Infrastructure Master Plan / Plan directeur de l'infrastructure

A growth-focused plan for Ottawa's water resources systems

FINAL

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List of Acronyms

BSDY	Basic Day Demand
BSDY+FF	Basic Day and Fire Flow
BTE	Benefit to Existing
CDP	Community Design Plane
CLI ECA	Consolidated Linear Infrastructure Environmental Compliance Approval
CSO	Combined Sewer Overflow
DC	Development Charge
EA	Environmental Assessment
ECA	Environmental Compliance Approval
EMP	Environmental Management Plan
HGL	Hydraulic Grade Line
I&I	Inflow and Infiltration
IMP	Infrastructure Master Plan
LCD	Litres per capita per day
LID	Low Impact Development
LOS	Level of Service
MCEA	Municipal Class Environmental Assessment
MECP	Ministry of Environment, Conservation and Parks
MLD	Millions of Litres per Day
MSS	Master Servicing Study
MVCA	Mississippi Valley Conservation Authority
MXDY	Maximum Day
MXDY+FF	Maximum Day + Fire Flow
NRW	Non-Revenue Water
OCCPS	Orleans Cumberland Collector Pumping Station
OWD	Outdoor Water Demand
PKHR	Peak Hour
PS	Pumping Station
PSA	Public Service Area
PVC	Polyvinyl Chloride
RCP	Representative Concentration Pathways
RDII	Rainflow-Derived Inflow and Infiltration
ROPEC	Robert O. Pickard Environmental Centre
RSPS	Raw Sewage Pumping Station
RVCA	Rideau Valley Conservation Authority
S&D	Screening & Degritting
SCADA	Supervisory Control and Data Acquisition
STAMP	Stormwater Asset Management Plan
SUC	South Urban Community
SWM	Stormwater Management
SWMF	Stormwater Management Facility
SWMS	Stormwater Management Strategy
SWS	Subwatershed Study
TAN	Total Ammonia Nitrogen
TMP	Transportation Master Plan
TOR	Terms of Reference
UEA	Urban Expansion Area
VS	Volatile Solids
WAS	Waste Activated Sludge
WMP	Water Master Plan
WPP	Water Purification Plants
WUC	West Urban Community

Executive Summary

The City of Ottawa's Infrastructure Master Plan (IMP) is the City's strategic blueprint that supports the City's Official Plan and sets growth-related policies, objectives, and priorities for municipal water resources infrastructure. The focus of the IMP is on the City's drinking water supply, wastewater collection, and stormwater management infrastructure.

The purpose of the IMP is to support the City's planned growth to 2046, when the population is expected to reach 1.4 million. Approximately 195,000 new dwellings are proposed to be constructed, of which the majority will be within existing or future urban serviced areas. Additionally, 95% of employment growth is forecast to occur within urban serviced areas. Comprehensive infrastructure planning will confirm that the City's water-related services infrastructure can adequately and sustainably serve existing and future city communities.

The objectives of the IMP are to provide baseline information to inform water resources infrastructure planning, maintain service levels in existing areas, forecast and address future water and wastewater needs, minimize capacity-related delays to development, and identify drinking water distribution and wastewater collection system upgrades required to accommodate growth through intensification and greenfield development. The IMP also provides associated policies to advance these objectives. The IMP is guided by key cross-cutting themes that include climate change, sustainability, extension of services, affordability, and intensification.

In addition to supporting the Official Plan, the IMP supports the achievement of key municipal planning policies and programs and aligns closely with other approved plans and initiatives. These include the Strategic Plan, Long Range Financial Plan, Comprehensive Asset Management Program and Asset Management Plans, Transportation Master Plan, Ottawa River Action Plan, and Climate Change Master Plan.

The Official Plan aims to make Ottawa the most liveable mid-sized city in North America. To help pursue this objective, the IMP supports community and economic development by planning for the necessary water and wastewater infrastructure and stormwater management strategies that provide vital service to existing and planned development. In addition to serving growth in the suburban transect areas, the IMP has a particular emphasis on planning for infrastructure to support intensification in existing, serviced areas which a priority of the Official Plan. Strategies for development in the City's Villages are also provided.

New Urban Expansion Areas encompassing a total of 2,003 hectares are to be added to the Suburban Transect under the Official Plan. This will expand the West Urban, South Urban, and East Urban communities, and add a new community known as Tewin. At 445 hectares, Tewin represents the largest Urban Expansion Area and it is not contiguous to an existing urban area.

Service extensions and/or upgrades are required in all of these Urban Expansion Areas to support their development.

The IMP helps achieve municipal goals through a combination of system-specific policies, plans, and strategies related to infrastructure investment and management. These include a renewed policy framework including 61 policies across 12 themes including levels of service, capacity planning, master servicing studies, intensification, and public service areas. Plans include Water Purification Plant and Wastewater Treatment Development Plans, Water Master Plan, Wastewater Master Plan, Stormwater Management Strategy, Rural Servicing Master Plan, and Intensification Servicing Program. The IMP combines elements of these plans into a strategy for making sure the backbone system is robust, reliable and able to accommodate the anticipated demand for capacity in a cost-effective manner.

The Stormwater Management Strategy provides high-level guidance on stormwater to protect watercourse against the impacts of development and to protect properties from flooding. The strategy includes a management planning framework for Future Neighbourhood areas and recommendations related to climate change, floodplain mapping, Low Impact Development, and retrofits to existing stormwater systems.

The Rural Servicing Master Plan guides infrastructure planning and implementation in the City's Rural Area and Villages in line with the policies provided in the Official Plan. The Plan provides an overview of existing conditions, identifies fully, partially, and privately serviced Villages, and development considerations within these areas.

The Intensification Servicing Program enables the City to address the servicing of residential intensification growth in established areas with existing infrastructure systems while maintaining levels of service. Such growth is expected to be directed to specific areas identified in the Official Plan, and where properties apply for a change in zoning. The program will also manage infrastructure capacity as intensification proceeds and will consider the impacts of climate change and flooding.

Water and Wastewater Master Plans set out the specific objectives for planning water and wastewater infrastructure and identifies core components and performance criteria for each system. Projected growth and expected demand form the basis of establishing a series of projects that will have to be undertaken for the City to achieve infrastructure, land use, and affordability goals. These include specific water, wastewater, and stormwater projects carried over from previous iterations of the IMP and new projects to accommodate projected growth during the planning horizon. The IMP provides an approximate timing for these projects and prioritizes them according to several factors include affordability analysis, collection of Development Charges in benefiting areas, and project-specific funding agreements.

The total cost of the major infrastructure projects outlined in the IMP is estimated at $1.51 billion. This figure excludes the projects required at the City's water purification and wastewater treatment plants, which totals $494 million. The IMP summarizes cost responsibility and the available financing mechanisms to the city. Projects are mainly to be funded by growth, and those that provide a benefit to existing systems will be partially funded by the City's rate budgets.

The IMP highlights an approval and monitoring process that will be utilized to measure the success of the various policies, projects, programs, and procedure for Plan amendments included. The success of long-range plans, such as the IMP, depend on monitoring the performance of the system and making adjustments and corrective actions early on to confirm if the servicing needs of existing and developing communities are met.

1 Introduction

1.1 Plan Purpose and Guiding Principles

In 2022, the province approved the City of Ottawa's comprehensive Official Plan (OP) designed to steer the City's development and expansion through to 2046, a year when the population is projected to rise to 1.4 million. Note: in 2022, this approval included 842 ha of land that was added by the province; in Fall 2023 those added lands were removed. A crucial component of the City's development is the assurance of robust infrastructure to accommodate the demands of a growing city. This necessity is the basis for the Infrastructure Master Plan (IMP), a strategic blueprint devised to meet the City's current and future water resources needs.

The IMP's primary purpose is to demonstrate that the City's water resources infrastructure, which includes drinking water supply, wastewater collection, and stormwater management, can adequately and sustainably serve the population in both the present and future. This plan includes an over-arching mission to maintain service levels in existing areas while also accommodating anticipated growth through greenfield and infill development.

Safety, affordability, and sustainability are the principles that guide the design and implementation of the IMP, ensuring that the City's water-related infrastructure services are delivered effectively, affordably, and responsibly.

The IMP was undertaken according to the Municipal Class Environmental Assessment (EA) framework and is considered a Master Plan project in that framework. The level of detail provided in this study is commensurate with the master planning approach, including Phase 1 and 2, as defined by the Class EA process. The IMP will be used as support for subsequent Schedule B and C Class EA processes.

DEFINITION

Greenfield development refers to development in previously undeveloped areas of the city, and typically occurs within the Urban Expansion Areas identified in the OP. These areas require provision of new services, including watermains, sewers, and pump stations.

Infill development, sometimes referred to as 'redevelopment' or 'intensification development', refers to development within previously developed areas of the city, generally resulting in increased residential and/or employment density. Infill development often relies on existing services, although new or expanded services may be required.

1.2 Strategic Objectives for Infrastructure Planning

Infrastructure planning is fundamentally about forecasting and preparing for future water and wastewater needs. This involves estimating the change in system demands, determining the necessary system upgrades to accommodate this demand, and outlining the timeline for their implementation. This detailed planning exercise aims to demonstrate that adequate system capacity is available to support planned development, with careful budgetary considerations made accordingly.

Despite the thoroughness of this approach, the inherent uncertainties in predicting development patterns across the city may present risks of capacity shortfalls in certain areas. To address this, the plan includes proactive infrastructure capacity management policies intended to minimize potential delays to development approvals due to insufficient capacity.

Moreover, infrastructure planning also aims to provide a solid foundation of baseline information and clear policy directives regarding infrastructure. This information serves as a guide for the development industry when preparing master studies, such as Master Servicing Studies and Environmental Management Plans, ensuring a coordinated and informed approach to city development.

A primary objective of the plan is to identify the upgrades required to the existing central drinking water distribution and wastewater collection systems to support greenfield and infill development. The upgrades that are identified in the IMP are focussed on major water and wastewater system components. For the purposes of discussion, the "backbone" systems generally include treatment facilities, large pumping facilities, storage facilities, and large diameter pipes. The backbone systems support small-diameter sewer and watermain networks in local neighbourhoods. The term "trunk" system is generally used to refer to the backbone of the sanitary collection system (i.e. all elements of the backbone system except for treatment facilities), but is sometimes used in reference to the backbone of the water distribution system. Cost estimates for these upgrades will contribute to the *Development Charges By-law update*, which establishes the basis for charges to be collected from development needed to fund a wide range of services that support the city's growing communities. City-led projects are typically termed "off-site" projects in the Development Charges context and are essential to the delivery of adequate service to both existing and future residents over large areas. Conversely, the development industry is responsible for any projects that occur on developer lands as well as most off-site connections needed to service these lands. These developer-led projects are typically termed "on-site" projects in the Development Charges context.

DEFINITION

Backbone systems generally include treatment facilities, large pumping facilities, storage facilities, and large diameter pipes.

Trunk systems is a term generally used to refer to the backbone of the sanitary collection system, including all elements of the backbone sanitary system except for treatment facilities.

The IMP also builds on the policies in the Official Plan to guide the provision of water-related services for new development. The plan includes detailed policies related to the planning of stormwater, sanitary, and drinking water services (intensification and greenfield), servicing of Public Service Areas, the preparation of Master Servicing Studies, and the funding and financing of infrastructure.

