgrades should be made if upgrades to the Sugarloaf are made prior to confirmation of the development and Quarry Pond stormwater management strategy.
- 2 – Greenfield to Existing Ditch Network: The existing downstream system has no available capacity to accommodate additional flows. Full on-site SWM would be required, likely along with downstream system upgrades.
- 3 – Greenfield to Existing Ditch Network: The existing ditch network does not have available capacity. Full on-site SWM would be required to control peak flows prior to discharge.

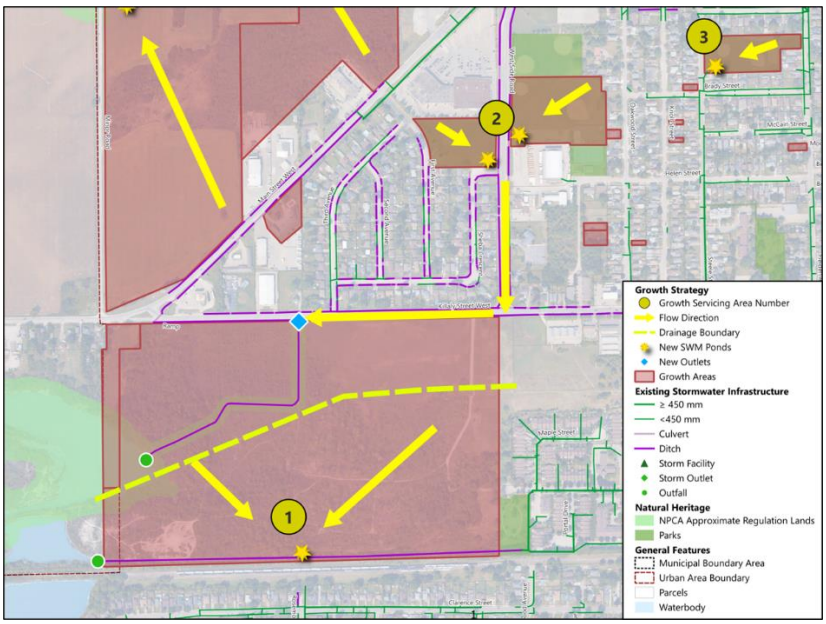


Figure 6-6: Western Growth Area

6.2.8 Northwestern Growth Area

The Northwestern Growth Area is a new greenfield development area with no existing local storm sewer infrastructure and is not expected to impact the existing local stormwater network. As shown on **Figure 6-7**, development will require establishment of appropriate outlets and conveyance routes to support future drainage.

- 1 – New Greenfield: A suitable outlet and drainage channel will need to be established to support future development. Full on-site stormwater management will be required to control both quantity and quality of runoff prior to discharge.
- 2 – Greenfield with No Local Storm Network: The area currently has no local storm sewer network. Full on-site SWM will be required, along with construction of a new storm sewer connection to the trunk network along Westside Road.

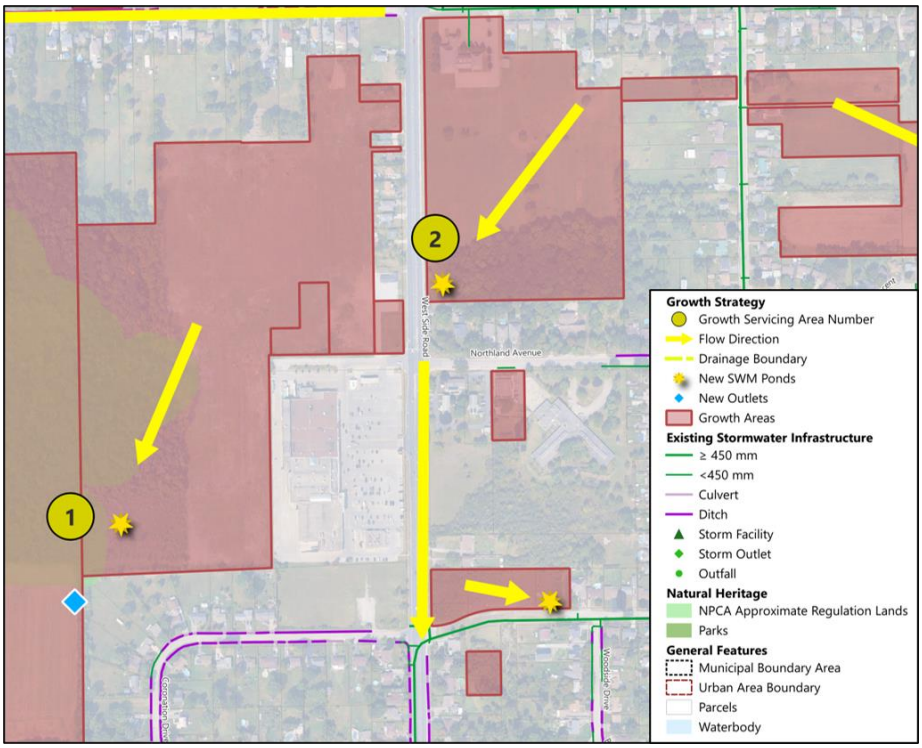


Figure 6-7: Northwestern Growth Area

6.2.9 Central Growth Area

The Central Growth Area consists of greenfield development that would connect into the existing storm sewer network. The existing system is generally performing to the desired criteria and is expected to accommodate controlled inflows from future development, subject to appropriate on-site stormwater management controls, and is shown in **Figure 6-8**.

- 1 – Greenfield Growth to Existing Storm Sewer: Development would discharge to the existing storm sewer system. The system is currently performing to the desired criteria; however, full on-site SWM will be required to control post-development flows prior to connection.
- 2 – Greenfield Growth to Existing Storm Sewer: Development would connect to the existing storm sewer network. The system is currently performing to the desired criteria; however, full on-site SWM will be required to control post-development flows prior to connection.

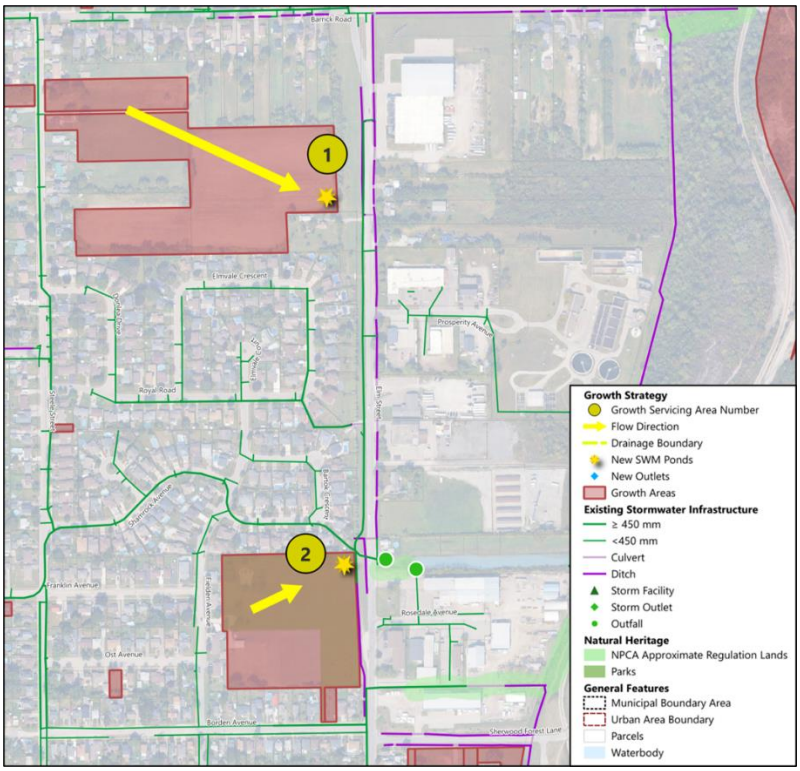


Figure 6-8: Central Growth Area

6.2.10 Northwestern Growth Area

The Northwestern Growth Area consists of greenfield development that will ultimately discharge to the existing ditch network, shown on **Figure 6-9**. The existing system is generally performing to the desired criteria. Full on-site stormwater management will be required for the growth.

- 1 – Greenfield Growth to Existing Ditch Network: Development would discharge to the existing ditch network; however, the system is currently at capacity. Full on-site SWM will be required to control post-development flows prior to connection.
- 2 – Greenfield Growth with Alternate Outlets Feasible: Alternate outlet options are feasible, with a recommendation to continue discharging to the existing ditch network. Full on-site SWM will be required to control post-development flows prior to connection.

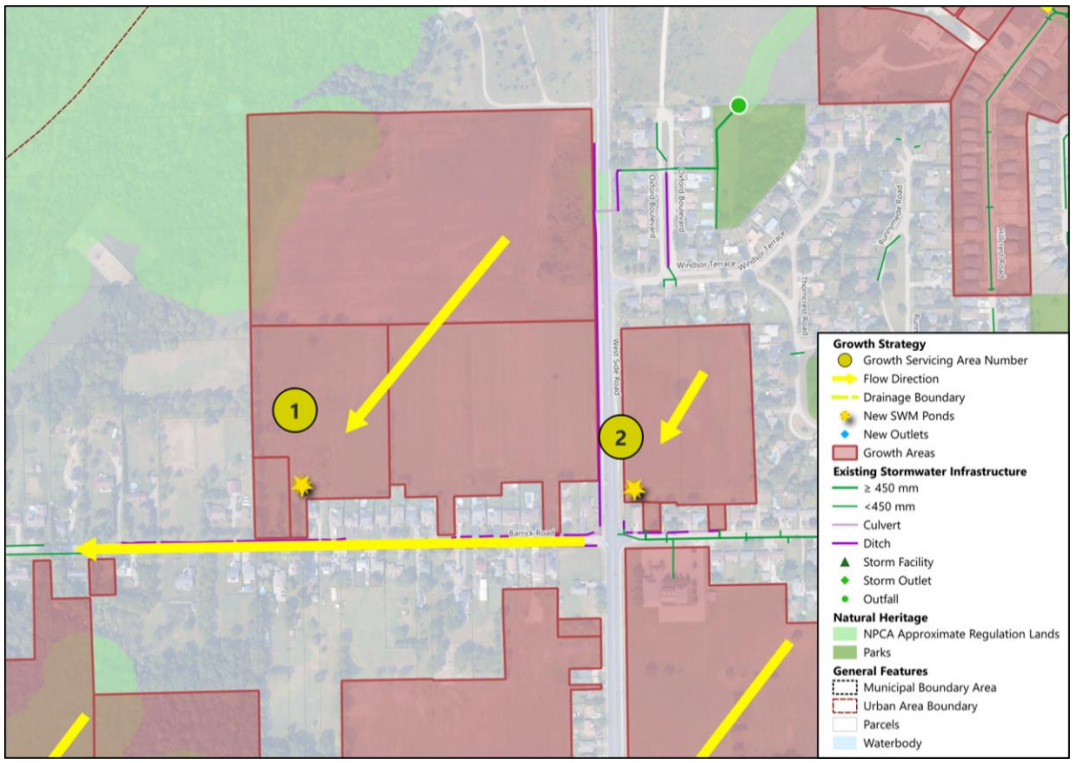


Figure 6-9: Northwestern Growth Area

6.2.11 Northwestern Growth Area

This portion of growth is located downstream of the existing storm sewer system. As such, future development is expected to integrate with the existing drainage patterns and infrastructure, as shown on **Figure 6-10**.

- Growth Downstream of Existing Storm System: Development in this area will be required to be designed in accordance with City standards. Appropriate stormwater management measures will be implemented to ensure flows are adequately controlled and downstream system performance is maintained.

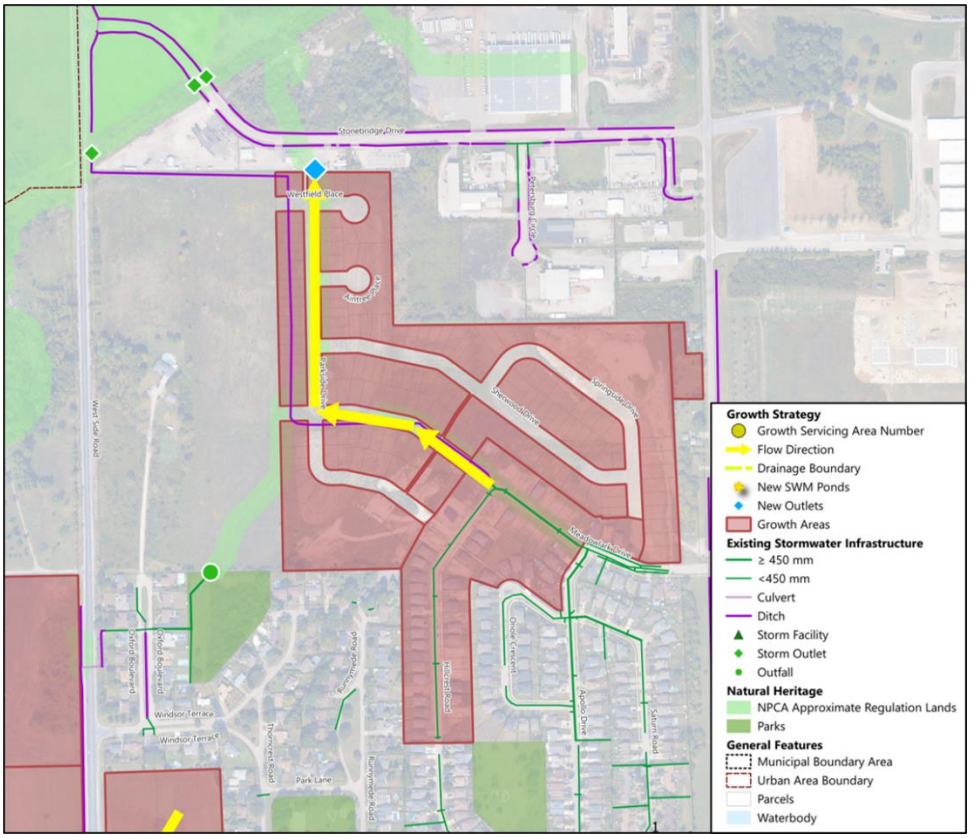


Figure 6-10: Northwestern Growth Area

6.2.12 Western Growth Area

The Western Growth Area is a new greenfield development area with no existing local storm sewer infrastructure and is not expected to impact the existing stormwater collection system. As shown on **Figure 6-11**, development will require the establishment of appropriate drainage outlets, conveyance routes, and stormwater management controls to support future growth.

- 1 – Greenfield to Municipal Drain: Existing lands generally drain toward an adjacent Municipal Drain. Development should maintain the overall drainage patterns, with runoff directed to the receiving ditch and Municipal Drain. Full on-site SWM will be required to control both quantity and quality of runoff, ensuring post-development flows do not exceed pre-development conditions. The area is not anticipated to impact the existing municipal stormwater system.
- 2 – Greenfield to Municipal Drain with New Shared Outlet: Development within this area will require routing flows toward a new shared outlet to the Municipal Drain. This outlet will also receive flows from Area 3. Full on-site SWM will be required to manage runoff quantity and quality prior to discharge.
- 3 – Similar to Area 2, development will direct flows toward the same new outlet to the receiving creek, approaching from a different drainage direction. Coordinated design of conveyance infrastructure and outlet capacity will be required to accommodate combined flows. Full on-site SWM will be required to control runoff and maintain pre-development flow conditions.
- 4 – Greenfield to Municipal Drain with New Outlet: This area is located closer to the existing stormwater system and may present opportunities to coordinate outlet works with nearby infrastructure. Development will require a separate new outlet to the receiving creek, along with supporting conveyance infrastructure. Design should consider integration with adjacent systems, overland flow routing, and potential downstream constraints to consolidate outlet and stormwater management facilities. Full on-site SWM will be required to control runoff quantity and quality prior to discharge.

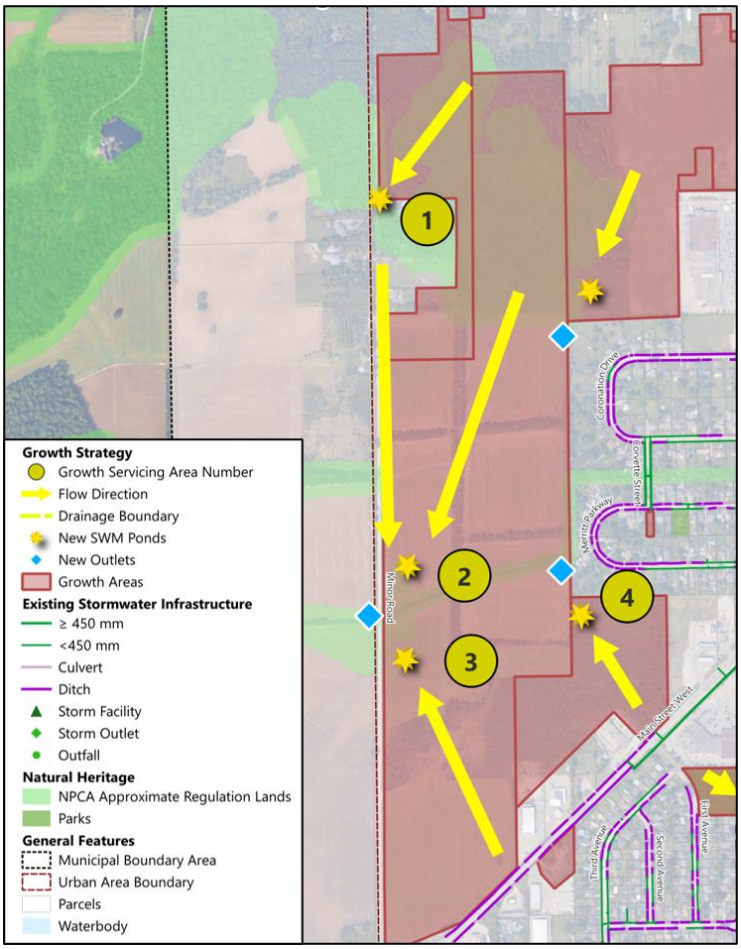


Figure 6-11: Western Growth Area

6.2.13 North Central Growth Area

The North Central Growth Area is a greenfield development area and is not expected to impact the existing stormwater network. As shown on **Figure 6-12**, a new outlet to the canal will be required to support future development.

- New Outlet to the Canal: Development will require a new discharge outlet to the canal. Appropriate SWM controls will be implemented to manage and water quality prior to discharge.

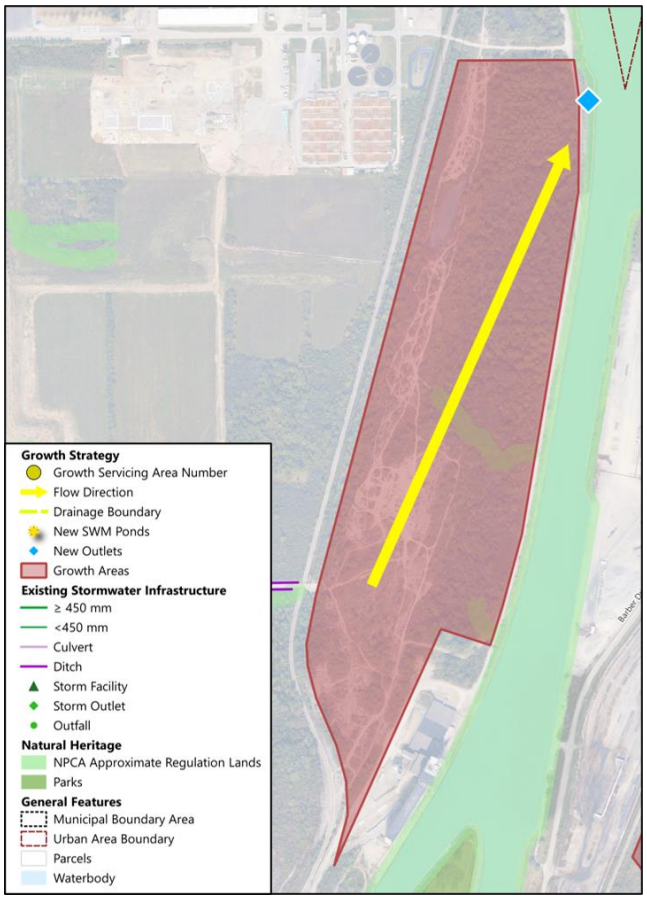


Figure 6-12: North Central Growth Area

6.3 Existing System

6.3.1 Clark Street Drainage

The Clark Street Drainage area experiences existing capacity limitations, including undersized local sewers and trunk sewer constraints. The trunk sewer is at capacity and passes through private properties, creating access and maintenance challenges. Local sewers are prone to flooding due to their size and the limited capacity of the trunk sewer, and some segments are suspected to be small-diameter infrastructure. While the Bell Street trunk sewer has adequate capacity, the overall system must accommodate multiple growth areas discharging to this network, increasing future demand.

A range of alternatives were evaluated to address both existing and future system needs:

- **Sewer Upgrades – Existing Alignment:** Utilizes the current sewer network to address capacity issues. Local sewers remain undersized for future development, and the trunk sewer still requires rehabilitation or replacement. Access and encroachment challenges limit feasibility.
- **Trunk Sewer Realignment:** Shifts the trunk sewer into road rights-of-way for improved access, maintenance, and system optimization. Enables flow diversion opportunities but requires reconstruction of local sewers and may involve routing through parklands.
- **Diversion to New Outfalls:** Reduces upstream upgrading needs and relieves downstream capacity constraints. Outfall options are constrained by canal and lock infrastructure, may require land acquisition, and additional EA processes, and does not eliminate the need for trunk sewer rehabilitation.
- **Localized Sewer Upgrades:** Targets specific areas with known flooding issues at a lower cost. While effective locally, this alternative does not address the broader system-wide deficiencies.

Table 6-1 presents the alternatives evaluated for the Clark Street Drainage Area, along with their advantages and disadvantages.

Through discussions with City staff and based on the advantages and limitations of the alternatives, a combined approach consisting of **Trunk Sewer Realignment and System Reconstruction**, along with **Localized Sewer Upgrades**, is identified as the preferred servicing strategy, as:

- The existing system does not adequately support current performance requirements or future growth.

- The preferred strategy allows for:
    - Realignment of the trunk sewer along Russell Avenue to improve access, capacity, and long-term maintainability;
    - Full reconstruction of the local sewer network north of Killaly Street to support future growth and improve system reliability;
    - Implement targeted local sewer upgrades to resolve localized capacity bottlenecks; and
    - Completion of detailed sewer investigation and inspection to confirm existing conditions, identify rehabilitation needs, and validate design assumptions for implementation.

Table 6-1: Clark Street Drainage Alternatives Evaluation

<table>
<tr><th colspan="2"></th><th>Sewer Upgrades – Existing Alignment</th><th colspan="3">Trunk Sewer Re-alignment and System Reconstruction</th><th>Diversion to New Outfalls</th><th colspan="3">Localized Sewer Upgrades</th></tr>
<tr><td colspan="2"></td><td></td><td colspan="3"></td><td></td><td colspan="3"></td></tr>
<tr><td colspan="2">Advantage</td><td>• Leverage existing network</td><td colspan="3">• Shifts the trunk sewer into road right-of-way for better access and long-term maintenance
• Allows system optimization and flow diversions to address other system issues
• Addresses trunk sewer rehabilitation/replacement needs</td><td>• Potential to minimize total sewer upgrade needs
• Potential to address downstream capacity issues</td><td colspan="3">• Addresses localized capacity issues
• Minimizes implementation costs</td></tr>
<tr><td colspan="2">Disadvantage</td><td>• Existing trunk sewer alignment has access and encroachment issues
• Local network is deficient and does not support potential developments
• Trunk sewer still requires rehabilitation or replacement</td><td colspan="3">• Requires reconstruction of local storm sewer network
• Requires diversion through parklands</td><td>• Outfall location may be limited due to canal locks
• New outfall likely to require land acquisition and additional EA investigation
• Trunk sewer needs rehabilitation/replacement</td><td colspan="3">• Does not address broader system-wide issues</td></tr>
<tr><td rowspan="2">Financial</td><td>Capital Cost</td><td>Medium</td><td colspan="3">High</td><td>Medium</td><td colspan="3">Low</td></tr>
<tr><td>O&M Cost</td><td>Medium</td><td colspan="3">Low</td><td>Medium</td><td colspan="3">Low</td></tr>
<tr><td colspan="2" rowspan="2">Evaluation</td><td>Technical</td><td>Environ-mental</td><td>Social Cultural</td><td>Technical</td><td>Environ-mental</td><td>Social Cultural</td><td>Technical</td><td>Environ-mental</td><td>Social Cultural</td><td>Technical</td><td>Environ-mental</td><td>Social Cultural</td></tr>
<tr><td>Medium</td><td>High</td><td>Medium</td><td>High</td><td>High</td><td>High</td><td>Low</td><td>Medium</td><td>Medium</td><td>Low</td><td>High</td><td>High</td></tr>
<tr><td colspan="2">Recommended Alternative</td><td colspan="3">Not Recommended: Does not address long-term operation and maintenance issues in the existing trunk sewer and provides limited opportunity to address local system deficiencies.</td><td colspan="3">Recommended: Addresses long-term operation and maintenance issues in the existing trunk sewer and provides opportunities to reconfigure local system.</td><td colspan="3">Not Recommended: Due to technical challenges related to securing and constructing a new outlet, it does not address long-term operation and maintenance issues of the existing trunk sewer.</td><td colspan="3">Recommended: To address localized issues.</td></tr>
</table>

6.3.2 Clark Street Outlet

The Clark Street outlet is constrained by downstream water levels and limited discharge capacity, particularly during periods of high lake levels. Outlet performance is currently insufficient to fully convey peak flows from the drainage area, and high lake levels further reduce system effectiveness. A range of alternatives was evaluated to improve outlet performance, reduce flooding risk, and better manage flows during elevated lake levels:

- **Status Quo:** Maintains the existing system with minimal disruption and relies on current storage to manage peak flows. This approach does not provide protection against elevated lake levels.
- **Capacity Upgrades:** Increases outlet conveyance capacity to reduce flooding risk. This alternative does not address high lake level conditions and requires coordination of works within the canal.
- **Flood Protection and Storage Improvements:** Provides protection against high lake levels while increasing storage to manage peak flows and flows during elevated lake conditions. Implementation may involve environmental considerations related to canal bank or ditch works and requires coordinated construction within the canal.
- **Real-Time Control:** Utilizes operational controls to optimize existing infrastructure at relatively low cost. This approach provides system-wide benefits but may result in a minor increase in flooding risk in the Elizabeth Street area.