1.3 Relationship to the Official Plan and Other Master Plans

One of the strategic directions in the Official Plan is to achieve, by 2046, more growth by intensification than by greenfield development. As such, this IMP includes a much greater focus on local system capacity management within existing serviced areas, compared to previous iterations of the plan.

The IMP aligns with the City's Comprehensive Asset Management program, including the Asset Management Plans for stormwater, drinking water, and sanitary systems. The basis for establishing priorities for condition-driven renewal of these systems is provided in the Asset Management Plans, whereas the purpose of the IMP is to establish priorities for growth-driven extensions or upgrades to these systems. As outlined in Section 13, the IMP includes recommendations to establish new programs that will identify and administer upgrades to local systems that are driven by intensification in coordination with the City's existing renewal program.

The IMP is also intended to align with the City's Climate Change Master Plan, which provides a long-term plan for mitigating and adapting to the potential impacts of climate change, all based on local long-term climate projections. The Climate Change Master Plan also includes identification of service-specific vulnerabilities and risks, which are considered in the preparation of the IMP. The IMP will also support future updates to the City's Long Range Financial Plan, which must account for future expenditures related to servicing. Key municipal planning initiatives are further discussed in Section 2.4 of the IMP.

1.4 Stakeholder Involvement

Development of the IMP included consultation with stakeholders including federal agencies, the development industry, community associations, Indigenous Communities, and the public. Refer to Section 18 for information on key public engagement milestones throughout the project. Refer to Appendix I for key consultation documents such as notices, newspaper advertisements, and *As We Heard It* reports.

1.5 Organization of the Plan

This document is organized in nine parts as follows:

Part I – Supporting Ottawa's Future

- Establishes the geographic, administrative, and policy context for infrastructure planning in the City of Ottawa. It reviews the growth and development forecasts alongside trends including climate change, water demand, and affordability.

Part II – Infrastructure Policy

- Establishes policy to guide infrastructure planning; relevant policies from the City's Official Plan are highlighted and supplementary policy is articulated.

Part III – Backbone System Master Plan

- Presents an overview of the development plans for water purification plants and the wastewater treatment plan. It also summarizes the Water Master Plan and the Wastewater Master Plan, including the core components of the systems, performance criteria, and proposed new projects.

Part IV – Tewin New Community

- Discusses requirements for the infrastructure serving Tewin, a new community identified in the Official Plan to be located in south-east Ottawa.

Part V – Stormwater Management Strategy

- Summarizes the existing stormwater conditions, programs, and recommendations.

Part VI – Rural Area

- Pertains to infrastructure serving villages and the Rural Countryside development.

Part VII – Intensification Capacity Management

- Discusses key considerations for intensification capacity management in terms of drinking water, wastewater, and stormwater.

Part VIII – Plan Implementation

- Discusses implementation of this IMP, including financing and affordability aspects, as well as approvals, monitoring, and amendments.

Part IX – IMP Public Consultation

- Summarizes the public consultation and engagement that was undertaken throughout the process of developing this IMP.

Appendices to the IMP include:

- Mapping that illustrates various planned components (Appendix A)
- Complete List of Supporting Studies (Appendix B)
- Guideline for Preparing Terms of Reference for Master Servicing Studies (Appendix C)
- Public Services Areas – Supplemental Information (Appendix D)
- Project and Program Sheets (Appendix E to G)
- Methods for Calculating Benefit to Existing Development (Appendix H)
- Public Consultation (Appendix I)

PART I – SUPPORTING OTTAWA'S FUTURE

2 The Geographic, Administrative and Policy Context for Infrastructure Planning

2.1 Overview

This section provides an overview of the geographic, administrative and policy context for infrastructure planning in the City of Ottawa. The objective is to describe the backdrop against which long-term infrastructure planning for the City of Ottawa takes place. Subsections identify the time horizons used for infrastructure planning and discuss the respective responsibilities of the municipality and developers. This is followed by a review of municipal planning initiatives and key provincial and federal legislation which pertain to infrastructure planning. The geographic areas of the City of Ottawa are then discussed, including both urban and rural components.

2.2 Infrastructure Planning Horizons

The IMP identifies infrastructure needs and related study requirements to support development to the year 2046. This aligns with the planning horizon of the Official Plan. However, the lifespan of the recommended infrastructure could range from approximately 20 years for facility components such as pumps and motors, to over 100 years for sewers, watermains, and water storage reservoirs. As such, it is critical that the planning of infrastructure consider potential growth that extends beyond the Official Plan’s horizon. Planning for growth beyond the horizon also provides a better understanding of opportunities for integration of long-term growth and renewal needs.

There is significant uncertainty in planning infrastructure growth beyond 2046, however projections to 2101 are included in Section 3 to support the planning and sizing of future infrastructure. It is important to emphasize that the incremental costs associated with meeting longer-term growth needs (e.g. by oversizing pipes), are typically relatively small compared to the base cost of a standard growth infrastructure project.

Moreover, given the acknowledged uncertainty in the planning process, including growth projections, the City understands the importance of having an adaptive approach to the IMP. This includes conducting regular IMP updates incorporating recalibration to new assumptions and criteria. The updates would reflect changes to expectations, constraints, and the changing climate.

2.3 Responsibilities of the City and the Development Industry

Both the City and development industry have important roles to play in the growth of the city and the provision of infrastructure.

The City reviews private development for compliance with provincial policies, as well as conformance with guidelines and standards for municipal planning and design. The City is responsible for preparing and implementing master plans, and designing and building major infrastructure projects that are needed to support growth. These City-led projects are typically termed “off-site” projects in the Development Charges context and are essential to the delivery of adequate service to both existing and future residents over large areas.

Conversely, the development industry is responsible for any projects that occur on developer lands as well as most projects which are required for growth, not eligible for Development Charge funding and typically located on public lands. These developer-led projects are typically termed “on-site” projects in the Development Charges context. These projects include all servicing required to connect to city infrastructure with available capacities. As described in the Future Neighbourhood Overlay section of the Official Plan, local plans (including Master Servicing Studies) for Urban Expansion Areas are prepared collaboratively with the development industry and are approved by the City. Once these plans are approved, individual development applications may be submitted in accordance with approved phasing plans. Through these individual applications, the bulk of infrastructure within a new Urban Expansion Area will be designed and built by the developers with controlling interests for the area. Some infrastructure, such as stormwater management facilities that serve multiple land holdings within an expansion area are typically planned, designed, and built through the coordinated efforts of the landowners.

2.4 Key Municipal Planning Initiatives

This subsection describes key municipal planning initiatives and their relationship to the IMP. The City’s Strategic Plan provides broad direction with which the IMP should align. The municipal budget and long-range financial planning processes verify the affordability of the IMP. Asset Management planning provides guiding principles for the IMP. The Official Plan provides the foundation for where growth is planned and needs to be supported by the IMP. The Transportation Master Plan identifies transportation facilities and services that will meet the needs of residents and businesses and supports the development policies and growth framework in the Official Plan. The Ottawa River Action Plan includes numerous projects that seek to improve or preserve the overall health of the Ottawa River. The Climate Change Master Plan provides an over-arching framework for how the IMP should consider climate change in the planning and design of all projects.

2.4.1 Strategic Planning

The City's Strategic Plan is a primary planning document that defines Council's priorities and guides the work of staff over each Term of Council. The priorities are determined at the onset of each term of council, through engagement with City staff and community partners. This process includes review of current approved master plans. During the development of the IMP, it was verified that all recent council priorities are considered in the plan.

2.4.2 Municipal Budget and Long-Range Financial Planning

The IMP is not a financial document, so it is critical that its recommendations are reflected in the City's annual capital and operating budgets, as well as the Long-Range Financial Plan. The Long-Range Financial Plans provide a series of financing strategies that balance the need to maintain and build capital assets (including water infrastructure) with the need to manage debt, reserve balances, and rate and tax increases. These financial plans typically provide a 10-year forecast of expenditures whereas the annual budget provides refined estimates of budget needs over a 4-year horizon, with detailed budget requests for the first year.

When the annual budget and Long-Range Financial Plan are prepared, capital cost estimates for IMP projects and programs are updated based on the most current information available.

2.4.3 Asset Management

Infrastructure Asset Management is the discipline of sustaining public infrastructure assets and the levels of service they provide. It tends to be focussed on the lifecycle of an asset, which includes planning, design, construction, maintenance, rehabilitation, and replacement of infrastructure.

Assets fundamentally exist to provide value or service to customers in a cost-constrained environment. Since revenues and budgets are finite, asset management decisions typically seek to find the right balance between cost, risk, and levels of service that customers experience.

This is not a static process, given that the following change over time:

- **External pressures:** such as economic instability or global pandemics.
- **Expectations**: such as how a system should behave in wet weather or objectives for natural assets and climate change.
- **Risk tolerance**: such as how much water in the road is acceptable during a storm to prevent water from entering a basement or how much people are willing to pay to towards fire protection.

The definition of 'level of service' varies depending on the specific infrastructure system and asset management strategy. For the purposes of the Infrastructure Master Plan, level of service refers to the quantifiable system performance criteria that govern the identification and sizing of projects needed to support growth. The levels of service concept are also used to establish targets for how intensification development can proceed without impacting existing properties.

Level of service is therefore an essential criterion for deciding whether the supply and capacity of infrastructure required for growth is adequate for the projected growth demands.

The City of Ottawa, like most municipalities in Canada, faces a growing infrastructure renewal liability. Many City assets were installed prior to modern practices to assess existing assets and the impacts of growth on the management of these assets. Historically it was not fully understood if rate revenue was adequate for the growth surges seen through the 1950s to present day. This growth paradigm resulted in rate revenue which has not been keeping pace with renewal requirements.

Rate funding is required for costs related to: operations and maintenance; interventions to extend the life of assets; renewal or replacement; as well as reserves for future renewal. When current rate revenue does not fully account for these factors, infrastructure renewal deficits can develop or grow. Increasing renewal funding alone is not considered sufficient to curtail the infrastructure renewal deficit. It is crucial that the City continues to explore a combination of financial and non-financial strategies to address this deficit.

To effectively manage the renewal deficit with non-financial strategies, it is essential to consider an asset's entire lifecycle. The following factors should be considered in the decision-making process prior to replacing an asset before the end of its useful life:

- **Remaining life of an asset.** By postponing replacement until absolutely necessary, the City can better optimize the funds needed each year for operations and maintenance.
- **Strategies to extend the life of assets.** The structural life of some assets, such as sewers, can be extended with techniques such as structural pipe lining, which additionally lessens costs for operations, maintenance, and renewal.
- **Leveraging existing system capacity to accommodate growth.** Using existing pipe capacity as an alternative to replacement not only reduces costs for development, it also can also help the city address the renewal deficit by increasing the number of ratepayers using the same assets.

Greenfield infrastructure is generally cost-neutral to the City initially (capital cost-neutral), because it is typically directly funded and installed by developers. However, this infrastructure does increase the City's overall operations and maintenance costs, and future renewal funding is needed as a result of the increased inventory of assets. It is typically much more expensive to replace infrastructure in built-up areas of the City than to initially install them in undeveloped areas. All of these non-capital costs are borne by the City, not development.