Table 6-2 presents the concepts along with their advantages and disadvantages. A hybrid approach incorporating **Capacity Upgrades, Flood Protection and Storage Improvements,** and **Real-Time Control** is identified as the preferred servicing strategy, as:

- No single alternative fully addresses the range of outlet constraints, particularly under varying lake level conditions.
- The preferred strategy allows for:
- Implement targeted sewer upgrades in the Bell Street Area to resolve localized capacity bottlenecks;
    - Increase outlet capacity to better manage system flows;
    - Integrate flood-protection measures to guard against high lake levels;
    - Rehabilitate and strengthen the drainage channel along Canal Bank Road;
    - Where feasible, expand storage capacity through in-ditch improvements or retention features; and

- Install real-time control mechanisms at Johnston Pump Station to delay pumping when canal storage is in use.

Table 6-2: Clarke Area Outlet Alternatives Evaluation

<table>
<tr><th colspan="2"></th><th>Status Quo</th><th colspan="3">Capacity Upgrades</th><th>Flood Protection and Storage Improvements</th><th colspan="3">Real-time Control</th></tr>
<tr><td colspan="2"></td><td></td><td colspan="3"></td><td></td><td colspan="3"></td></tr>
<tr><td colspan="2">Advantage</td><td>• Maintains the existing system with minimal disruption
• Utilizes current storage to manage peak flows</td><td colspan="3">• Increases conveyance to reduce flooding risk</td><td>• Protects against high lake levels
• Increases storage capacity to manage peak flows and/or flows during high lake levels</td><td colspan="3">• Limited implementation cost; operation controls
• Optimizes use of existing infrastructure</td></tr>
<tr><td colspan="2">Disadvantage</td><td>• Does not protect against high lake levels</td><td colspan="3">• Does not protect against high lake levels
• Requires coordination of works in the canal</td><td>• Potential environmental issues with the canal bank ditch improvements
• Requires coordination of work in the canal</td><td colspan="3">• Minor increase in flooding risk to Elizabeth Street Area</td></tr>
<tr><td rowspan="2">Financial</td><td>Capital Cost</td><td>Low</td><td colspan="3">Medium</td><td>Medium</td><td colspan="3">Low</td></tr>
<tr><td>O&M Cost</td><td>Low</td><td colspan="3">Low</td><td>Medium</td><td colspan="3">Medium</td></tr>
<tr><td colspan="2" rowspan="2">Evaluation</td><td>Technical</td><td>Environ-mental</td><td>Social Cultural</td><td>Technical</td><td>Environ-mental</td><td>Social Cultural</td><td>Technical</td><td>Environ-mental</td><td>Social Cultural</td><td>Technical</td><td>Environ-mental</td><td>Social Cultural</td></tr>
<tr><td>Low</td><td>High</td><td>Low</td><td>Medium</td><td>Medium</td><td>Medium</td><td>High</td><td>Low</td><td>High</td><td>Medium</td><td>High</td><td>High</td></tr>
<tr><td colspan="2">Recommended Alternative</td><td colspan="3">Not Recommended: Does not address flooding issues</td><td colspan="3">Recommended as Part of Hybrid Solution: Minimizes risk of flooding, and ensures storage is available during high lake levels.</td><td colspan="3">Recommended as Part of Hybrid Solution: Best protection against high lake levels.</td><td colspan="3">Recommended as Part of Hybrid Solution: Low-cost solution and provides additional benefit.</td></tr>
</table>

6.3.3 Elm Street & King Street North

The Elm Street and King Street North area system, generally consisting of west of the canal draining directly to the Canal via eight (8) primary outlets and several smaller outlets, is constrained by limited outlet capacity and is sensitive to elevated lake levels, resulting in localized flooding and reduced system performance. An assessment of system capacity indicates that outlet performance is generally adequate under typical conditions but becomes restricted during high lake levels. Portions of the system that were not formally designed are limited in their conveyance capacity, further contributing to localized flooding and operational constraints.

A range of alternatives were evaluated to address both existing deficiencies and future servicing needs:

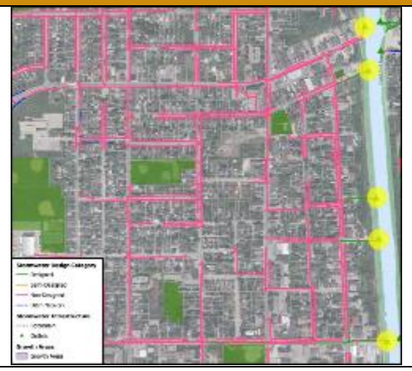
- **Outlet Flood Protection:** Focuses on inspection and rehabilitation of existing outlets to reduce backwater effects and provide partial protection from elevated lake levels. This approach does not increase overall system capacity and remains vulnerable during extreme lake conditions. Implementation requires construction within the canal corridor.
- **Localized Sewer Upgrades:** Improves conveyance within the existing network by addressing undersized sewers and localized capacity constraints. This approach leverages existing outlet capacity but is limited by downstream restrictions and does not provide protection from high lake levels.
- **Outlet Capacity Upgrades:** Increases outlet conveyance capacity, typically in combination with local network improvements. This approach can provide additional storage benefits when paired with flood protection measures; however, outlet options are constrained by canal lock locations and remain susceptible to elevated lake levels. Implementation requires coordinated work within the canal.
- **Diversion and Pumping:** Introduces a new trunk sewer and pump station to convey flows during high lake level conditions. This approach provides protection from elevated lake levels and significantly improves overall system performance. However, it requires substantial new infrastructure and results in higher long-term operating costs associated with pumping.

Table 6-3 presents the alternatives along with the advantages and disadvantages. Through discussions with City staff and based on the relative advantages and limitations of the

alternatives, a hybrid approach incorporating **Outlet Flood Protection** and **Localized Sewer Upgrades** is identified as the preferred servicing strategy.

- The preferred strategy consists of:
    - Construct a new trunk sewer along Neff Street to enhance system capacity and connectivity;
    - Build a new trunk sewer along Field Avenue to support future growth and reliability;
    - Implement local sewer improvements on Charles Street to address existing deficiencies;
    - Upgrade local sewers on Minto and Erie Streets to improve flow and service reliability; and
    - Enhance outlet performance through inspection, rehabilitation, and flow protection measures.

Table 6-3: Elm Street and King Street North Alternatives Evaluation

		Outlet Flood Protection			Localized Sewer Upgrades			Outlet Capacity Upgrades			Diversion and Pumping		
													
Advantage		• Partial protection from high lake levels			• Addresses localized capacity issues • Leverages existing outlets and capacity • Improves conveyance and capacity			• Provides additional capacity to improve local system performance • Can provide additional storage when paired with outlet flood protection			• Protects against high lake levels with pump operating • Can provide substantial improvement in system performance		
Disadvantage		• No increase in system capacity • Still vulnerable during extreme lake conditions • Requires canal-side construction			• Limited by existing outlet capacity • Does not protect against high lake levels			• Outlet options constrained by canal lock locations • Still susceptible to high lake levels • Requires coordinated work in the canal			• Requires substantial infrastructure investment • Higher long-term operating costs due to pumping		
Financial	**Capital Cost**	Low			Low			Medium			High		
	O&M Cost	Low			Low			Low			High		
Evaluation		**Technical**	**Environ-mental**	**Social Cultural**	**Technical**	**Environ-mental**	**Social Cultural**	**Technical**	**Environ-mental**	**Social Cultural**	**Technical**	**Environ-mental**	**Social Cultural**
		High	Medium	High	High	High	High	Medium	Medium	Medium	Low	Low	Low
Recommended Alternative		**Recommended as Part of Hybrid Solution:** Provides partial protection against high lake levels			**Recommended as Part of Hybrid Solution:** Targeted upgrades to address highest flood risk areas			**Not Recommended:** Outlets sufficiently sized to support existing design objectives. Upsizing provides marginal benefit.			**Not Recommended:** High implementation and operational cost.		

6.3.4 Elm Street & King Street South

The Elm Street and King Street South systems experience capacity limitations and are sensitive to downstream constraints, particularly during periods of elevated lake levels. An assessment of system capacity indicates that outlet performance is significantly influenced by lake levels, with generally adequate capacity under typical conditions and restricted capacity during high lake levels. Much of the existing, undesigned system performs adequately under normal conditions; however, there remains potential to service areas draining to the south, subject to outlet capacity constraints. A range of alternatives were evaluated to improve system performance and address existing and future servicing needs:

- **Outlet Flood Protection:** Focuses on inspection and rehabilitation of existing outlets to reduce backwater effects and provide partial protection from elevated lake levels. This approach does not increase system capacity and remains vulnerable during extreme lake conditions. Implementation requires construction within the canal corridor.
- **Redirection of Drainage Areas:** Redirects flows to leverage available capacity within adjacent systems and existing outlets. This approach can improve conveyance and address localized capacity issues; however, it is constrained by downstream outlet capacity and does not provide protection from high lake levels.
- **Outlet Capacity Upgrades:** Increases outlet conveyance capacity, typically in combination with local network improvements. This approach can provide additional storage benefits when paired with flood protection measures; however, outlet options are constrained by canal lock locations and remain susceptible to elevated lake levels. Implementation requires coordinated work within the canal.
- **Diversion and Pumping:** Introduces a new trunk sewer and pump station to convey flows during high lake level conditions. This approach provides protection from elevated lake levels and significantly improves overall system performance. However, it requires substantial new infrastructure and results in higher long-term operating costs associated with pumping.

Table 6-4 presents the four concepts along with their advantages and disadvantages. **Outlet Flood Protection** is identified as the preferred servicing strategy, as:

- The primary system constraint is related to outlet performance and sensitivity to elevated lake levels.
- The preferred strategy allows for:

- Inspect and rehabilitate outlets to maintain structural integrity and hydraulic performance; and
- Implement flow protection measures to reduce erosion and enhance system reliability.

Table 6-4: Elm Street and King Street South Alternatives Evaluation

		Outlet Flood Protection			Redirection of Drainage Areas			Outlet Capacity Upgrades			Diversion and Pumping		
													
Advantage		• Partial protection from high lake levels • Reduces backwater effects at the outlet			• Leverages existing outlets and capacity • Improves conveyance and capacity • Addressed localized capacity issues			• Provides additional capacity to improve local system performance • Can provide additional storage when paired with outlet flood protection			• Protection from high lake levels • Can provide substantial improvement in system performance		
Disadvantage		• No increase in system capacity • Still vulnerable during extreme lake conditions • Requires canal-side construction			• Limited by existing outlet capacity • No protection from high lake levels			• Outlet options constrained by canal lock locations • Still susceptible to high lake levels • Required coordinated work in the canal			• Requires significant new infrastructure • Higher long-term operating costs due to pumping		
Financial	**Capital Cost**	Low			Medium			Medium			High		
	O&M Cost	Low			Low			Low			High		
Evaluation		**Technical**	**Environ-mental**	**Social Cultural**	**Technical**	**Environ-mental**	**Social Cultural**	**Technical**	**Environ-mental**	**Social Cultural**	**Technical**	**Environ-mental**	**Social Cultural**
		High	Medium	High	Medium	High	High	Medium	Medium	Medium	Low	Low	Low
Recommended Alternative		**Recommended:** Provides partial protection against high lake levels			**Not Recommended:** Limited by capacity of existing drainage network			**Not Recommended:** Outlets sufficiently sized to support existing design objectives. Upsizing provides marginal benefit.			**Not Recommended:** High implementation and operational cost.		

6.3.5 Sugarloaf Area

The Sugarloaf area is constrained by outlet capacity and system configuration uncertainties, with performance significantly influenced by downstream lake levels. An assessment of system capacity indicates that outlet performance is generally adequate under typical conditions but becomes restricted during periods of elevated lake levels. Portions of the undesigned system are also limited in their conveyance capacity, contributing to localized constraints.

Improvements to the local system are likely to increase flows to the outlet, which may further exacerbate downstream capacity limitations. Additional pressures on the system are anticipated from upstream development along Rosemount Avenue. There is also a high degree of uncertainty in the local system configuration and outlet conditions, which affects the identification and prioritization of improvements. Opportunities exist to divert flows to adjacent catchments to the east or west to help reduce system demand.

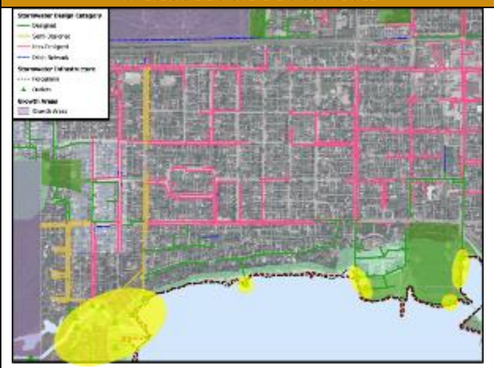
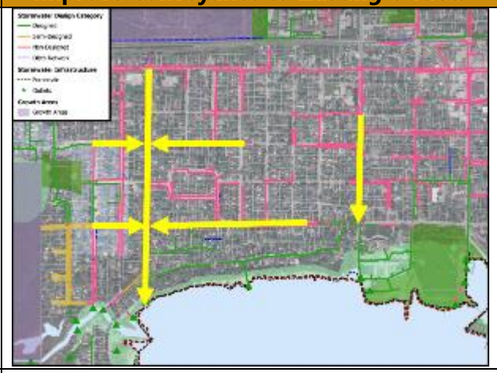
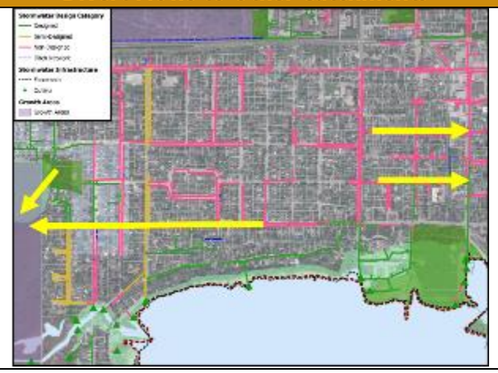
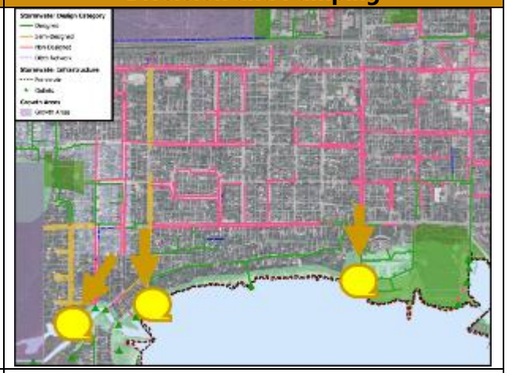
A range of alternatives were evaluated to address both existing deficiencies and future servicing needs:

- **Outlet Flood Protection:** Provides flood protection at outlets to reduce the impacts of elevated lake levels and includes inspection and rehabilitation of existing infrastructure to maintain performance. This approach requires lakeshore work and does not increase system capacity for future growth.
- **Improve Conveyance to Existing Outlets:** Involves construction of new trunk sewers and improvements to existing outfalls to increase system capacity. This approach addresses existing system condition issues and can be coordinated with planned road improvements while supporting future growth areas. Implementation may require substantial upgrades and lakeshore construction.
- **Divert Flows to Other Catchments:** Enhances capacity within undesigned systems to better serve local areas and diverts minor flows to adjacent east and west catchments to reduce demand on the trunk system. This approach has limited impact on overall system capacity and may be constrained by timing and downstream development.
- **Diversion and Pumping:** Intercepts and diverts flows along Sugarloaf to the west into new development areas and incorporates pump stations at outfalls to operate during elevated lake levels. This approach can be combined with conveyance upgrades to improve overall system performance but requires significant infrastructure investment and results in increased long-term operating costs.

Table 6-5 presents the four concepts along with their advantages and disadvantages. Through discussions with City staff and based on the relative benefits of the alternatives, a hybrid strategy combining **Outlet Flood Protection** and **Improved Conveyance to Existing Outlets** is recommended, as:

- The area is constrained by outlet capacity, high lake levels, and an undesigned local system with uncertain configuration.
- The preferred strategy allows for:
    - Provide an outlet to the development area north of Clarence Street;
    - Provide capacity to allow partial diversion of flow away from Quarry Ponds;
    - Construct new trunk sewers along Rosemount Avenue, Sugarloaf Street, and Stanley Street to improve system capacity and reliability;
    - Provide upgraded outlets to support existing and future drainage areas;
    - Upgrade local trunk sewers on Steele Street and Ash Street to address current deficiencies and improve flow performance;
    - Inspect and rehabilitate existing outlets to maintain structural integrity; and
    - Implement flow protection measures to reduce erosion and improve system reliability.

Table 6-5: Sugarloaf Area Alternatives Evaluation

<table>
<tr><th colspan="2"></th><th>Outlet Flood Protection</th><th>Improve Conveyance to Existing Outlets</th><th>Divert Flows to Other Catchments</th><th>Diversion and Pumping</th></tr>
<tr><td colspan="2"></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Advantage</td><td>• Partial protection against high lake levels</td><td>• New trunk sewer and outlets provide the required system capacity
• Addresses existing system condition and aligns with planned Sugarloaf Road rehabilitation
• Supports future growth areas</td><td>• Divert minor flows to east and west catchments to reduce trunk demand</td><td>• Protects against high lake levels
• Can provide substantial improvement in system performance</td></tr>
<tr><td colspan="2">Disadvantage</td><td>• Does not increase system capacity
• Still susceptible to high lake levels
• Requires work along the lake shore
• Existing system conditions and rehabilitation requirements remain
• Does not provide capacity for growth areas</td><td>• Substantial upgrades required
• Does not protect against high lake levels
• Requires work along the lakeshore</td><td>• Diversions are insufficient to address capacity issues
• May not provide capacity for growth areas
• Triggers additional downstream upgrades
• Timing and downstream development may constrain effectiveness
• Still susceptible to high lake levels</td><td>• Requires substantial infrastructure investment
• Increased operational cost due to pumping</td></tr>
<tr><td rowspan="2">Financial</td><td>Capital Cost</td><td>Low</td><td>Medium</td><td>Low</td><td>High</td></tr>
<tr><td>O&M Cost</td><td>Low</td><td>Low</td><td>Low</td><td>High</td></tr>
<tr><td colspan="2" rowspan="2">Evaluation</td><td>Technical</td><td>Environ-mental</td><td>Social Cultural</td><td>Technical</td><td>Environ-mental</td><td>Social Cultural</td><td>Technical</td><td>Environ-mental</td><td>Social Cultural</td><td>Technical</td><td>Environ-mental</td><td>Social Cultural</td></tr>
<tr><td>Medium</td><td>Medium</td><td>High</td><td>High</td><td>Medium</td><td>Medium</td><td>Medium</td><td>Medium</td><td>Medium</td><td>Low</td><td>Low</td><td>Low</td></tr>
<tr><td colspan="2">Recommended Alternative</td><td colspan="3">Recommended as Part of Hybrid Solution: Provides partial protection against high lake levels</td><td colspan="3">Recommended as Part of Hybrid Solution: Addresses existing system capacity issues and provides capacity for growth areas.</td><td colspan="3">Not Recommended: Trunk upgrades still required and triggers additional downstream upgrades. Limited by the timing of development.</td><td colspan="3">Not Recommended: High implementation and operational cost.</td></tr>
</table>

6.4 Local Servicing Needs

The following sections outline the local stormwater servicing needs and requirements for each local drainage area, with the objective of providing guidance on the recommended improvements for stormwater infrastructure.

6.4.1 Chippawa Road Area

The proposed stormwater improvements for the Chippawa Road area are focused on addressing existing capacity limitations and improving overall system reliability (**Figure 6-13**). Key components of the plan include:

- Redirecting flows from Chippawa Road to the Wellington Street trunk sewer.
- Upgrading the Wellington Street sewer to provide adequate conveyance for current and future flows.
- Implementing localized drainage improvements along Chippawa Road and Berkley Avenue to reduce flooding risk.

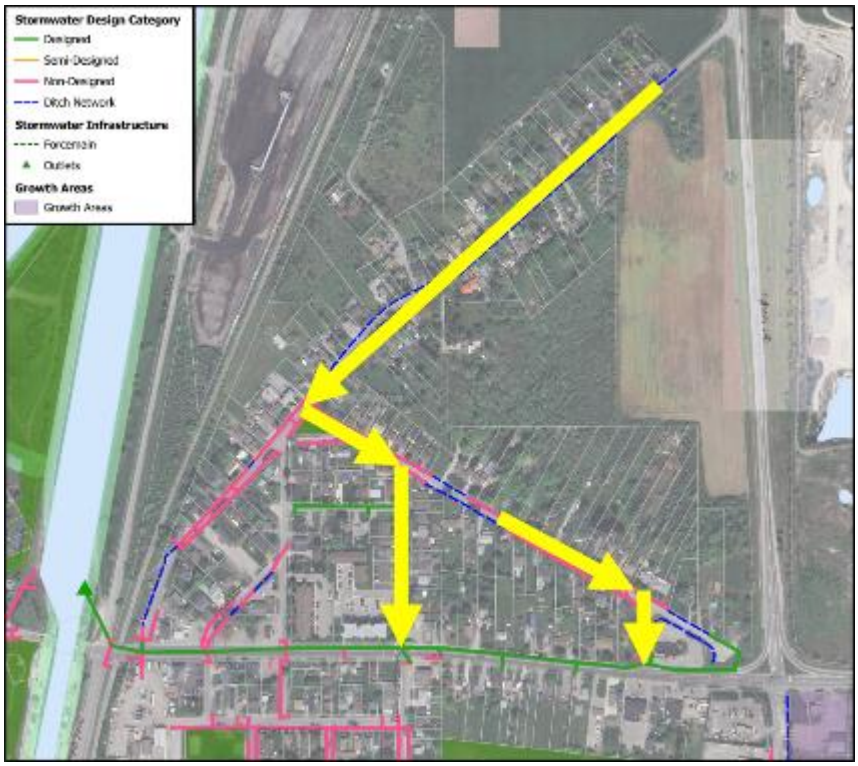


Figure 6-13: Chippawa Road Area

6.4.2 Third Avenue Area

The proposed stormwater improvements for the Third Avenue area are designed to address localized capacity constraints and support future growth (**Figure 6-14**). Key elements include:

- Investigating and confirming sizing requirements for local culverts and roadside ditches.
- Upgrading sewers and ditch drainage along Killaly Street and West Side Road to improve conveyance.
- Implementing targeted drainage improvements on Third Avenue and Sheba Crescent to reduce flooding risk.
- Coordinating all upgrades with planned growth to ensure long-term system performance.