2.4.4 Official Plan

The Official Plan includes five broad policy directions as the foundation to becoming the most liveable mid-sized city in North America over the next century. The IMP plays a crucial role in supporting Ottawa's Official Plan. By aligning the IMP with the Official Plan's strategic vision, the City will confirm that drinking water, wastewater, and stormwater infrastructure is developed and maintained in a sustainable, efficient, and resilient manner and will provide the capacity required to support the projected growth.

One of the Official Plan's policy directions is to achieve greater urban density and manage growth, via a growth management framework. The growth management framework is premised on the ability to provide sufficient development opportunities and an appropriate range of choices, locating and designing growth so as to increase sustainable transportation mode shares and use existing infrastructure efficiently, while reducing greenhouse gas emissions. The IMP supports this by planning for water infrastructure capacity that is adequate to meet the needs of Ottawa's growing population, while also considering the impacts of urban intensification on wastewater and stormwater systems. This alignment ensures that infrastructure development keeps pace with the increasing demands of a growing urban population.

Another policy direction of the Official Plan is promoting environmental sustainability and climate resilience. The IMP addresses these concerns by prioritizing the protection of water resources, ensuring water infrastructure is suited for (or provides services in) future climate conditions, and promoting sustainable practices such as Low Impact Development (LID) for stormwater management.

Lastly, the Official Plan emphasizes the importance of collaboration and engagement with stakeholders, including the development industry, Indigenous communities, businesses, and residents. Throughout the implementation of the IMP, the City committed to fostering partnerships, seeking input from diverse groups, and ensuring that water infrastructure projects align with the needs and aspirations of the broader community. By working together, the IMP and the Official Plan can create a more livable and resilient future for the city.

2.4.5 Transportation Master Plan

The Transportation Master Plan (TMP) is the City's blueprint for transportation growth management policies. The TMP addresses the planning, funding and implementation of the City's walking, cycling, transit and road networks over the next several decades. The most recent TMP was issued in 2013 and an update is currently underway.

Similar in function to this IMP, the updated TMP will also be a strategic document that sets growth-related goals, objectives, and priorities in support of the Official Plan - but in the realm of transportation, rather than water, wastewater and stormwater management infrastructure.

2.4.6 Ottawa River Action Plan

In 2010 City Council approved the implementation of 17 initiatives designed to enhance the health of the Ottawa River and protect Ottawa's overall water environment into the future. This collection of projects forms the Ottawa River Action Plan. The Ottawa River Action Plan seeks to improve water environment health at the regional level for the residents of Ottawa, Eastern Ontario and communities in Quebec that interact with the Ottawa River. Protecting the Ottawa

River means maintaining a healthy aquatic ecosystem, ensuring compliance with regulatory requirements, optimizing recreational use and reducing beach closures, and developing a long-term strategy to guide and prioritize actions.

To date, 10 of the identified 17 initiatives are complete and all others are underway (Table 2-1). The IMP development process benefited from the implementation of some of these Ottawa River Action Plan initiatives. For example, the Wet Weather Infrastructure Management Plan improved the understanding of the City's urban water resources infrastructure systems and generated hydraulic models that formed the foundation of the current sanitary system model used to support the planning of sewer infrastructure in the IMP.

Table 2-1: Projects Identified as part of the Ottawa River Action Plan

Project	Status
1) Implementation of Real Time Control	Complete
2) Critical CSO and Storm Outfall Monitoring	Complete
3) CSO Storage for Ultimate Combined Sewer Area	Complete
4) Review and Implement Sewer Interconnection Program	Complete
5) Sewer Separation outside of Ultimate Combined Sewer Area	Ongoing
6) Development of a WW-IMP	Complete
7) Implementation of a WW-IMP	Ongoing
8) Installation of Floatable Traps in Canadian Standard Association catchbasins	Complete
9) Pinecrest Creek/Westboro Stormwater Management Retrofit Plan	Complete
10) Eastern Subwatersheds Stormwater Management Retrofit Plan	Complete
11) Implementation of Stormwater Management Retrofit Plans	Ongoing
12) Effluent Dechlorinization	Complete
13) Water Environment Strategy	Complete
14) Monitoring and Source Control Programs	Ongoing
15) Wastewater and Drainage Environmental Quality Management System	Ongoing
16) Updates to the Ottawa River Bacterial Water Quality Computer Model	Complete
17) Public Outreach and Education	Ongoing

2.4.7 Climate Change Master Plan

Through the declaration of a Climate Emergency in 2019, Council directed staff to embed climate change considerations across all elements of City business. The Climate Change Master Plan provides a framework for how Ottawa will mitigate and adapt to climate change over the next three decades. The vision of the Climate Change Master Plan is to take unprecedented, collective action that transitions Ottawa to a clean, renewable and resilient city by 2050. It sets guiding principles, goals, greenhouse gas emission reduction targets, and priority actions for 2020 through 2025.

One priority of the Climate Change Master Plan is the application of a climate change lens to the Official Plan and its supporting documents. This lens provides a framework which outlines key requirements and considerations to be addressed in the City's master plans, including both mitigation (greenhouse gas emissions reductions) and adaptation (climate change resiliency) strategies. In the context of the IMP, the climate lens has focused primarily on adaptation. Despite the limited opportunities for mitigation through direct greenhouse gas emissions reductions, there are two areas being explored: 1) the use of wastewater energy transfer systems to supply zero carbon energy for heating and cooling for buildings, and 2) capturing renewable natural gas from wastewater.

Development of a Climate Resiliency Strategy is another priority action identified in the Climate Change Master Plan. The work includes development of local climate projections, assessing climate vulnerabilities and risks, and identifying strategies to mitigate the greatest climate risks to the community, infrastructure, natural environment and economy. The final strategy is expected to be completed in 2024.

Climate change projections for the National Capital Region were published in June 2020 and apply advanced climate modeling to predict changes in temperature, precipitation, wind, and extreme weather until the year 2100. These projections are considered in the planning of IMP infrastructure to confirm water systems perform in future climate conditions, including higher and more variable precipitation and more extreme weather.

A comprehensive climate vulnerability and risk assessment for existing water, wastewater and stormwater infrastructure was completed in 2022 and used the climate projections data to assess the possible impacts and risks of climate change for these systems. The assessment confirms that many existing infrastructure planning practices and design guidelines already directly or indirectly consider potential risks to system performance that are posed by climate change. Further information and recommendations are provided in the service-specific sections of the IMP document, including recommended capital improvements or operational response plans.

Further review of the climate projections and the associated vulnerability and risk assessment recommendations will be required to determine the need for future updates of the City's current design guidelines that are used to support infrastructure planning. Where there are additional climate change and resiliency considerations to be applied to infrastructure planning studies, these will be included in study-specific terms of reference.

2.5 Key Provincial and Federal Legislation and Programs

This subsection identifies the key provincial and federal regulations and programs that are relevant to the planning of water-related infrastructure. Provincial and federal regulations and programs are of primary importance to the planning, design, construction, and management of infrastructure in the City. This section discusses the impact to the IMP of various provincial acts, the Provincial Policy Statement, and the planning performed by the National Capital Commission, including their Plan for Canada's Capital Region and the Greenbelt Master Plan.

2.5.1 Provincial and Federal Legislation

The *Municipal Act* is a consolidated provincial statute that outlines powers and duties, roles and responsibilities, as well as structure and internal organization of Ontario municipalities. The *Planning Act* is the primary planning legislation in Ontario. It establishes the rules for land use planning and therefore provides the basis for the preparation of the City's Official Plan, which the IMP supports. The *Planning Act* integrates matters of provincial interest into provincial and municipal planning decisions by requiring that all decisions be consistent with the Provincial Policy Statement and conform with provincial plans.

Ontario's *Environmental Assessment Act* generally requires an environmental assessment of any major public or designated private undertaking in order to determine the ecological, cultural, economic and social impact of the project. The Act also establishes a Class EA process for planning certain municipal projects such as water, sanitary, and stormwater projects. All projects identified in the IMP are subject to Class EA requirements, although some are pre-approved under the Act if they are limited in scale and have limited potential for adverse environmental effects. Projects that impact federal lands must also meet the requirements of Canada's *Impact Assessment Act*.

As details of the planning of individual infrastructure projects are advanced, proponents must identify the need for authorization or permit approvals under provincial and federal legislation. These approvals could fall under the federal *Fisheries Act*, as an example, whereby authorization would set the terms and conditions for a proposed undertaking that may result in serious harm to fish or fish habitat.

The *Ontario Water Resources Act* governs the protection and management of Ontario's water resources and provides for their efficient and sustainable use. Permits to take water from ground or surface water sources are regulated under the Act. The Act regulates the approval, construction and operation of water works, including groundwater wells. The Act also regulates sewage works and prohibits the discharge of polluting materials that may impair water quality.

The Rideau Valley Conservation Authority, Mississippi Valley Conservation or South Nation Conservation will issue permits for undertakings in areas regulated under the *Conservation Authorities Act*.

Ontario's *Infrastructure for Jobs and Prosperity Act* includes regulations governing Asset Management Planning in Ontario. These regulations are intended to improve how municipalities plan for maintaining infrastructure in a state of good repair and govern the preparation of Asset Management Plans.

2.5.2 Provincial Policy Statement Provincial Policy Statement

The Provincial Policy Statement provides policy direction on matters of provincial interest related to land use planning and development in Ontario. The statement provides for appropriate development while protecting resources of provincial interest, public health and safety, and the quality of the natural and built environment. All decisions affecting land use planning matters made by the City are required to be consistent with the statement.

Provincial Policy Statement policies relevant to municipal infrastructure planning relate to:

- The provision of stormwater, sanitary, and drinking water infrastructure;
- The protection of natural water resources; and
- The protection of public health and safety by directing development away from natural hazards such as floodplains.

The Statement also directs municipalities to address energy conservation and prepare for the impacts of a changing climate. All City planning decisions must be consistent with the Statement through policy directions in the Official Plan, Zoning By-law and decisions on planning matters.

2.5.3 National Capital Commission Planning

The Plan for Canada's Capital is a long-range planning document created by the National Capital Commission that acts as a blueprint for the evolution of federal lands within the National Capital Region. The Plan provides broad planning guidance and guidance for federal management of National Capital Commission lands to ensure that the capital reflects its national importance. The Plan acknowledges a shared and collective responsibility with municipal and provincial planning authorities to achieve the objectives of the plan.

The National Capital Commission's Greenbelt Master Plan describes the purpose of the Greenbelt and outlines the values that should inform any planning decisions made pertaining to the Greenbelt. The Plan sets infrastructure policies that pertain to the IMP, including additional requirements for new linear (pipe) and vertical (facility) infrastructure which are located inside the Greenbelt but service land outside the Greenbelt. Requirements include environmental impact mitigation, alignment justification and rationale, and the use of best practices to prevent impacts upon streams, soils, water, vegetation, overall natural systems, land use and visual quality. These requirements must be considered as part of all proposed IMP projects that will have potential impacts on the NCC Greenbelt.

2.6 Ottawa's Geographic Areas

The current geographical organization of the City's Official Plan reflects the combined influence of natural features, market forces that have shaped historical development patterns, and land use plans and policies. The Official Plan establishes six concentric policy areas called "transects" that each represent a different gradation in the type and evolution of the built environment and planned function of the lands within it. Transects are shown Appendix A, Schedule 1.

Each transect has policies within the Official Plan to guide future growth and development. Five of the transects, are contained within the urban area, whereas the Rural Transect is located outside the urban boundary:

- The Downtown Core Transect
- The Inner Urban Transect
- The Outer Urban Transect
- The Suburban Transect
- The Greenbelt Transect
- The Rural Transect

The Official Plan establishes designations largely based on urban function rather than land use. It is recognized that many different types of land use can exist as part of the function of a single designation. For the transects located within the City's urban boundary, urban designations include Hubs and Corridors.

- **Hubs:** This designation centered on planned or existing rapid transit stations and/or frequent street transit stops. Hubs are also known as Protected Major Transit Station Areas for the purposes of the Provincial Policy Statement.
- **Corridors:** This designation applies to bands of land along specified streets whose planned function combines a higher density of development, but lower density than nearby Hubs.

The designations of Hubs and Corridors are relevant to the IMP since these are the primary areas where intensification is anticipated to occur over the planning horizon. Consultation with the development industry occurred during the Official Plan process, identifying preferred areas for intensification. Appendix A, Schedule 2 shows the corridors and hubs as identified in the Official Plan. The Urban Transects also contain the designations of Neighbourhoods, Industrial and Logistics, Mixed Industrial, and Special Districts, along with designations specific to the Greenbelt Transect.

2.6.1 Future Neighbourhoods

The City's Growth Management Strategy (March 2020) utilized a balanced approach to meeting housing needs to the 2046 planning horizon. This was achieved through a combination of growth by intensification in existing neighbourhoods, and greenfield development in urban expansion areas. The intent of this strategy was that by 2046, most development in the City would be within the existing urban boundary through infill and intensification.

The lands added to the urban boundary are shown in Appendix A, Schedule 1. The urban expansion lands represent the following total areas of net developable land:

i. 836 ha of residential land, expansions to existing communities;
ii. 445 ha of residential land in the new Tewin community;
iii. 140 ha of industrial land;

The growth projections and servicing constraints associated with the urban expansion areas are discussed in depth in Section 3.2.3

3 Ottawa Growth Forecasts, Trends, Opportunities and Constraints

3.1 Overview

This section reviews the residential and employment projections of the Official Plan and approved Urban Expansion Areas. Water and wastewater trends are discussed, including water supply and demand, wastewater generation, and wet weather flows in the sanitary collection system. Climate change trends are discussed. Constraints in future infrastructure planning are discussed, with climate change being paramount to the discussion. The objective is to provide an overview of the range of considerations which have informed the development of infrastructure policy and proposed future projects.

Note: The expansion area names described herein are referring to the Official Plan Schedule C17 from November 4, 2022, and as labelled on Schedule 1 (Appendix A).

3.2 Growth and Development Forecasts

This subsection summarizes the residential and employment forecasts provided by the Official Plan and subsequent studies. The forecasts included are for the 2046 planning horizon as well as the 2101 long-term forecast.

3.2.1 Residential Projections Applied to the IMP

Population and housing in Ottawa are all expected to grow significantly by 2046. During the period from 2018 to 2046, the population is expected to grow by about 400,000 people, a 40 percent increase over 2018. The Official Plan provides a breakdown of where this growth will occur. These projections were further refined for the IMP, using Traffic Zone delineations. The resulting projections are shown in Table 3-1 below. The data shows that, over the planning period, approximately 50% of new urban dwelling units are expected to be constructed outside the greenbelt, compared to 42% inside the greenbelt. Occupancy rates, or persons per unit, are expected to continue to drop in all areas.

Table 3-1: 2046 Official Plan Residential Projections

	Population			Dwelling units			Occupancy rate	
Area	**2018**	**2046**	**Increase**	**2018**	**2046**	**Increase**	**2018**	**2046**
Inside Greenbelt	519,000	657,000	139,000	233,000	315,000	82,000	2.22	2.09
Outside Greenbelt	405,000	634,000	229,000	141,000	239,000	98,000	2.86	2.66
Rural	84,000	118,000	34,000	30,000	45,000	15,000	2.81	2.59
Total Urban	924,000	1,291,000	368,000	374,000	554,000	180,000	2.46	2.33
Total City	1,008,000	1,410,000	402,000	404,000	599,000	195,000	2.49	2.35

Source: City of Ottawa, Planning and Growth Management, Research and Forecasting Unit, 2018-mid year population estimates and Ottawa Official Plan Projections (2021). Projections from the Official Plan were further discretized based on traffic zone delineations.

The Official Plan proposes that by the end of the planning period, more growth will be achieved by intensification than by greenfield development. Intensification and greenfield growth will support 15-minute neighbourhoods, which are compact, well-connected places with a clustering of a diverse mix of land uses that support active transportation and transit and reduce car-dependency. Higher densities will be directed closer to main streets, corridors, rapid transit stations, hubs and major neighbourhood amenities.

The IMP considers detailed projections prepared by City planning staff. The detailed data provided further understanding of the projected intensification described in the Official Plan. Projections were derived using several sources, including the Vacant Urban Residential Land Survey, the Urban Expansion Lands as approved in the Official Plan, and the Rural Residential Land Survey. Figure 3-1 provides a comparison of the different types of residential units that currently exist (baseline used was the year 2018) to those units that are projected to be built by 2046. This breakdown illustrates the magnitude of projected change to new residential units in the City, informing the IMP of forecasted intensification locations in general. For example, the proportion of new multiple dwelling units is expected to nearly double by 2046.

Figure 3-1: Projected New Residential Growth by Housing Type

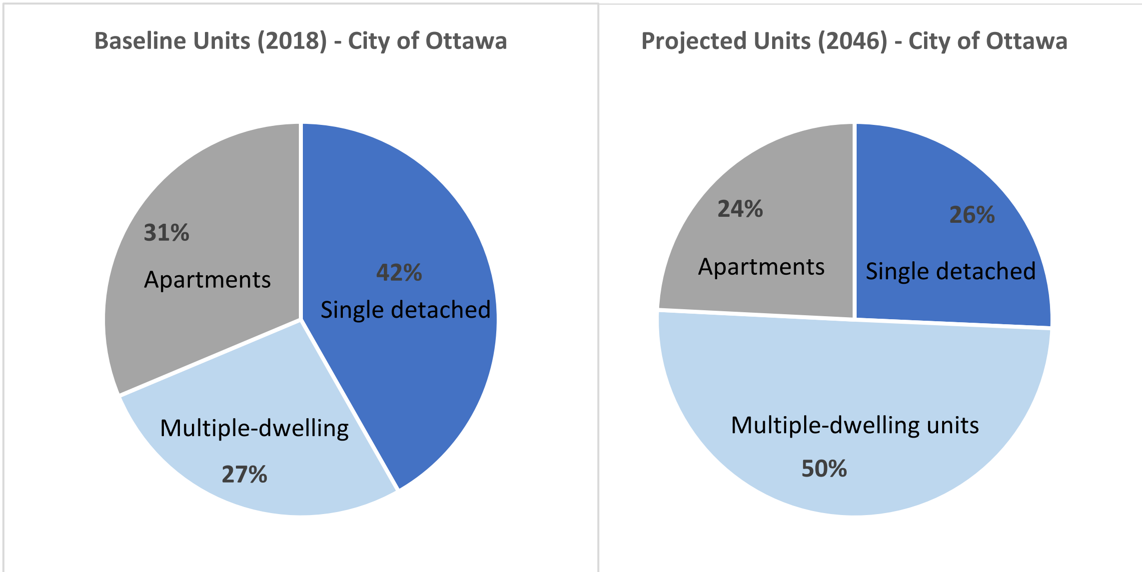
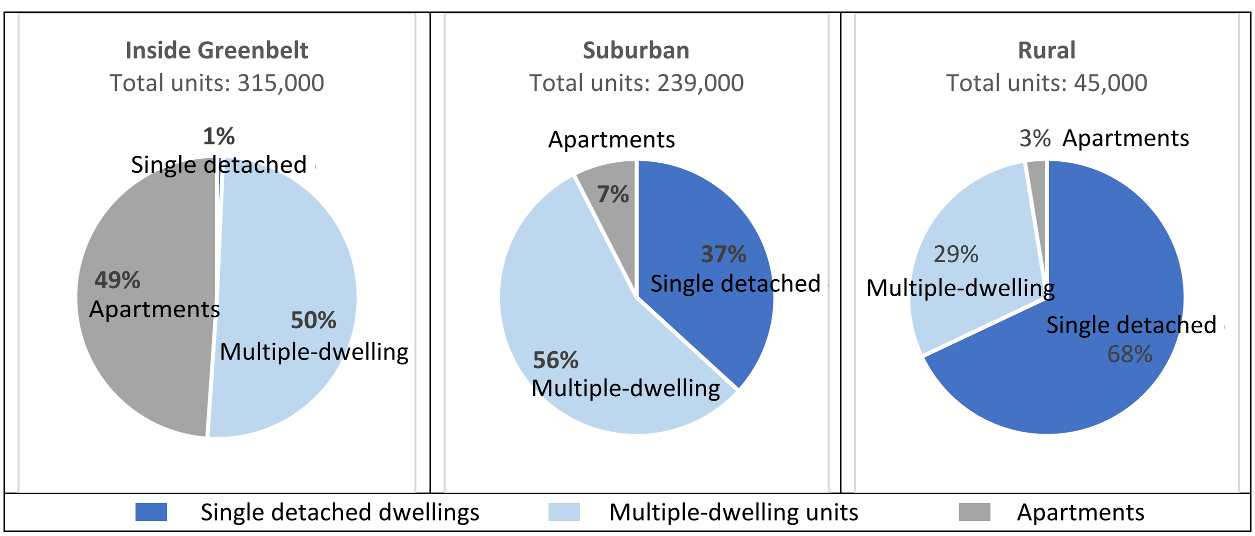


Figure 3-2 provides the projected new residential housing types by area. The projections predict that single-detached housing inside the Greenbelt will be a small portion of the total units by 2046. Furthermore, while a significant number of single-detached homes are projected to be built in the suburban area, projections for denser living units, such as apartments and multi-dwelling units, will account for most of the projected growth (63%) in that area.

Intensification and greenfield growth will support 15-minute neighbourhoods, which are compact, well-connected places with a clustering of a diverse mix of land uses that support active transportation and transit and reduce car-dependency.

Figure 3-2: Projected Total Residential Housing Types By Area by 2046



3.2.2 Employment Projections

The Official Plan describes growth policies and provides forecasts for economic development. Per Section 3 of the Plan, by 2046 most of the employment growth will occur within the built-up portion of the urban area. The Plan describes the understanding that most employment in the City is knowledge-based and primarily office-based. The Plan also explains that "office and knowledge-based employment areas should not be segregated from other uses and should be allowed to evolve into mixed-use areas. This also provides more flexibility in responding to the impacts of how people live within and move through neighbourhoods post-COVID-19 pandemic".

Employment is expected to grow by about 189,000 jobs from 2018 to 2046. The Downtown Core will remain the most important employment hub in the City. Inner Urban, Outer Urban Corridors, Hubs and Suburban Town Centres will see their role increase significantly as places for employment growth. Industrial areas and the rural area are also anticipated to accommodate job growth. 95% of the total employment growth will occur within the urban area of the City, with 58% of the total growth expected to occur inside the Greenbelt.