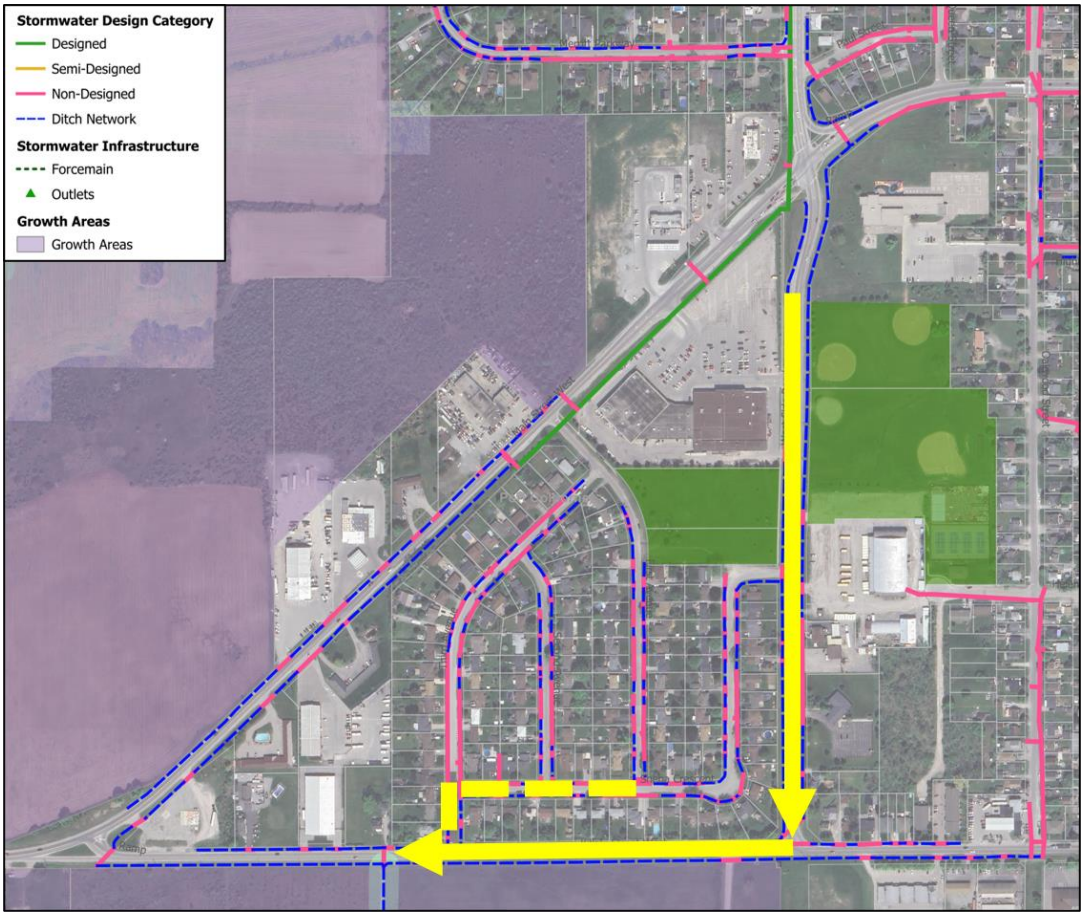


Figure 6-14: Third Avenue Area

6.4.3 Omer Avenue Area

The proposed stormwater improvements for the Omer Avenue area are intended to enhance system capacity and support coordinated infrastructure planning (**Figure 6-15**). Key elements include:

- Constructing new sub-trunk sewers along Fielden Avenue and Omer Avenue/Steele Street to expand conveyance capacity.
- Implementing partial flow re-direction to relieve constraints and improve performance along Main Street.
- Coordinating timing with planned wastewater upgrades to maximize corridor efficiency.

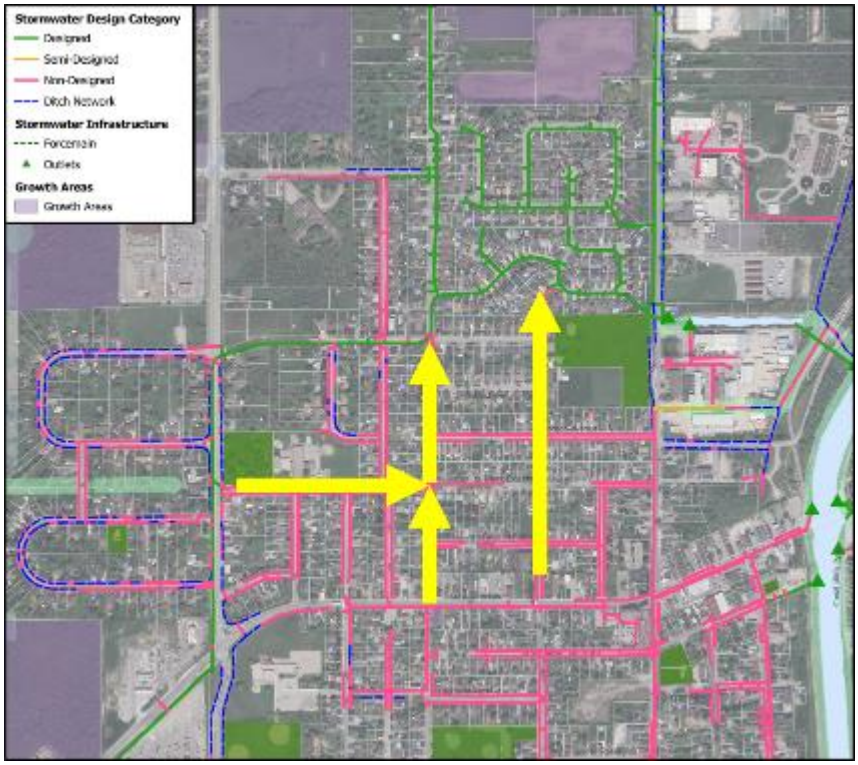


Figure 6-15: Omer Avenue Area

6.4.4 Lakeshore Road Area

The proposed stormwater considerations for the Lakeshore Road Area are focused on maintaining system performance and addressing localized constraints (**Figure 6-16**). Key elements include:

- Confirming that existing outlets and drainage ditches have sufficient capacity to accommodate flows under typical conditions.
- Recognizing that elevated lake levels can negatively impact system performance and drainage in the area.
- Identifying capacity constraints associated with the undersized Lakeshore Road West infrastructure.
- Assigning a low priority to further upgrades based on current system performance and available outlet capacity.

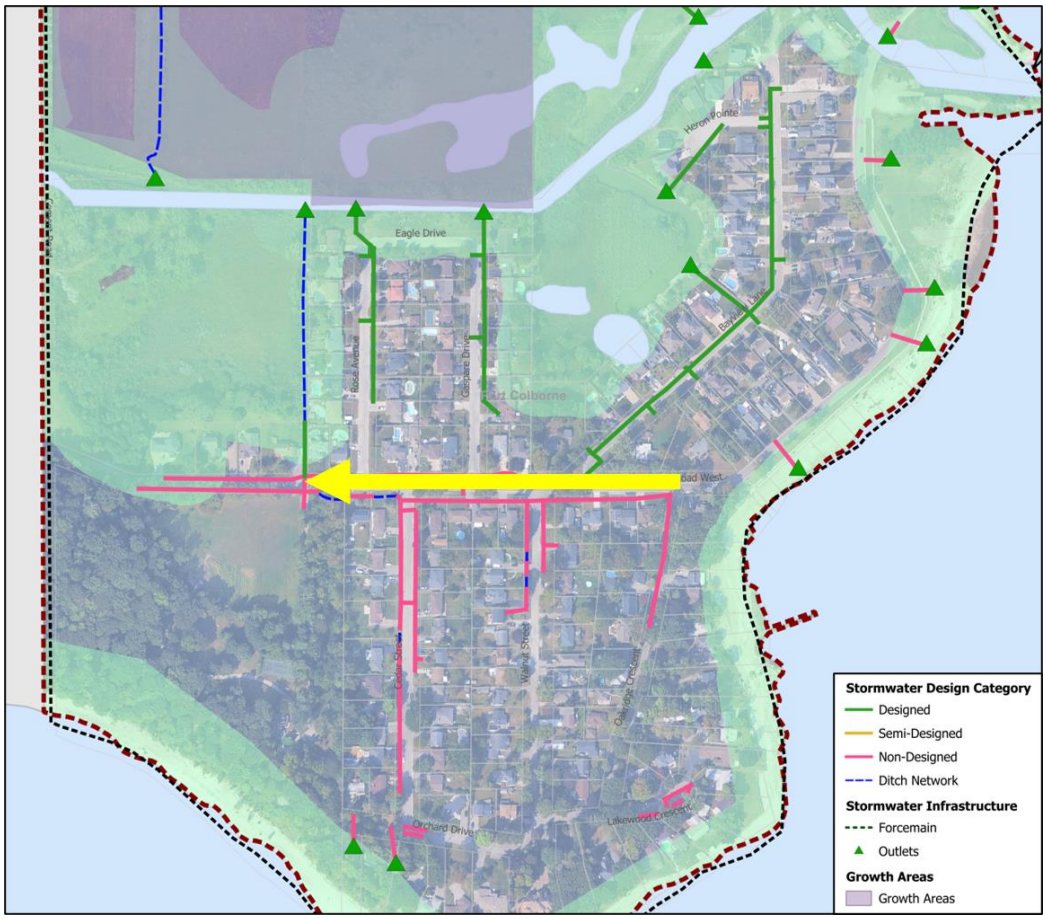


Figure 6-16: Lakeshore Road Area

7 Preferred Stormwater Servicing Strategy

The City of Port Colborne's understanding of the existing stormwater system, including its condition and performance, continues to develop. The City is continuously working to build and improve the stormwater datasets to remove uncertainties.

Throughout the development of this MSP, the approach to stormwater infrastructure focused on a high-level assessment of the existing system, local servicing needs, and potential growth servicing strategies. The goal was to establish an overall vision and framework for the management of the stormwater system, while recognizing that detailed timing, phasing, and site-specific designs remain to be determined.

This assessment and evaluation inform preliminary servicing strategies, including:

- **Existing System Servicing Strategies:** Review and evaluation of current system performance and recommended improvements for key drainage areas.
- **Trunk Servicing Needs:** Identification of trunk and neighbourhood capacity constraints, outlet limitations, and potential targeted upgrades.
- **Growth Servicing Recommendations:** Provisional plans for new development, including general system needs and potential connections to the existing system.

The strategies identified in this MSP provide guidance for future detailed studies and capital planning. Subsequent investigations, fieldwork, and site-specific SWM studies will refine the understanding of system condition and performance, confirm servicing objectives, and finalize specific upgrade needs.

7.1.1 Upgrade of Local Stormwater Network within Undesigned Areas

The MSP does not identify the detailed local stormwater system upgrades needed to fully address stormwater servicing needs within the existing undesigned areas. The recommended MSP capital program identifies areas with undersized trunk and local conveyance capacity constraints and recommends preliminary preferred trunk network upgrades needed to support upgrading the local stormwater collection system to current City standards.

The timing and trigger for the local stormwater system upgrades will vary based on local conditions, including replacement of failing infrastructure, roadway improvements, replacement/upgrading of other underground infrastructure, local infill development, etc. The MSP establishment of the trunk stormwater system upgrades will allow the City to appropriately plan, coordinate, and design the local sewer upgrades in an overall coordinated manner.

7.2 Preferred Stormwater Servicing Strategy Overview

The preliminary preferred stormwater servicing strategy is organized into major drainage areas and local servicing areas, with both system-wide and localized upgrades identified. The strategy has been developed to address existing deficiencies, while ensuring that future growth, expansion, and intensification are accommodated in a manner that maintains or improves post-development conditions relative to existing conditions. The preferred stormwater servicing strategy is presented in **Figure 7-1**.

A summary of the preliminary preferred stormwater servicing strategy is as follows:

Major Drainage Areas:

- **Clark Street Drainage Area:** Implement trunk sewer realignment along Russell Avenue, full reconstruction of the local sewer network north of Killaly Street to improve reliability.
- **Clark Street Outlet:** Undertake capacity upgrades, implement flood protection and storage improvements, and integrate real-time control measures to optimize system performance.
- **Elm Street & King Street North:** Implement outlet flood protection measures and targeted local sewer upgrades, including new trunk sewers along Neff Street and Fielden Avenue, and local improvements along Charles, Minto, and Erie Streets.
- **Elm Street & King Street South:** Inspect and rehabilitate outlets to maintain structural integrity and implement flow protection measures to enhance reliability.
- **Sugarloaf Area**: Implement outlet flood protection and improve conveyance to existing outlets, including construction of new trunk sewers along Rosemount Avenue, Sugarloaf Street, and Stanley Street, upgrades on Steele Street and Ash Street, and partial flow diversion to reduce trunk demand.

Local Servicing Areas:

- **Chippawa Road Area:** Address existing capacity limitations and improve overall system reliability by redirecting flows to the Wellington Street trunk sewer, upgrading the Wellington Street sewer to provide adequate conveyance, and implementing localized drainage improvements along Chippawa Road and Berkey Avenue.
- **Third Avenue Area:** Improve local conveyance and reduce flooding risk through targeted upgrades to sewers and roadside ditches along Killaly Street and West Side Road, drainage improvements along Third Avenue and Sheba Crescent, and coordination with planned growth.

- **Omer Avenue Area:** Enhance system capacity and performance through construction of new sub-trunk sewers along Fielden Avenue and Omer Avenue/Steele Street, partial flow re-direction along Main Street, and coordinated timing with planned wastewater upgrades.
- **Lakeshore Road Area:** Maintain overall system performance by relying on available outlet capacity, while recognizing potential impacts from elevated lake levels. Improvements to Lakeshore Road West have addressed previous conveyance constraints, and no major upgrades are currently recommended beyond monitoring and minor localized improvements as needed.

Outlet Upgrades

- **Capacity Upgrades:** Implement capacity upgrades to the Bell Street and Rosemount Avenue outfalls to accommodate increased peak flows due to the upgrading of the existing non-designed and semi-designed systems.
- **Flooding Protection:** For existing outlets discharging to Lake Erie and the Welland Canal south of Lock 8, rehabilitate and install new backflow protection to protect against high lake level conditions
- **New Outlet:** Explore potential overflow option for the Quary Ponds.