3.2.3 Urban Expansion Areas

Urban expansion areas are new lands added to the Suburban Transect by the Official Plan. This includes Industrial and Logistics areas as well as areas subject to Future Neighbourhood Overlay. These areas require extension and/or upgrading of services to support greenfield development. The following section discusses the size, projected population and approximate units attributed to the new lands, as well as a brief discussion of the infrastructure-related issues associated with each expansion area.

Table 3-2 summarizes the projected residential growth statistics that are being factored in the planning of infrastructure for the Official Plan planning horizon to the year 2046. The areas are broken down into the following communities: West Urban, South Urban, East Urban and Tewin. The urban expansion areas are shown in Appendix A, Schedule 1.

Table 3-2: Summary of Urban Expansion Areas Subject to Future Neighbourhood Overlay

Cluster Area	Gross Area (ha)	Net Dev. Area (ha)	Net Res. Area (ha)	Approx. Units	Approx. Population
West Urban	164	75	38	1,221	2,969
East Urban	424	321	160	5,134	12,367
South Urban	577	440	220	7,022	16,833
Tewin	838	445	223	7,180	16,530
Total	**2,003**	**1,281**	**641**	**20,557**	**48,699**

Notes:
(1) Areas rounded to nearest hectare
(2) Net residential area assumed to be 50% of net developable area
(3) Units values were provided by the Research and Forecasting group
(4) Population based on 2.4 people/unit
(5) Units could be higher (to be refined through secondary planning process)
(6) Small lots (two hectares and smaller), in addition to rural estate subdivisions, excluded from net developable area. Servicing of these lots should be taken into consideration through Master Servicing Study (MSS)
(7) Net developable area does not include school blocks, commercial areas, etc., which need to be factored in MSS

Table 3-3 summarizes the projected areas associated with the new Industrial and Logistics areas added to the West Urban and South Urban communities. The net areas shown below were established in the City's Growth Management Strategy report.

Table 3-3 Expansion Cluster Area – Industrial and Logistic Areas

Cluster Area	Gross Area (ha)	Net Area (ha)
West Urban (W-2)[1]	237	100
South Urban (S-1) [1]	81	40
Total	**318**	**140**

(1) Excluding new Residential areas

3.2.3.1 West Urban Community

A total net area of 75 hectares has been added to the West Urban Community, in addition to 100 net hectares of industrial and logistics lands. The expansion area lands are divided into the following two cluster areas, where more detailed servicing plans will need to be prepared to support development:

- W-2 – North Stittsville
- W-4 – South Stittsville

Table 3-4 summarizes the areas, estimated population and projected units associated with the two (2) cluster areas located in the West Urban Community urban expansion area.

Table 3-4: Urban Expansion Area Clusters for the West Urban Community

Cluster Area	Gross Area (ha)	Net Dev. Area (ha)	Net Res. Area (ha)	Approx. Units	Approx. Population
W-2 [1]	96	37	19	603	1,465
W-4	68	38	19	618	1,504
Subtotal	**164**	**75**	**38**	**1,221**	**2,969**

Notes:
(1) Excluding new Industrial and Logistics areas

Water Supply

A potential challenge for servicing expansion lands in the West Urban Community is providing water supply at acceptable water pressures due to some higher elevations in expansion area W-2. The future master servicing study required for the W-2 lands may need to develop local area-specific water servicing strategies to maximize water pressure throughout the W-2 area.

Wastewater Servicing

The City has made significant investment in the wastewater collection system in the West Urban Community in recent years. The servicing of growth areas in the West Urban Community can largely be achieved by accessible gravity connections to existing wastewater outlets.

Stormwater Outlets

The management of stormwater in both cluster areas in the West Urban Community could prove challenging given the location of urbanization being in the upper watershed area of available storm outlets, and the need to manage increased runoff volumes through downstream drainage systems in built-out areas, or across lands not owned by the City.

Other Challenges

Planning of servicing in area W-2 is complicated by the presence of existing development using private services. Allowance for future demands generated in this existing area of development will need to consider possible future extension of services through Local Improvement projects. Planning for servicing is further complicated because land use includes a mix of existing and future commercial and residential lands.

Servicing in area W-4 is also challenging due to the presence of shallow bedrock, and the proximity of adjacent rural development on private wells.

3.2.3.2 South Urban Community

A total net area of 440 ha has been added to the South Urban Community (SUC), in addition to 40 net hectares of industrial and logistics lands. The expansion area lands are divided into the following five cluster areas where more detailed servicing plans will need to be prepared to support development:

- S-1 – Barrhaven South – West of Greenbank
- S-2 – Barrhaven South – East of Greenbank
- S-3 – Riverside South (Bowesville Road lands)
- S-4 – Leitrim – West of Bank Street
- S-5 – Leitrim – East of Bank Street

Table 3-5 summarizes the areas, estimated population and projected units associated with the five (5) cluster areas located in the SUC urban expansion area.

Table 3-5: Urban Expansion Area Clusters for the South Urban Community (Including Leitrim)

Cluster Area	Gross Area (ha)	Net Dev. Area (ha)	Net Res. Area (ha)	Approx. Units	Approx. Population
S-1 [1]	45	43	22	694	1,675
S-2	77	65	33	1,041	2,514
S-3	407	309	155	4,879	11,653
S-4	15	8	4	181	438
S-5 [2]	34	14	7	227	553
Subtotal	**577**	**440**	**220**	**7,022**	**16,833**

Notes:
(1) S-1 excludes new Industrial and Logistics areas
(2) S-5 excludes quarry buffer zone (50ha) from the gross and net development areas

Water Supply

The SUC pressure zone reconfiguration is expected to provide sufficient water supply with good pressure to all areas. However, some minor servicing challenges may exist due to local topographic constraints in area S-3.

Wastewater Servicing

Generally, there are no notable wastewater constraints to service the urban expansion areas in the South Urban Community. Increased capacity may be required in short lengths of existing or planned sewers that will need to be defined during completion of master servicing studies of the expansion areas.

Stormwater Outlets

Establishing a legal and sufficient outlet through *Drainage Act* processes will be required in areas S-1 and S-2 and shall be factored in the master planning processes of these areas. The largest stormwater servicing challenge in the SUC will be managing post-development runoff volume in the Mosquito Creek watershed. The scale of development in S-3 will require completion of a restoration plan for Mosquito Creek to be prepared during Master Planning of the S-3 community to guide development, the scope of channelization, as well as channel erosion and bank protection.

Other Challenges

Master planning in area S-3 will need to be coordinated with on-going master planning / build-out of the existing Riverside South community and associated Mosquito Creek improvements.

3.2.3.3 East Urban Community

A total net area of 321 ha has been added to the East Urban Community, generally divided into the following four cluster areas where more detailed servicing plans will need to be prepared to support development:

- E-1 – South Orleans – Wall Road lands
- E-2 – South Orleans – Trim & Innes Road lands
- E-4 – Cardinal Creek Village – Central
- E-5 – Cardinal Creek Village – North

Table 3-6 summarizes the areas, estimated population and projected units associated with the four (4) cluster areas located in the East Urban Community urban expansion area.

Table 3-6: Urban Expansion Area Clusters for the East Urban Community

Cluster Area	Gross Area (ha)	Net Dev. Area (ha)	Net Res. Area (ha)	Approx. Units	Approx. Population
E-1	288	259	129	4,225	10,199
E-2	80	20	10	239	550
E-4	45	35	17	540	1,302
E-5	11	8	4	130	315
Subtotal	**424**	**321**	**160**	**5,134**	**12,367**

Water Supply

The East Urban Community cluster areas can all be serviced by the 2E pressure zone by extension of existing watermains, and adequate water pressure can be achieved without the need for any pump station upgrades. The only water supply concern is providing redundancy to cluster area E-4, which will have to be addressed during preparation of more detailed servicing plans.

Wastewater Servicing

Providing wastewater services to the East Urban Community includes a few challenges. Servicing cluster area E-1 will need to resolve capacity constraints of the existing Tenth Line pumping station and forcemains. The master servicing study for the E-1 lands will need to develop a preferred wastewater servicing solution in this area.

Stormwater Outlets

Establishing sufficient stormwater outlets is the greatest of all servicing challenges for cluster areas E-1 through E-4. Due to the presence of sensitive marine clay soils and related grade raise constraints in the E-1 development area, management of stormwater will rely on establishing legal and sufficient outlets to McKinnons Creek, for which a lower profile is proposed to be constructed through an on-going Municipal Drain process still requiring approval, and possible resolution of appeals. Area E-2 and E-4 rely on Cardinal Creek, for their outlet. Establishing a storm water outlet from Area E-2 is complicated by limited on-site topographic relief, which will require consideration of alternative off-site drainage improvements during master planning of the area. Area E-4 relies on establishing a sufficient and stable stormwater outlet through the deep valley lands of the south tributary of Cardinal Creek, which is anticipated to require channel, bank, and slope stabilization works prior to receiving urban stormwater runoff. Further, the cumulative impact of increased runoff volumes from E-2 and E-4 on erosion and slope stability in the lower Cardinal Creek valley will need to be addressed on a watershed basis. By contrast, stormwater management of area E-5 is expected to be less complex because of the availability of a storm outlet to the Ottawa River being established through the existing Cardinal Creek Village.

Other Challenges

The Village of Notre Dame des Champs has been designated a serviced village in the Official Plan. Consequently, wastewater planning in the East Urban Community will need to factor the potential for increased capacity requirements that could be required, should village residents support the expansion of the sanitary collection system by way of the Local Improvement process.

3.2.3.4 Tewin Community

The new Tewin Community represents an addition of a net area of 445 hectares to the urban boundary. The initial planning of this new community involves identifying the preferred development area from an overall area of 838 hectares which straddles the Ramsay Creek and Bear Brook watersheds in southeast Ottawa. Table 3-7 summarizes the area, populations and units projected for the new Tewin Community.

Table 3-7: Summary of Urban Expansion Area Statistics for the Tewin Community

Cluster Area	Gross Area (ha)	Net Dev. Area (ha)	Net Res. Area (ha)	Approx. Units	Approx. Population
Tewin	838	445	223	7,180	16,530

Establishing a water supply and wastewater service to the new community will involve large up-front capital costs. The water system may initially include high operational costs associated with maintaining water quality, until sufficient demand is generated as a result of development of the community to avoid excessive water age. The planning and implementation of the water supply system and wastewater collection system will be a coordinated effort between the City and Tewin developers. The City will be responsible for the planning of all off-site works, which will connect to the internal water and wastewater networks planned and constructed by the Tewin developers.

Planning for stormwater drainage of the Tewin community will involve preparation of various studies such as the Bear Brook watershed plan by the City and South Nation Conservation; a cumulative impact study of Ramsay Creek; as well as *Drainage Act* processes to address the issue of legal and sufficient outlet requirements associated with downstream Municipal Drains.

As for other developing areas in the east end of the City, the Tewin area contains sensitive marine clay soils that will increase the complexity and the cost of constructing services. The expansion area also includes several hundred existing homes that are connected to the Carlsbad Springs trickle feed water supply system and are serviced by private waste disposal systems. Planning of servicing the Tewin area will need to factor the constraints imposed by existing development, while also considering the future water and wastewater servicing of existing development, in addition to potential longer-term development west to the Village of Leitrim. Detailed constraints, opportunities and alternatives will be furthered discussed in Section 8 of this document.

3.2.4 Long-term Infrastructure Planning Projections

Long-term infrastructure planning beyond the 2046 horizon is imperative due to the long operational life of water and wastewater infrastructure, as well as the high cost to install, replace or upgrade assets. There is significant uncertainty in planning infrastructure growth beyond 2046, however projections to 2101 are included in the following section to better support future modeling.

The information in Table 3-8 reflects the significant intensification that is anticipated to continue beyond 2046 in established urban areas of the City. Population is projected to increased by an additional 400,000 between 2046 and 2101, with an additional 184,000 dwelling units and 190,000 jobs. Most of the intensification is expected to take place inside the urban boundary, particularly in the vicinity of transit stations, in mixed-use centres, and along mainstreet corridors. The other major portion of growth to 2101 is expected to occur within areas that are currently outside of the Urban Boundary.

Table 3-8: Projections for Long-term Infrastructure Planning

Area	2018 Existing			2046 Increase			Projected increase (2046 to 2101)		
	Pop	Units	Jobs	Pop	Units	Jobs	Pop	Units	Jobs
Built-up area	918,000	372,000	NA	345,000	170,000	NA	143,103[1]	98,765[2]	161,484
New Greenfields	NA	NA	NA	NA	NA	NA	253,611	84,224	22,179
Rural[3]	90,000	32,000	NA	58,000	25,000	NA	3,247	1,082	6,961[4]
Citywide	1,008,000	404,000	638,000	402,000	195,000	189,000	399,960	184,072	190,624

Notes:
(1) The built-up net population growth includes a net increase in 23,152 people in institutional housing (nursing homes, correctional facilities, etc.)
(2) The relatively large increase in dwelling units in the built-up area is explained by two main factors: the occupancy rate per dwelling in the built-up area is assumed to decrease over time, resulting in a decline in population but not a decline in units. Therefore, the growth in population that will occur through intensification is forecasted to result in an overall lower net growth in population compared to units.
(3) The rural area includes both villages and the surrounding rural area. Growth of 650 units and 2,210 people are assumed to occur in the villages.
(4) The projections for the rural jobs apply to areas outside of villages and existing rural industrial areas.

3.3 Infrastructure Supply and Demand Management Trends

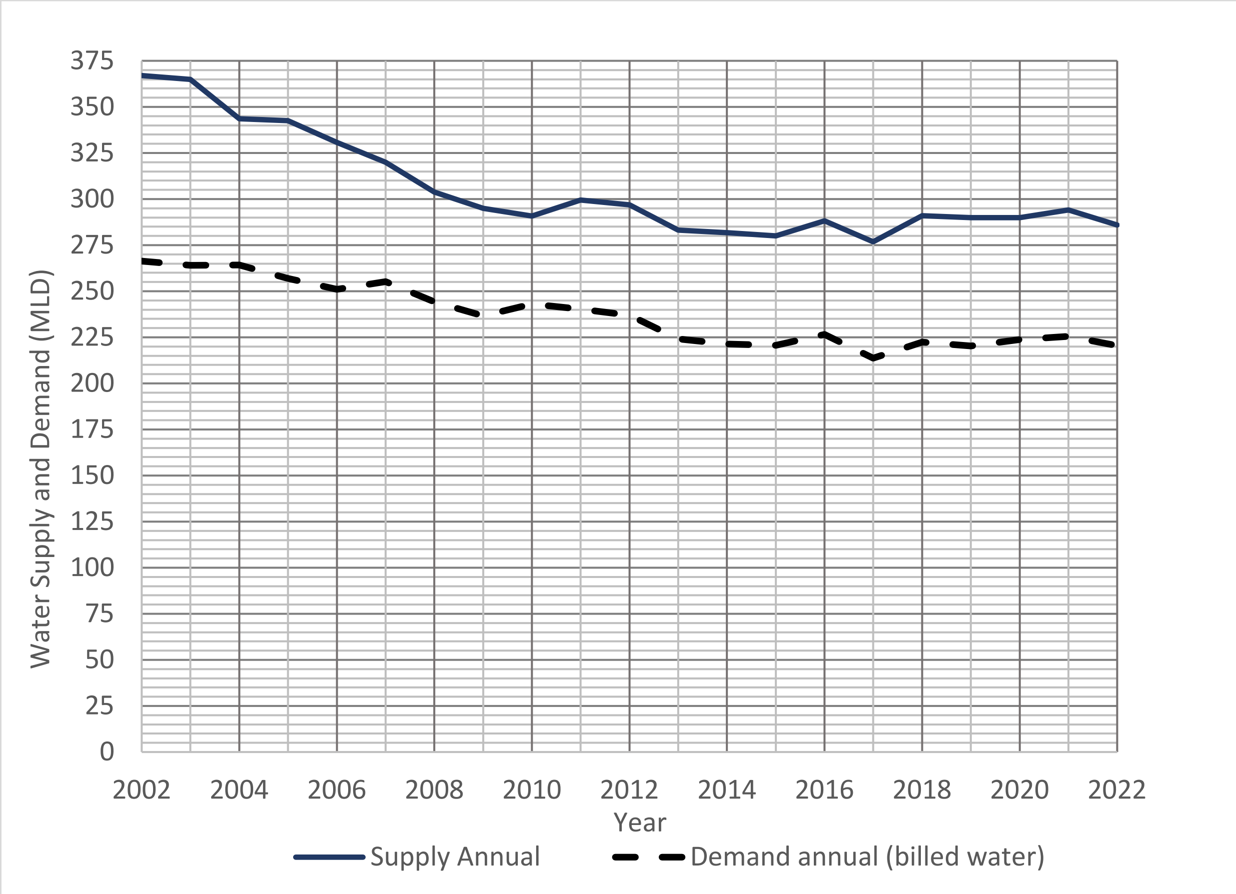
This section will explore recent water supply, water demand, and wastewater generation trends that have been documented in the last twenty years.

3.3.1 Overall Water Recent Historical Trends

Despite yearly growth in population and employment, both supply and demand for drinking water saw yearly decreases from the early 2000s to 2015, as presented in Figure 3-3. Drinking water system supply peaked in 2002 at 367 million liters per day (MLD) and has decreased by 24% to 280 MLD by 2015. Water demand, as determined by billing data, peaked in 2002 at 266 MLD and decreased by 17% to 221 MLD by 2015. From 2017 to 2022, there has been a leveling or slight increase in average day supply and demand. This trend may indicate incipient increases in overall system demand, where the rate of increases in demand due to population growth may have finally surpassed the rate of decrease in water demand. Per capita demand is further explored in Section 3.3.3.

Factors that may lead to the reduction in water consumption include water price, water efficiency awareness, water-efficient fixtures and appliances replacing older models, smaller residential yards or gardens (requiring less outdoor water use) and reduced leakage due to leak detection programs and lifecycle infrastructure replacement.

Figure 3-3: Overall Annual Water Demand and Supply



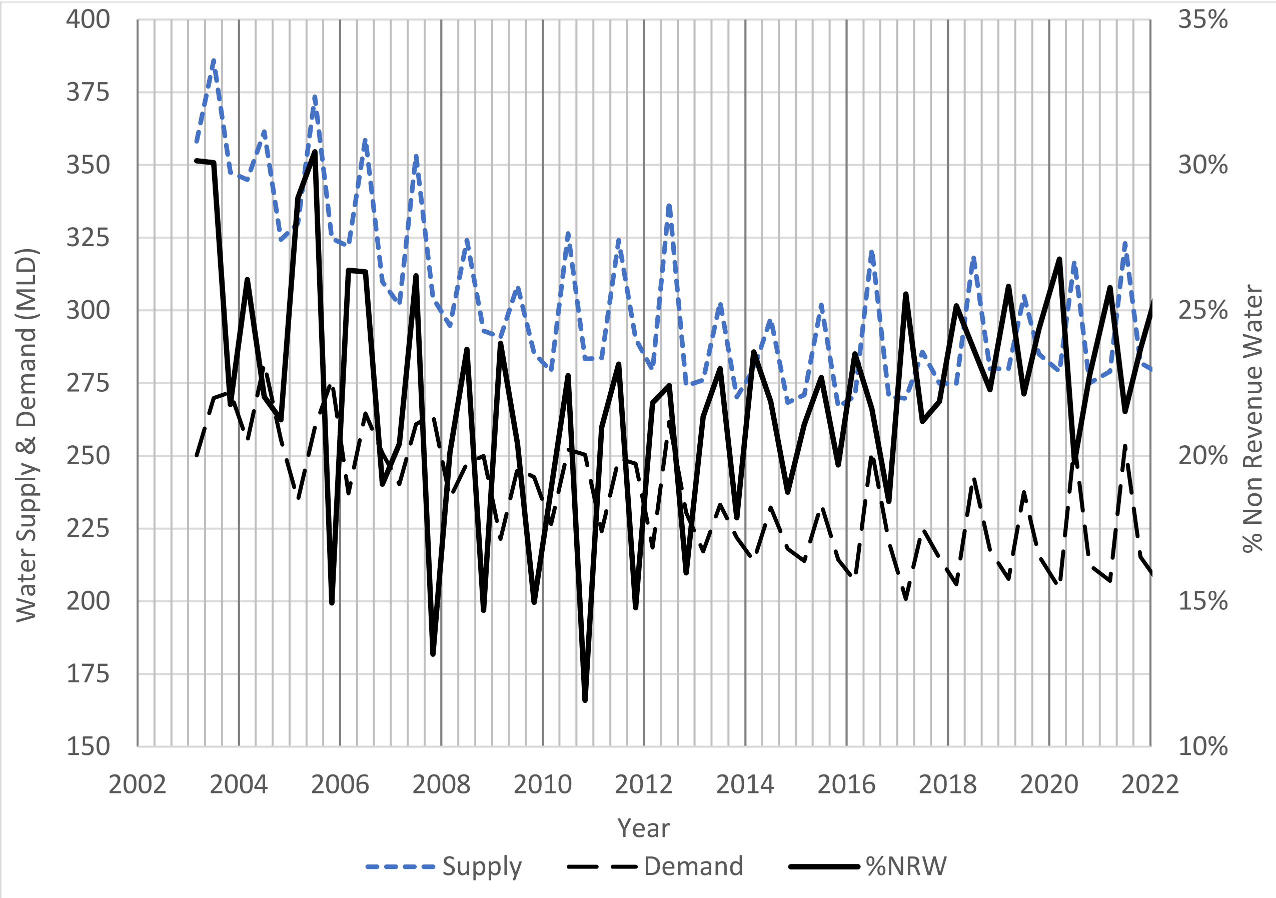
3.3.2 Non-Revenue Water

Demand, as determined by billing data, is always less than supply because water losses occur throughout the system and certain water uses are not billed. This excess demand due to losses is called non-revenue water because it is supplied by the system (at a cost) but there is no offsetting water revenue. The 'Let Water Run' program, a program implemented to reduce the risk of pipes freezing in the winter, is an example of recorded water use that is not being reflected in billing data or the demand calculation. Other examples include meter inaccuracies system leaks, breaks, illegal withdrawals, and watermain flushing programs.