The strategies summarized above will require additional, subcatchment-specific investigations and fieldwork to refine design details, confirm infrastructure requirements, and finalize implementation priorities.



Figure 7-1 Preferred Servicing Strategy

7.3 Capital Program

The preferred stormwater servicing strategy has been developed to support the servicing needs of the existing and future growth areas within the City of Port Colborne. The capital costs for each project of the Preferred Strategy were estimated according to the costing methodology within **Volume 2**. A detailed listing of all projects, including individual project numbers, is provided in **Table 7-3**. **Table 7-1** summarizes the projects by Area. **Table 7-2** further summarizes the capital program by Benefit to Existing classification, distinguishing projects that primarily address existing system needs from those required to support growth-related servicing requirements.

Table 7-1: Capital Program Summary by Project Type

	Length	Estimated Cost ($)
Omer	1,155	$ 5,659,000
King Street	1,520	$ 6,679,000
Sugarloaf	2,766	$ 24,241,000
Clarke	4,887	$ 25,304,000
Chippawa	784	$ 2,832,000
Third Ave	634	$ 2,823,000
Lakeshore	359	$ 1,206,000
Corvette	158	$ 484,000
Total	**12,262**	**$ 69,228,000**
Outlet Improvements		**$ 10,594,000**

Table 7-2: Benefit to Existing Summary

	% DC Eligible Cost	Estimated Cost ($)
BE-1	100	$ -
BE-2	90	$ 16,927,000.00
BE-3	70	$ 4,388,000.00
BE-4	50	$ 4,623,000.00
BE-5	20	$ 45,608,000.00
BE-6	0	$ 8,276,000.00
Total		**$ 79,822,000.00**

Table 7-3: Stormwater Capital Program Summary

Description					Infrastructure Details					Cost Summary		
Project	Project Letter	Project Description	Area	Type	Pipe Type	Length (m)	Diameter (mm)	Total Project Cost	Priority	Total BTE Cost	Total DC Cost	Total Developer Cost
S-W-06	A	Local Servicing Study - Clarke	Clarke	Study				$150,000	High	$45,000	$105,000	$0
S-W-28	A	Local Sewer Upgrade Allowance - Clarke Area	Clarke	Sewer	Storm Sewer	200	600	$933,000	Low	$933,000	$0	$0
S-W-29	A	Trunk Sewer Re-Alignment - Clarke Area	Clarke	Trunk	Storm Sewer	264	1,200	$1,839,000	High	$1,471,200	$367,800	$0
S-W-29	B	Trunk Sewer Re-Alignment - Clarke Area	Clarke	Trunk	Storm Sewer	241	1,500	$2,920,000	High	$2,336,000	$584,000	$0
S-W-29	C	Trunk Sewer Re-Alignment - Clarke Area	Clarke	Trunk	Storm Sewer	177	1,850	$2,655,000	High	$2,124,000	$531,000	$0
S-W-30	A	Culvert Replacement - Clarke Area	Clarke	Trunk	Storm Sewer	60	2,100	$1,517,000	High	$1,213,600	$303,400	$0
S-W-30	B	Culvert Replacement - Clarke Area	Clarke	Trunk	Storm Sewer	100	2,100	$1,244,000	High	$995,200	$248,800	$0
S-W-30	C	Outlet Upgrade and Flood Protection - Clarke	Clarke	Outlet	Storm Sewer	75	2,100	$1,350,000	High	$1,080,000	$270,000	$0
S-W-31	A	Ditch - Rehab and Excavation	Clarke	Storage	Storm Sewer	199		$183,000	High	$146,400	$36,600	$0
S-W-31	B	Ditch - Rehab and Excavation	Clarke	Storage	Storm Sewer	254		$234,000	High	$187,200	$46,800	$0
S-W-31	C	Ditch - Rehab and Excavation	Clarke	Storage	Storm Sewer	149		$138,000	High	$110,400	$27,600	$0
S-W-31	D	Ditch - Rehab and Excavation	Clarke	Storage	Storm Sewer	118		$110,000	High	$88,000	$22,000	$0
S-W-32	A	Local Sewer Reconstruction - Clarke Area	Clarke	Sewer	Storm Sewer	237	300	$937,000	Low	$749,600	$187,400	$0
S-W-32	B	Local Sewer Reconstruction - Clarke Area	Clarke	Sewer	Storm Sewer	229	300	$904,000	Low	$723,200	$180,800	$0
S-W-32	C	Local Sewer Reconstruction - Clarke Area	Clarke	Sewer	Storm Sewer	235	300	$929,000	Low	$743,200	$185,800	$0
S-W-32	D	Local Sewer Reconstruction - Clarke Area	Clarke	Sewer	Storm Sewer	238	450	$995,000	Low	$796,000	$199,000	$0
S-W-32	E	Local Sewer Reconstruction - Clarke Area	Clarke	Sewer	Storm Sewer	220	600	$1,063,000	Low	$850,400	$212,600	$0
S-W-32	F	Local Sewer Reconstruction - Clarke Area	Clarke	Sewer	Storm Sewer	230	600	$1,111,000	Low	$888,800	$222,200	$0
S-W-32	G	Local Sewer Reconstruction - Clarke Area	Clarke	Sewer	Storm Sewer	258	450	$1,077,000	Low	$861,600	$215,400	$0
S-W-32	H	Local Sewer Reconstruction - Clarke Area	Clarke	Sewer	Storm Sewer	251	450	$1,048,000	Low	$838,400	$209,600	$0
S-W-32	I	Local Sewer Reconstruction - Clarke Area	Clarke	Sewer	Storm Sewer	258	300	$1,019,000	Low	$1,019,000	$0	$0
S-W-32	J	Local Sewer Reconstruction - Clarke Area	Clarke	Sewer	Storm Sewer	244	300	$966,000	Low	$772,800	$193,200	$0
S-W-33	A	Local Sewer Reconstruction - Clarke Area	Clarke	Sewer	Storm Sewer	269	600	$1,263,000	High	$378,900	$884,100	$0
S-W-33	B	Local Sewer Reconstruction - Clarke Area	Clarke	Sewer	Storm Sewer	196	525	$885,000	High	$265,500	$619,500	$0
S-W-33	C	Local Sewer Reconstruction - Clarke Area	Clarke	Sewer	Storm Sewer	261	425	$1,058,000	High	$317,400	$740,600	$0
S-W-49	A	Johnston Street Pump Station - RTC	Clarke	Storage		1		$126,000	Low	$63,000	$63,000	$0

Table 7-4: Stormwater Pond and Low Impact Development Capital Program Summary

Description		Scope		Total Cost Summary		Cost Allocation		
Project	Project Description	Project Type	Quantity (m3)	Total Project Cost	Priority	Total BTE Cost	Total DC Cost	Total Developer Cost
S-W-M-01	655 m3 SWM pond.	SW Pond	655	$1,174,000	Triggered By Local Developer	$0	$0	$1,174,000
S-W-M-02	1725 m3 SWM pond.	SW Pond	1,725	$1,227,000	Triggered By Local Developer	$0	$0	$1,227,000
S-W-M-03	4499 m3 SWM pond.	SW Pond	4,499	$1,139,000	Triggered By Local Developer	$0	$0	$1,139,000
S-W-M-04	15367 m3 SWM pond.	SW Pond	15,367	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-05	11907 m3 SWM pond.	SW Pond	11,907	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-06	2993 m3 SWM pond.	SW Pond	2,993	$1,139,000	Triggered By Local Developer	$0	$0	$1,139,000
S-W-M-07	10107 m3 SWM pond.	SW Pond	10,107	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-08	6352 m3 SWM pond.	SW Pond	6,352	$1,139,000	Triggered By Local Developer	$0	$0	$1,139,000
S-W-M-09	509 m3 SWM pond.	SW Pond	509	$1,227,000	Triggered By Local Developer	$0	$0	$1,227,000
S-W-M-10	694 m3 SWM pond.	SW Pond	694	$1,227,000	Triggered By Local Developer	$0	$0	$1,227,000
S-W-M-11	1417 m3 SWM pond.	SW Pond	1,417	$1,227,000	Triggered By Local Developer	$0	$0	$1,227,000
S-W-M-12	1675 m3 SWM pond.	SW Pond	1,675	$1,227,000	Triggered By Local Developer	$0	$0	$1,227,000
S-W-M-13	774 m3 SWM pond.	SW Pond	774	$1,227,000	Triggered By Local Developer	$0	$0	$1,227,000
S-W-M-14	68126 m3 SWM pond.	SW Pond	68,126	$2,705,000	Triggered By Local Developer	$0	$0	$2,705,000
S-W-M-15	68126 m3 SWM pond.	SW Pond	68,126	$2,705,000	Triggered By Local Developer	$0	$0	$2,705,000
S-W-M-16	70721 m3 SWM pond.	SW Pond	70,721	$2,705,000	Triggered By Local Developer	$0	$0	$2,705,000
S-W-M-17	20101 m3 SWM pond.	SW Pond	20,101	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-18	127812 m3 SWM pond.	SW Pond	127,812	$2,705,000	Triggered By Local Developer	$0	$0	$2,705,000
S-W-M-19	48674 m3 SWM pond.	SW Pond	48,674	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-20	111610 m3 SWM pond.	SW Pond	111,610	$2,705,000	Triggered By Local Developer	$0	$0	$2,705,000
S-W-M-21	36212 m3 SWM pond.	SW Pond	36,212	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-22	36212 m3 SWM pond.	SW Pond	36,212	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-23	4166 m3 SWM pond.	SW Pond	4,166	$1,139,000	Triggered By Local Developer	$0	$0	$1,139,000
S-W-M-24	12156 m3 SWM pond.	SW Pond	12,156	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-25	8642 m3 SWM pond.	SW Pond	8,642	$1,139,000	Triggered By Local Developer	$0	$0	$1,139,000

7.3.1 Local Stormwater Network

The Capital Program identifies approximately 8 km of trunk storm system upgrades within the existing undesigned and semi-designed system, which can support future upgrades to the local stormwater system to improve the level of service provided. Approximately 17 km of additional local stormwater system upgrades, representing a potential additional $54M investment requirement to replace, rehabilitate, and upgrade the local stormwater collection system, are estimated to be required to improve the level of service within the existing undesigned and semi-designed system. A summary of potential additional local sewer lengths by neighbourhood and associated high-level costs is provided in **Table 7-5**.

Table 7-5: Local Stormwater Network Sewer Lengths and Costs

Neighbourhood	Sewer Length[1] (m)	Estimated Cost ($M)
Clarke	*Captured in Capital Program Project S-W-32 and S-W-33*	*($13.3 M)*
Elm & King North	6,500	$22.1M
Elm and King South	4,000	$13.6M
Sugarloaf	4,000	$11.7M
Omer	1,500	$3.7M
Chippawa	400	$1.1M
The Island	700	$1.9M

1- Lengths are approximate for the purposes of high-level budgetary estimation.

7.3.2 Outfall Flood Control

The Capital Program identifies the installation of flood control measures at multiple major outlets discharging to Lake Erie and the Welland Canal. These flood control structures would consist of flap gates (or other similar structures) that would prevent high levels from backing up into the system. The City will need to undertake appropriate inspection and assessment work to confirm the presence and condition of existing flood control structures and identify the most appropriate construction and/or rehabilitation measures to achieve the desired objectives.

The City has conducted an initial outfall condition assessment (May 2025 by Aquafor Beach), which did not identify flap gaps or flood control structures at the majority of the outlets discharging to Lake Erie. The status of the majority of the Welland Canal outfalls are unknown, as the outlets were not accessible at the time of this assessment.

8 Implementation Plan

As outlined in **Section 2** of **Volume 2**, the MSP fulfills the requirements of Approach 1 under the MEA Class EA process. The Preferred Water Servicing Strategy supports the City of Port Colborne's growth to 2051 and beyond and will be implemented in accordance with the applicable Class EA schedules.

Class EA requirements for each project are identified within the Capital Program. Schedule A and A+ projects may proceed directly to design and construction, with A+ projects requiring public notification prior to implementation in accordance with the MEA Class EA process. Schedule B (or equivalent) projects identified within the Preferred Water Servicing Strategy will be addressed through developer-led local servicing plans under the Planning Act municipal development review process, or through separate Class EA studies prior to design and construction. No Schedule C projects were identified as part of the preferred strategy.

All required supporting studies (e.g., environmental impact, cultural heritage, and archaeological) should be completed by qualified professionals as early as possible in the planning process for Schedule B projects.

During implementation, particularly at the detailed design stage, the following should be considered:

- Finalization of property and right-of-way requirements;
- Refinement of infrastructure alignments;
- Identification of preferred construction methodologies;
- Completion of additional supporting investigations (e.g., geotechnical, hydrogeological);
- Review and mitigation of potential construction-related impacts; and
- Fulfillment of all provincial, municipal, and conservation authority approval requirements.

For planning and budgeting purposes, the recommended capital program provides a high-level baseline for the City's capital budget. Project cost estimates will be further refined as individual projects advance and more detailed information becomes available.

Project timing should be aligned with projected population and employment growth within the City. The water program has also been coordinated with wastewater and stormwater programs to align projects where possible. Given the growth-related nature of the servicing strategies, the water capital program forms the basis for the water component of the City of Port Colborne's Development Charges By-law.

8.1 Project Implementation and Coordination

The City's stormwater system carries greater uncertainty than the water system due to undesigned local networks, infrastructure data gaps, and the influence of lake levels. As such, the stormwater strategy focuses predominantly on addressing areas with undersized trunk and local conveyance capacity constraints and recommends preliminary preferred trunk network upgrades needed to support upgrading the local stormwater collection system to current City standards. A coordinated, risk-based approach integrates system understanding, corridor coordination, and capital planning to guide both immediate and long-term stormwater improvements.

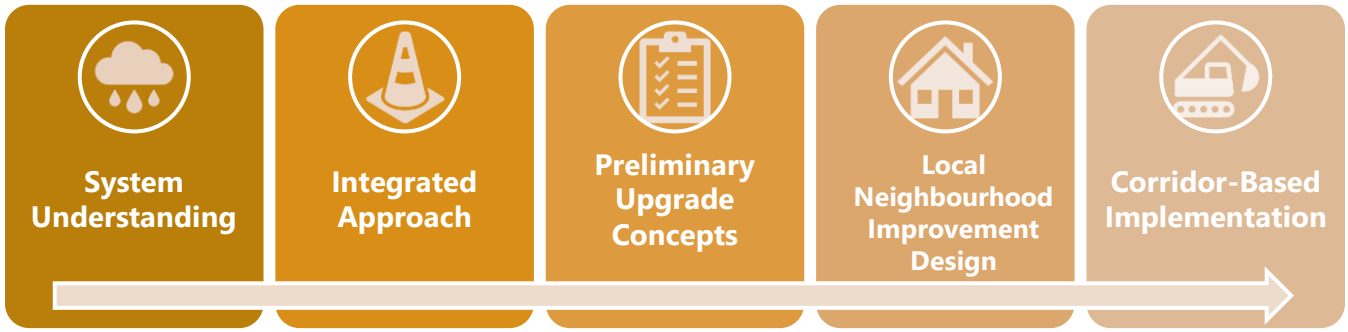


Figure 8-1: Path to Implemenation

Key Principles:

- **System Understanding:** Ongoing assessment of system capacity, outlet performance, and flow paths informs project selection. The City has recently undertaken field investigations to address significant gaps in historical data. However, due to field investigation constraints, such as a collapsed sewer, an underwater sewer, and the field identification of infrastructure not previously recorded in the City's database, additional field investigations are required prior to implementation of major upgrades.
- **Integrated Approach:** Stormwater projects are coordinated with water and wastewater infrastructure in shared corridors to reduce construction disruption and improve efficiency.
- **Preliminary Upgrade Concepts:** High-level concepts, such as outlet flood protection, trunk sewer upgrades, and localized system improvements, guide long-term planning, with refinements informed by modelling, inspections, and targeted studies.
- **Local Neighbourhood Improvement Design:** Undertake local conceptual and detailed design studies to confirm the design of the trunk sewer upgrades and alignments, and develop a conceptual design of local stormwater systems. Conceptual

design basis will allow for the implementation of appropriate local system improvement in advance of trunk sewer upgrades if local stormwater improvements are triggered due to condition and/or coordination with other infrastructure upgrade needs.

- **Corridor-Based Implementation:** A coordinated approach manages growth, reduces risk, and ensures efficient planning across the City's stormwater system.

Implementation Framework:

1. **Assessment & Data Review**
   - Compile and validate stormwater system data.
   - Conduct targeted investigations to confirm capacity, outlet performance, and structural condition.
   - Verify flow paths, particularly in undesigned or constrained systems influenced by high lake levels.
2. **Neighbourhood Design Studies:**
   - Undertake Class EA Study or other local servicing study to confirm the preferred trunk sewer and outlet alignment and capacity.
   - Undertake design of trunk sewer upgrades and outlet upgrades.
   - Undertake conceptual design of local stormwater system upgrades.
   - Develop an upgrade and construction implementation plan, identifying phasing of system upgrades.
3. **Corridor Coordination & Design Integration**
   - Align stormwater upgrades with water and wastewater projects in shared corridors.
   - Advance detailed designs in priority subcatchments and growth areas.
   - Incorporate area-specific studies and MSP guidance.
4. **Implementation (Capital Program)**
   - Prioritize short and long-term stormwater capital needs, including outlet flood protection, trunk sewer upgrades, conveyance improvements, and localized system enhancements.
   - Schedule projects to optimize corridor construction and reduce community disruption.
5. **Financial Analysis**
   - Identify project costs and provide guidance on Development Charges and operational impacts.

- Ensure financial planning supports long-term stormwater management and growth servicing.

This framework supports a flexible, long-term approach for the stormwater system, balancing immediate operational needs, high lake-level challenges, and anticipated growth while improving system reliability.

8.2 Project Timing and Triggers

The timing of the recommended stormwater infrastructure projects have been developed to reflect system priorities, growth-related needs, and opportunities for coordination with other municipal works. The Capital Program is intended to provide a flexible, risk-based framework that supports both immediate system needs and long-term servicing objectives.

Project prioritization is guided by the following:

- Priority projects address known operational issues, such as collapsed pipes, and are advanced to maintain system reliability and protect against localized flooding.
- Remaining projects are grouped by neighbourhood and categorized as either growth-related stormwater upgrades or lower-priority system improvements. Lower-priority projects may be advanced when coordinated with planned road reconstruction.
- Projects triggered by upstream development or roadway reconstruction are categorized to help guide prioritization and scheduling.
- The City maintains separate lists for development-related projects and operational work to ensure urgent issues, such as collapsed pipes, are addressed promptly.
- Some designs are already included in the Capital Program budget; ongoing operational review may trigger spot repairs, redesigns to match trunk system capacity, or full replacement as needed.
- Projects are not limited to pipe replacements but aim to improve the overall storm trunk network to better support long-term system performance.
- Projects in areas with high sewer inflow and infiltration to assist in diverting stormwater away from the existing wastewater system.

Project implementation may be influenced by the following key triggers:

- Upstream development and associated servicing requirements;
- Planned roadway reconstruction or corridor improvements; and
- Results from ongoing operational review, condition assessments, and asset management planning.

Stormwater outfalls and ponding facilities are also prioritized to optimize long-term system performance:

- Outfall projects are grouped to reduce costs and may be implemented alongside an expanded annual maintenance program, including flap gate installations.
- Stormwater ponds are planned to meet updated standards. For new subdivisions, it is assumed that some stormwater structures or ponds will be built by developers and later maintained by the City. A small pond concept is used for planning purposes, with multiple locations identified and a future stormwater management plan to consolidate as appropriate.

The Capital Program is structured to provide flexibility, with a long-term vision supported by medium-term adjustments and annual refinements. Condition assessment results will inform updates, helping to flag neighbourhoods for risk-based prioritization, design, spot repairs, or full replacement. It is recognized that project timing may change due to coordination with regional infrastructure, updates to growth projections, and funding availability.

8.3 Stormwater Condition Assessment

The City has completed a comprehensive stormwater condition assessment to evaluate the current state of pipes, outfalls, and ponding facilities. The assessment highlights areas of concern, including locations with collapsed or deteriorated pipes, while also identifying gaps in system knowledge where further investigation may be required. These findings support a flexible approach to planning, allowing the City to refine project timing, scope, and design as more information becomes available.

Condition assessment outcomes should be used to re-prioritize the local sewer upgrade based on:

- Flag high-risk neighbourhoods for immediate review or targeted upgrades;
- Prioritize implementation of the identified trunk system upgrades;
- Coordinate with other corridor upgrade priorities; and
- Coordinate with growth-related triggers.

This approach ensures that MSP recommendations and the Capital Program remain adaptive, reflecting both existing system conditions and anticipated future needs.

Appendix A – Capital Program

Table 1-1: Stormwater Capital Program Costing Details

Description					Scope				Hard Cost Allowances														Total Construction Cost
									General Construction Overhead			Site Complexity			Special Conditions			Market and Inflation Adjustment			Special Activities				
Project	Project Description	Benefit to Existing	Contributing Area (ha)	Class EA Project	Project Type	Quantity (m3)	Base Unit Cost	Base Construction Cost	Cost Factor	Uplift %	Uplift Cost	Cost Factor	Uplift %	Uplift Cost	Cost Factor	Uplift %	Uplift Cost	Cost Factor	Uplift %	Uplift Cost	Activity 1	Cost	Activity 2	Cost	
S-W-M-01	655 m3 SWM pond.	Dev	1.235	Schedule A	SW Pond	655	N/A	$600,000	High	25%	$150,000	Medium	10%	$60,000	Medium	10%	$60,000	Low	0%	$0					$870,000
S-W-M-02	1725 m3 SWM pond.	Dev	3.254	Schedule A	SW Pond	1,725	N/A	$600,000	High	25%	$150,000	Medium	10%	$60,000	Medium	10%	$60,000	Low	0%	$0					$870,000
S-W-M-03	4499 m3 SWM pond.	Dev	8.488	Schedule A	SW Pond	4,499	N/A	$600,000	Medium	20%	$120,000	Medium	10%	$60,000	Medium	10%	$60,000	Low	0%	$0					$840,000
S-W-M-04	15367 m3 SWM pond.	Dev	28.993	Schedule A	SW Pond	15,367	N/A	$1,000,000	Medium	20%	$200,000	Medium	10%	$100,000	Medium	10%	$100,000	Low	0%	$0					$1,400,000
S-W-M-05	11907 m3 SWM pond.	Dev	22.466	Schedule A	SW Pond	11,907	N/A	$1,000,000	Medium	20%	$200,000	Medium	10%	$100,000	Medium	10%	$100,000	Low	0%	$0					$1,400,000
S-W-M-06	2993 m3 SWM pond.	Dev	5.647	Schedule A	SW Pond	2,993	N/A	$600,000	Medium	20%	$120,000	Medium	10%	$60,000	Medium	10%	$60,000	Low	0%	$0					$840,000
S-W-M-07	10107 m3 SWM pond.	Dev	19.069	Schedule A	SW Pond	10,107	N/A	$1,000,000	Medium	20%	$200,000	Medium	10%	$100,000	Medium	10%	$100,000	Low	0%	$0					$1,400,000
S-W-M-08	6352 m3 SWM pond.	Dev	11.984	Schedule A	SW Pond	6,352	N/A	$600,000	Medium	20%	$120,000	Medium	10%	$60,000	Medium	10%	$60,000	Low	0%	$0					$840,000
S-W-M-09	509 m3 SWM pond.	Dev	0.959	Schedule A	SW Pond	509	N/A	$600,000	High	25%	$150,000	Medium	10%	$60,000	Medium	10%	$60,000	Low	0%	$0					$870,000
S-W-M-10	694 m3 SWM pond.	Dev	1.309	Schedule A	SW Pond	694	N/A	$600,000	High	25%	$150,000	Medium	10%	$60,000	Medium	10%	$60,000	Low	0%	$0					$870,000
S-W-M-11	1417 m3 SWM pond.	Dev	2.673	Schedule A	SW Pond	1,417	N/A	$600,000	High	25%	$150,000	Medium	10%	$60,000	Medium	10%	$60,000	Low	0%	$0					$870,000
S-W-M-12	1675 m3 SWM pond.	Dev	3.16	Schedule A	SW Pond	1,675	N/A	$600,000	High	25%	$150,000	Medium	10%	$60,000	Medium	10%	$60,000	Low	0%	$0					$870,000
S-W-M-13	774 m3 SWM pond.	Dev	1.459	Schedule A	SW Pond	774	N/A	$600,000	High	25%	$150,000	Medium	10%	$60,000	Medium	10%	$60,000	Low	0%	$0					$870,000
S-W-M-14	68126 m3 SWM pond.	Dev	128.538	Schedule A	SW Pond	68,126	N/A	$1,500,000	Low	15%	$225,000	Medium	10%	$150,000	Medium	10%	$150,000	Low	0%	$0					$2,025,000
S-W-M-15	68126 m3 SWM pond.	Dev	128.538	Schedule A	SW Pond	68,126	N/A	$1,500,000	Low	15%	$225,000	Medium	10%	$150,000	Medium	10%	$150,000	Low	0%	$0					$2,025,000
S-W-M-16	70721 m3 SWM pond.	Dev	133.435	Schedule A	SW Pond	70,721	N/A	$1,500,000	Low	15%	$225,000	Medium	10%	$150,000	Medium	10%	$150,000	Low	0%	$0					$2,025,000
S-W-M-17	20101 m3 SWM pond.	Dev	37.926	Schedule A	SW Pond	20,101	N/A	$1,000,000	Medium	20%	$200,000	Medium	10%	$100,000	Medium	10%	$100,000	Low	0%	$0					$1,400,000
S-W-M-18	127812 m3 SWM pond.	Dev	241.154	Schedule A	SW Pond	127,812	N/A	$1,500,000	Low	15%	$225,000	Medium	10%	$150,000	Medium	10%	$150,000	Low	0%	$0					$2,025,000
S-W-M-19	48674 m3 SWM pond.	Dev	91.837	Schedule A	SW Pond	48,674	N/A	$1,000,000	Medium	20%	$200,000	Medium	10%	$100,000	Medium	10%	$100,000	Low	0%	$0					$1,400,000
S-W-M-20	111610 m3 SWM pond.	Dev	210.584	Schedule A	SW Pond	111,610	N/A	$1,500,000	Low	15%	$225,000	Medium	10%	$150,000	Medium	10%	$150,000	Low	0%	$0					$2,025,000
S-W-M-21	36212 m3 SWM pond.	Dev	68.323	Schedule A	SW Pond	36,212	N/A	$1,000,000	Medium	20%	$200,000	Medium	10%	$100,000	Medium	10%	$100,000	Low	0%	$0					$1,400,000
S-W-M-22	36212 m3 SWM pond.	Dev	68.323	Schedule A	SW Pond	36,212	N/A	$1,000,000	Medium	20%	$200,000	Medium	10%	$100,000	Medium	10%	$100,000	Low	0%	$0					$1,400,000
S-W-M-23	4166 m3 SWM pond.	Dev	7.86	Schedule A	SW Pond	4,166	N/A	$600,000	Medium	20%	$120,000	Medium	10%	$60,000	Medium	10%	$60,000	Low	0%	$0					$840,000
S-W-M-24	12156 m3 SWM pond.	Dev	22.935	Schedule A	SW Pond	12,156	N/A	$1,000,000	Medium	20%	$200,000	Medium	10%	$100,000	Medium	10%	$100,000	Low	0%	$0					$1,400,000
S-W-M-25	8642 m3 SWM pond.	Dev	16.304	Schedule A	SW Pond	8,642	N/A	$600,000	Medium	20%	$120,000	Medium	10%	$60,000	Medium	10%	$60,000	Low	0%	$0					$840,000