The quantity of non-revenue water supplied by the city's drinking water system is substantial. Figure 3-4 plots the percentage of non-revenue water compared to supply and demand on a quarterly basis. Non-revenue water is highest in the first quarter partly due to the Let Water Run program and potentially also due to pipe leaks caused by frozen pipes.

However, the background level of non-revenue water in the last three quarters of the year is still substantial. Over the past five years non-revenue water has varied from 20 to 27%. Section 6.7 of this plan describes the City's efforts to address water loss.

Figure 3-4: Non-Revenue Water by Quarter Compared to System Supply and Demand



The City must continue to work to identify causes of NRW increases, and work to reduce the losses. Reduction of NRW sources will benefit the available supply, and therefore benefit growth. Section 6.7 Water Loss Prevention Initiatives describes the City's efforts to address this issue.

3.3.3 Residential and Employee Demands

Gross estimates of residential and employee water consumption rates were determined for specific years using available information from Federal Censuses of Population, City Employment Surveys, and water billing data. The water usage trends are shown in Figure 3-5.

Overall, both residential and employee demands have been decreasing over the analyses period. From 2006 to 2016, demand decreased from 243 liters per capita per day to 193 liters per capita per day; and decreased from 147 liters per employee per day to 122 liters per employee per day. The 2021 census year data tells a different story because water usage changed over the COVID-19 pandemic. Many people started to work from home or lost work due to business closures. Some of the daily water use that would have previously been part of the employee demand shifted to residential. As such, the residential water demand somewhat levelled off for the 2021 census year.

The water use per employee for specific land uses varies substantially. For example, industrial land uses have much higher water demand per employee than offices. However, the overall non-residential water use has been declining. Employee water demand could not be reliably calculated over the COVID-19 period because the location of work of many employees was continually changing.

Figure 3-5: Citywide Water Consumption Trends per Capita and per Employee

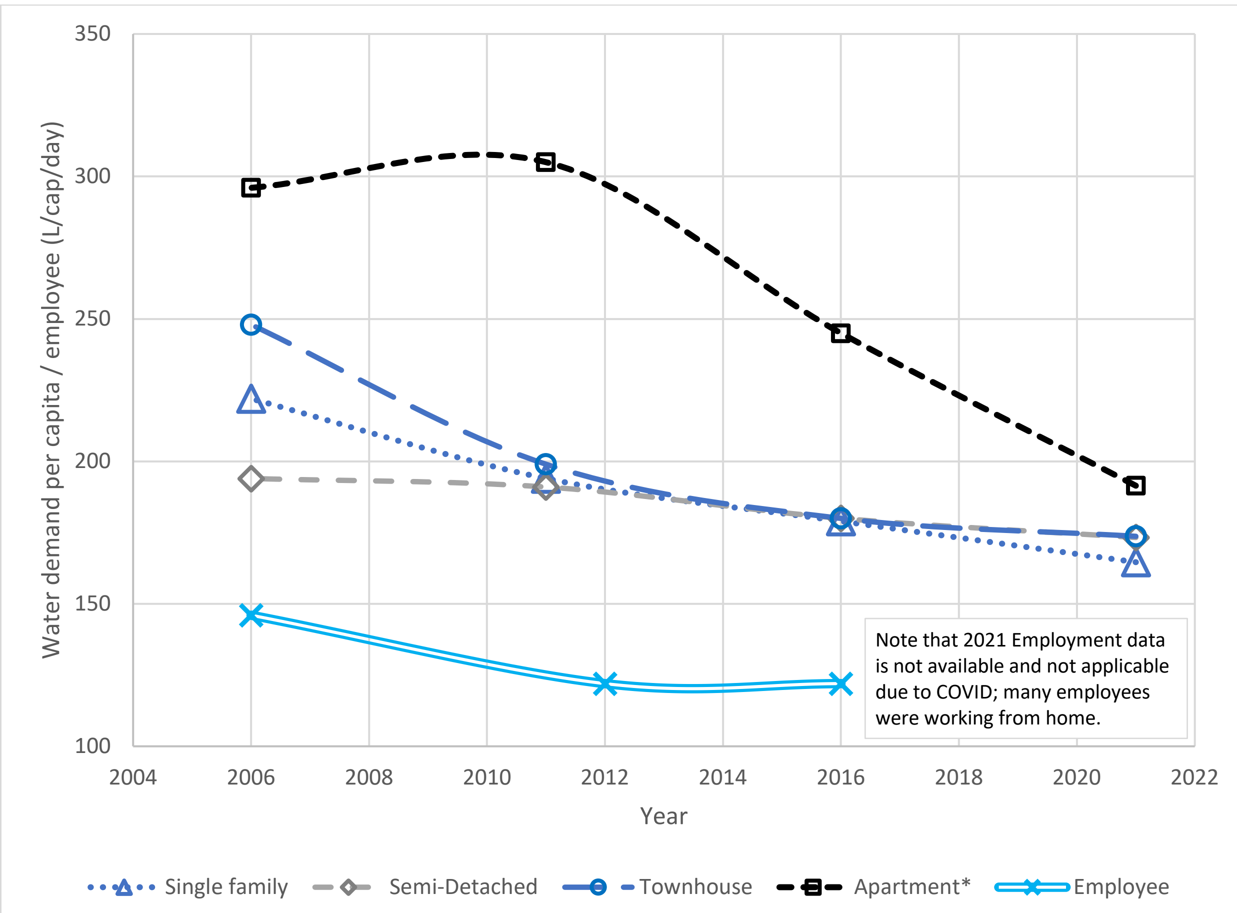
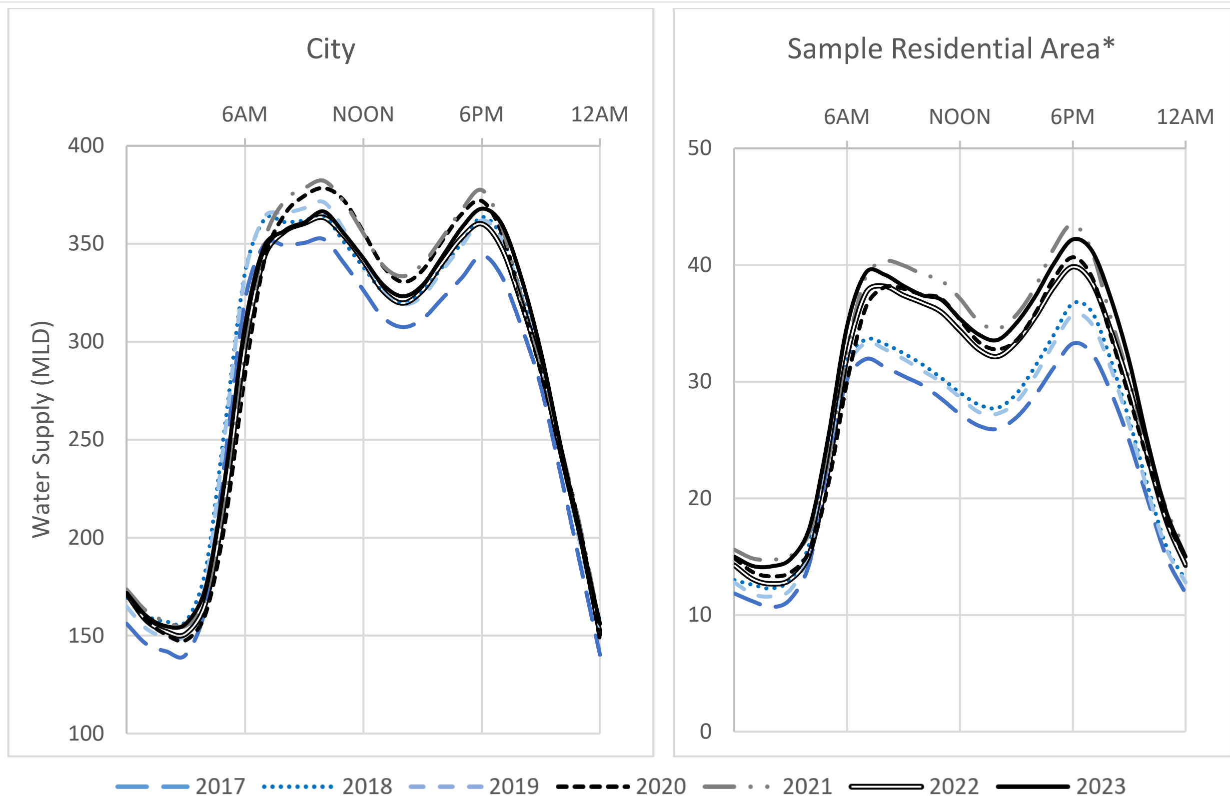


Figure Notes:
**Sample areas were used to calculate the rates. Actual rates could vary based on full City data sets.*

At a citywide scale, the total water and wastewater flows did not change significantly during the COVID-19 pandemic. However, as seen in the previous Figure some water usage shifted in location from Industrial, Commercial, & Institutional customers to residential areas. This trend is also reflected in the diurnal water usage patterns. The difference in water supply patterns for 2017 to 2023 seen in Figure 3-6 shows the impact of this behaviour during the COVID-19 pandemic. As seen on the left of the graph, there was a slight change in the Citywide daily water usage pattern in the first two years of COVID-19 (2020 and 2021), however by 2022 and 2023 the pattern returns to the pre-COVID-19 curve. Comparatively, the graph on the right shows the same diurnal patterns for a sample residential area, in which an increase in demand and a slight shift in pattern can be observed over the COVID-19 period. Similarly, reductions were noted in wastewater flows from Industrial, Commercial, & Institutional customers in some locations due to changes in operation and usage over the COVID-19 pandemic.

Demands were continually changing throughout the COVID-19 period and are still different from the pre-COVID-19 period. Constant monitoring will be required to determine how these changes will impact future demands. Demands and diurnal patterns will continue to be monitored by the City to inform future infrastructure planning and design exercises.