Table 1-2: Stormwater Pond and LID Capital Program Costing Details

Description					Scope				Soft Cost Allowances										Total Non-Construction 'Soft' Costs	Project Contingency Allowances			Total Cost Summary		Cost Allocation		
									Land Acquisition Needs			Preceding Engineering and Study Cost			Design, Contract Administration and Inspection			Internal Cost Allowance											
Project	Project Description	Benefit to Existing	Contributing Area (ha)	Class EA Project	Project Type	Quantity (m3)	Base Unit Cost	Base Construction Cost	Cost Factor	Uplift %	Land Acquisition Needs	Cost Factor	Uplift %	Engineering and Study Costs	Cost Factor	Uplift %	Contract Administration	Cost Factor	Uplift %	City-Related Costs		Cost Factor	Uplift %	Project Contingency	Total Project Cost	Priority	Total BTE Cost	Total DC Cost	Total Developer Cost
S-W-M-01	655 m3 SWM pond.	Dev	1.235	Schedule A	SW Pond	655	N/A	$600,000	Medium	5%	$43,500	High	10%	$87,000	Low	8%	$48,000	Low	3%	$18,000	$196,500	Low	10%	$106,650	$1,174,000	Triggered By Local Developer	$0	$0	$1,174,000
S-W-M-02	1725 m3 SWM pond.	Dev	3.254	Schedule A	SW Pond	1,725	N/A	$600,000	Medium	5%	$43,500	High	10%	$87,000	Low	8%	$48,000	Low	3%	$18,000	$196,500	Medium	15%	$159,975	$1,227,000	Triggered By Local Developer	$0	$0	$1,227,000
S-W-M-03	4499 m3 SWM pond.	Dev	8.488	Schedule A	SW Pond	4,499	N/A	$600,000	Medium	5%	$42,000	Medium	5%	$42,000	Low	8%	$48,000	Low	3%	$18,000	$150,000	Medium	15%	$148,500	$1,139,000	Triggered By Local Developer	$0	$0	$1,139,000
S-W-M-04	15367 m3 SWM pond.	Dev	28.993	Schedule A	SW Pond	15,367	N/A	$1,000,000	Medium	5%	$70,000	Medium	5%	$70,000	Low	8%	$80,000	Low	3%	$30,000	$250,000	Medium	15%	$247,500	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-05	11907 m3 SWM pond.	Dev	22.466	Schedule A	SW Pond	11,907	N/A	$1,000,000	Medium	5%	$70,000	Medium	5%	$70,000	Low	8%	$80,000	Low	3%	$30,000	$250,000	Medium	15%	$247,500	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-06	2993 m3 SWM pond.	Dev	5.647	Schedule A	SW Pond	2,993	N/A	$600,000	Medium	5%	$42,000	Medium	5%	$42,000	Low	8%	$48,000	Low	3%	$18,000	$150,000	Medium	15%	$148,500	$1,139,000	Triggered By Local Developer	$0	$0	$1,139,000
S-W-M-07	10107 m3 SWM pond.	Dev	19.069	Schedule A	SW Pond	10,107	N/A	$1,000,000	Medium	5%	$70,000	Medium	5%	$70,000	Low	8%	$80,000	Low	3%	$30,000	$250,000	Medium	15%	$247,500	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-08	6352 m3 SWM pond.	Dev	11.984	Schedule A	SW Pond	6,352	N/A	$600,000	Medium	5%	$42,000	Medium	5%	$42,000	Low	8%	$48,000	Low	3%	$18,000	$150,000	Medium	15%	$148,500	$1,139,000	Triggered By Local Developer	$0	$0	$1,139,000
S-W-M-09	509 m3 SWM pond.	Dev	0.959	Schedule A	SW Pond	509	N/A	$600,000	Medium	5%	$43,500	High	10%	$87,000	Low	8%	$48,000	Low	3%	$18,000	$196,500	Medium	15%	$159,975	$1,227,000	Triggered By Local Developer	$0	$0	$1,227,000
S-W-M-10	694 m3 SWM pond.	Dev	1.309	Schedule A	SW Pond	694	N/A	$600,000	Medium	5%	$43,500	High	10%	$87,000	Low	8%	$48,000	Low	3%	$18,000	$196,500	Medium	15%	$159,975	$1,227,000	Triggered By Local Developer	$0	$0	$1,227,000
S-W-M-11	1417 m3 SWM pond.	Dev	2.673	Schedule A	SW Pond	1,417	N/A	$600,000	Medium	5%	$43,500	High	10%	$87,000	Low	8%	$48,000	Low	3%	$18,000	$196,500	Medium	15%	$159,975	$1,227,000	Triggered By Local Developer	$0	$0	$1,227,000
S-W-M-12	1675 m3 SWM pond.	Dev	3.16	Schedule A	SW Pond	1,675	N/A	$600,000	Medium	5%	$43,500	High	10%	$87,000	Low	8%	$48,000	Low	3%	$18,000	$196,500	Medium	15%	$159,975	$1,227,000	Triggered By Local Developer	$0	$0	$1,227,000
S-W-M-13	774 m3 SWM pond.	Dev	1.459	Schedule A	SW Pond	774	N/A	$600,000	Medium	5%	$43,500	High	10%	$87,000	Low	8%	$48,000	Low	3%	$18,000	$196,500	Medium	15%	$159,975	$1,227,000	Triggered By Local Developer	$0	$0	$1,227,000
S-W-M-14	68126 m3 SWM pond.	Dev	128.538	Schedule A	SW Pond	68,126	N/A	$1,500,000	Medium	5%	$101,250	Low	3%	$60,750	Low	8%	$120,000	Low	3%	$45,000	$327,000	Medium	15%	$352,800	$2,705,000	Triggered By Local Developer	$0	$0	$2,705,000
S-W-M-15	68126 m3 SWM pond.	Dev	128.538	Schedule A	SW Pond	68,126	N/A	$1,500,000	Medium	5%	$101,250	Low	3%	$60,750	Low	8%	$120,000	Low	3%	$45,000	$327,000	Medium	15%	$352,800	$2,705,000	Triggered By Local Developer	$0	$0	$2,705,000
S-W-M-16	70721 m3 SWM pond.	Dev	133.435	Schedule A	SW Pond	70,721	N/A	$1,500,000	Medium	5%	$101,250	Low	3%	$60,750	Low	8%	$120,000	Low	3%	$45,000	$327,000	Medium	15%	$352,800	$2,705,000	Triggered By Local Developer	$0	$0	$2,705,000
S-W-M-17	20101 m3 SWM pond.	Dev	37.926	Schedule A	SW Pond	20,101	N/A	$1,000,000	Medium	5%	$70,000	Medium	5%	$70,000	Low	8%	$80,000	Low	3%	$30,000	$250,000	Medium	15%	$247,500	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-18	127812 m3 SWM pond.	Dev	241.154	Schedule A	SW Pond	127,812	N/A	$1,500,000	Medium	5%	$101,250	Low	3%	$60,750	Low	8%	$120,000	Low	3%	$45,000	$327,000	Medium	15%	$352,800	$2,705,000	Triggered By Local Developer	$0	$0	$2,705,000

Description					Scope				Soft Cost Allowances										Total Non-Construction 'Soft' Costs	Project Contingency Allowances			Total Cost Summary		Cost Allocation		
									Land Acquisition Needs			Preceding Engineering and Study Cost			Design, Contract Administration and Inspection			Internal Cost Allowance										
Project	Project Description	Benefit to Existing	Contributing Area (ha)	Class EA Project	Project Type	Quantity (m3)	Base Unit Cost	Base Construction Cost	Cost Factor	Uplift %	Land Acquisition Needs	Cost Factor	Uplift %	Engineering and Study Costs	Cost Factor	Uplift %	Contract Administration	Cost Factor	Uplift %	City-Related Costs		Cost Factor	Uplift %	Project Contingency	Total Project Cost	Priority	Total BTE Cost	Total DC Cost	Total Developer Cost
S-W-M-19	48674 m3 SWM pond.	Dev	91.837	Schedule A	SW Pond	48,674	N/A	$1,000,000	Medium	5%	$70,000	Medium	5%	$70,000	Low	8%	$80,000	Low	3%	$30,000	$250,000	Medium	15%	$247,500	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-20	111610 m3 SWM pond.	Dev	210.584	Schedule A	SW Pond	111,610	N/A	$1,500,000	Medium	5%	$101,250	Low	3%	$60,750	Low	8%	$120,000	Low	3%	$45,000	$327,000	Medium	15%	$352,800	$2,705,000	Triggered By Local Developer	$0	$0	$2,705,000
S-W-M-21	36212 m3 SWM pond.	Dev	68.323	Schedule A	SW Pond	36,212	N/A	$1,000,000	Medium	5%	$70,000	Medium	5%	$70,000	Low	8%	$80,000	Low	3%	$30,000	$250,000	Medium	15%	$247,500	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-22	36212 m3 SWM pond.	Dev	68.323	Schedule A	SW Pond	36,212	N/A	$1,000,000	Medium	5%	$70,000	Medium	5%	$70,000	Low	8%	$80,000	Low	3%	$30,000	$250,000	Medium	15%	$247,500	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-23	4166 m3 SWM pond.	Dev	7.86	Schedule A	SW Pond	4,166	N/A	$600,000	Medium	5%	$42,000	Medium	5%	$42,000	Low	8%	$48,000	Low	3%	$18,000	$150,000	Medium	15%	$148,500	$1,139,000	Triggered By Local Developer	$0	$0	$1,139,000
S-W-M-24	12156 m3 SWM pond.	Dev	22.935	Schedule A	SW Pond	12,156	N/A	$1,000,000	Medium	5%	$70,000	Medium	5%	$70,000	Low	8%	$80,000	Low	3%	$30,000	$250,000	Medium	15%	$247,500	$1,898,000	Triggered By Local Developer	$0	$0	$1,898,000
S-W-M-25	8642 m3 SWM pond.	Dev	16.304	Schedule A	SW Pond	8,642	N/A	$600,000	Medium	5%	$42,000	Medium	5%	$42,000	Low	8%	$48,000	Low	3%	$18,000	$150,000	Medium	15%	$148,500	$1,139,000	Triggered By Local Developer	$0	$0	$1,139,000