Figure 3-6: Average Weekday Pattern for City before, during, and after COVID-19 period



*Sample residential area in Water pressure Zone 3W (Kanata-Stittsville)

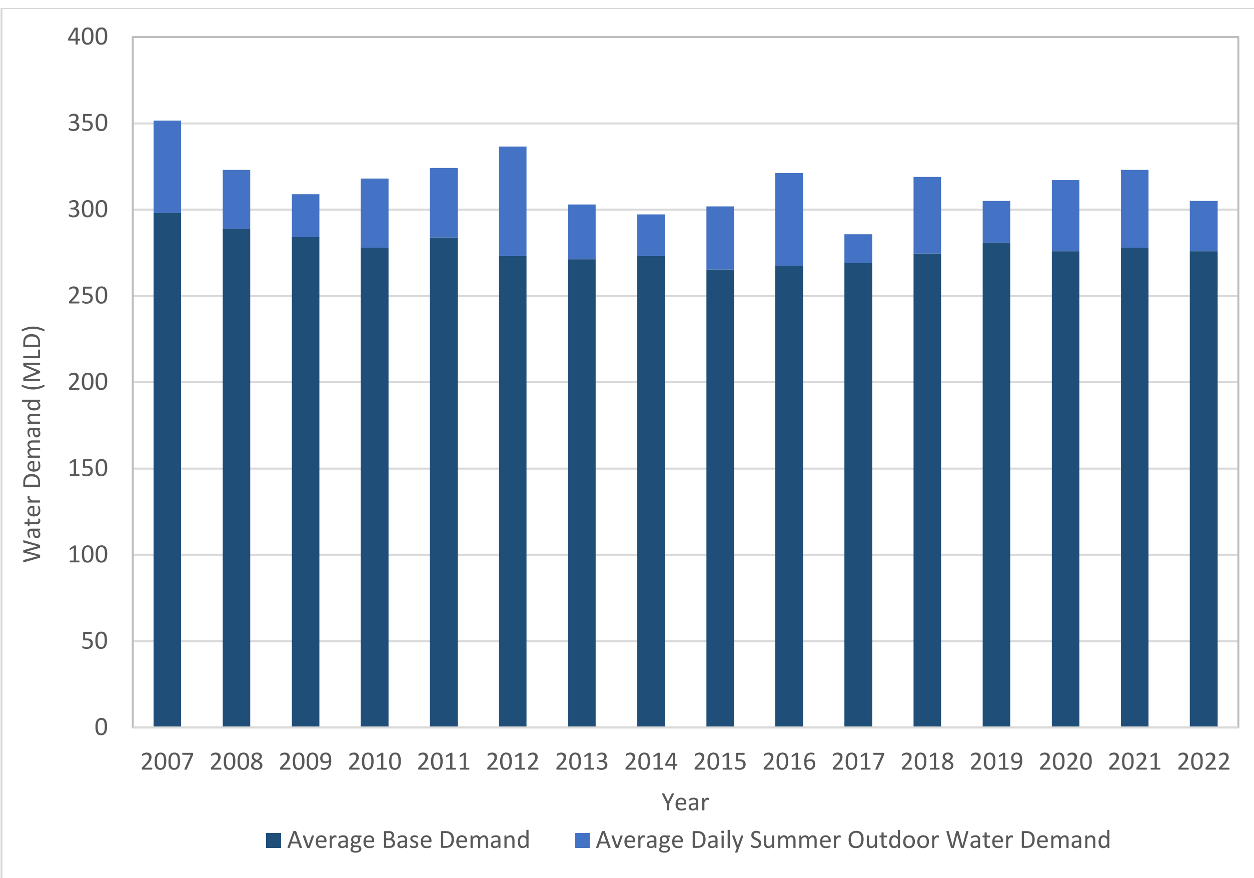
3.3.4 Outdoor Water Demand

Water demand varies seasonally because outdoor water use significantly increases during the summer months. Outdoor water use itself varies over the summer months with high demand in dry periods and lower demand in rainy periods. The outdoor water demand is a small component of the overall volume demand on the drinking water system but can be very significant on hot dry summer days.

The fall months of October, November and December typically give the best estimation of base demands, as these months have little to no outdoor water demand and the lowest levels of non-revenue water as well. The summer months (May to August), on the other hand, are used to determine the outdoor water demand. Figure 3-7 shows the base and summer demands from 2007 to 2022.

Most of the decline in the total summer demand is attributed to the declining base demand, whereas the summer outdoor water demand generally varies with climatic conditions; outdoor water demand increases during long dry periods and decreases during periods with high precipitation.

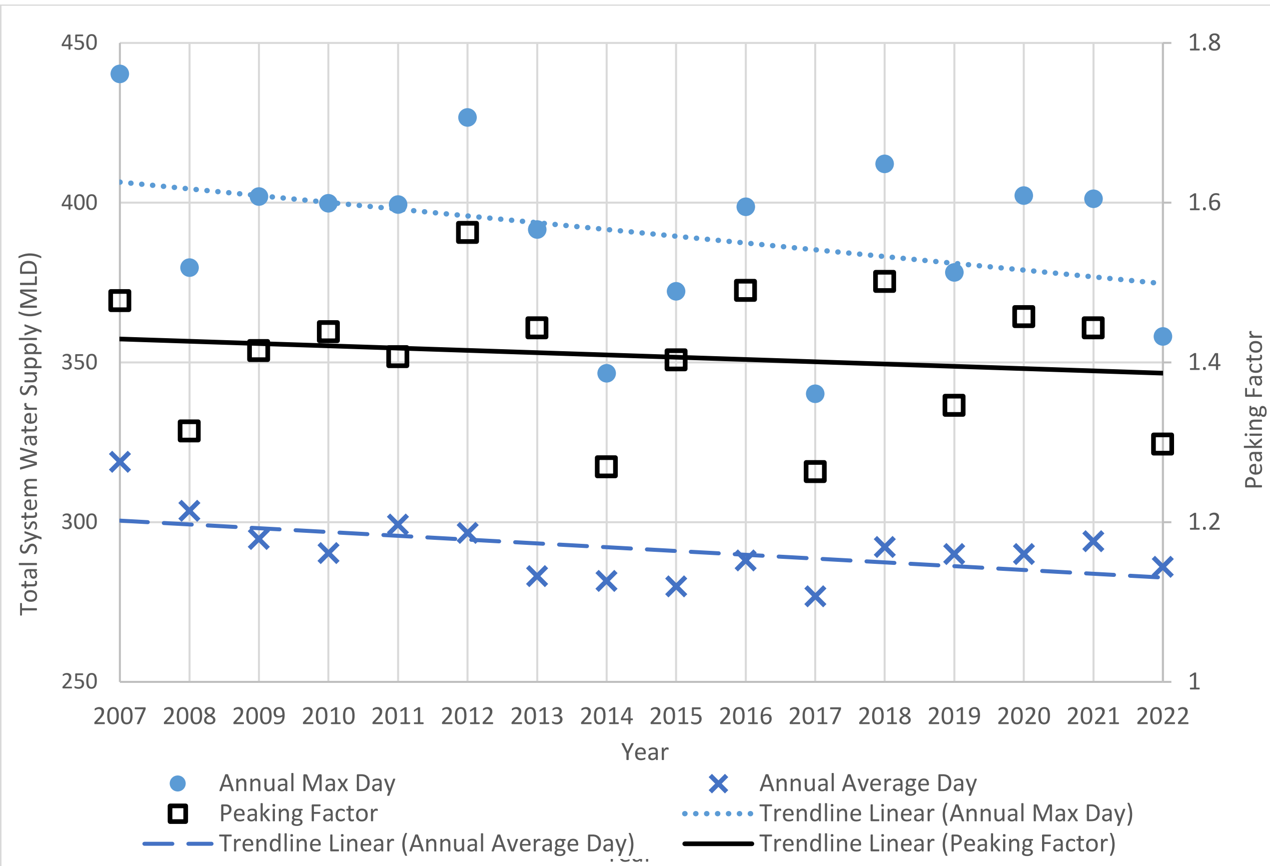
Figure 3-7: Summer Water Demand Trends



3.3.5 Maximum Day Demand

Outdoor Water Demand (OWD) is the primary component of Maximum Day Demand (MDD), which is defined as the 24-hr demand volume on the highest demand day of the year. MDD governs the sizing of backbone water systems. A review of trends since 2007 indicates that MDD has decreased in parallel with Average Day Demand (ADD, the 24-hr demand volume on a typical day), while the maximum day peaking factor (determined by dividing MDD by ADD) has remained relatively constant over the past 10 years. These trends are shown in Figure 3-8**.** Factors contributing to the decrease in OWD include intensification and reduction in pervious areas, increased water rates, and changing norms in water use.

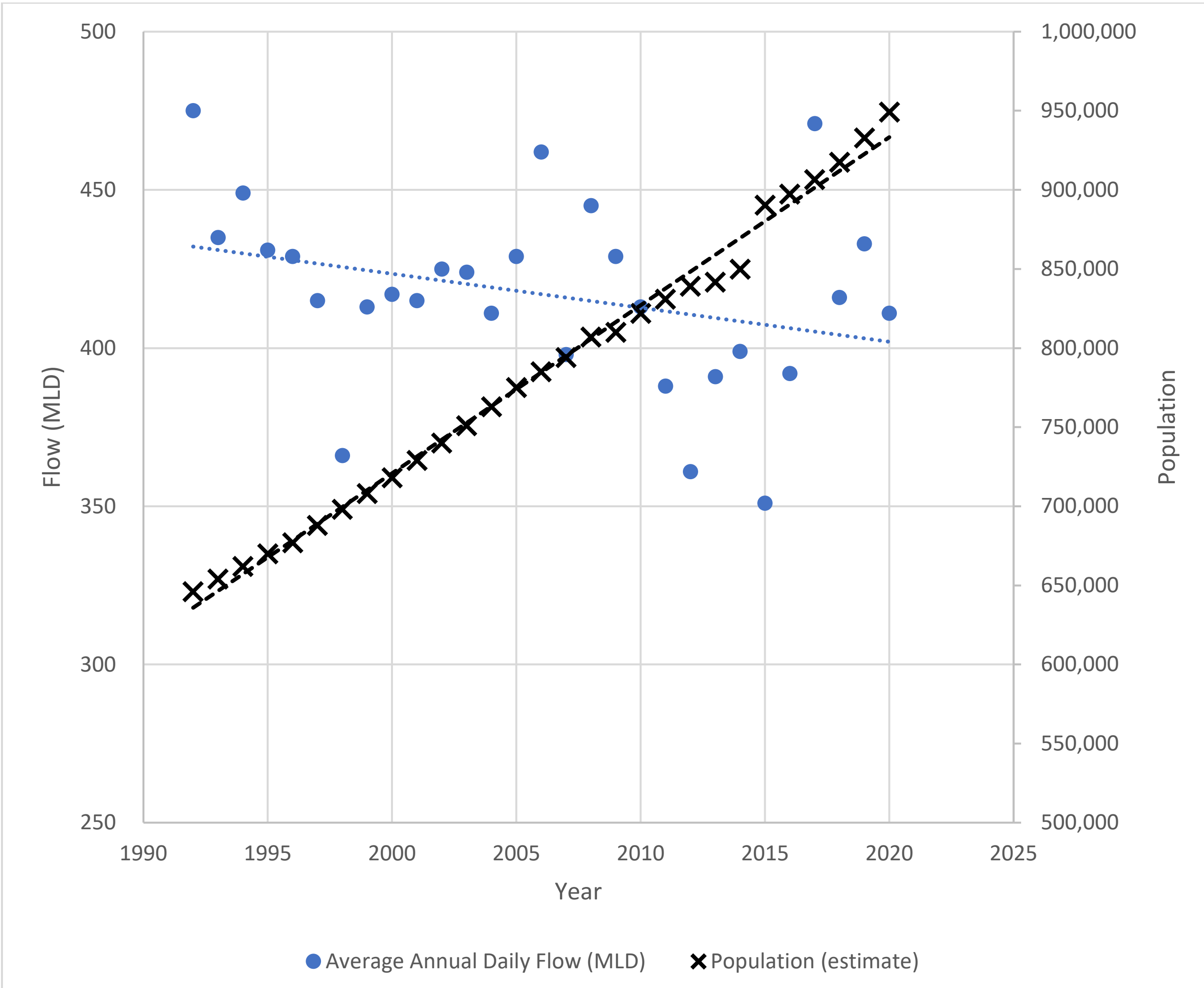
Figure 3-8: Annual Average and Maximum Day Demands



3.3.6 Average Daily and Peak Wastewater Flows

Annual average daily wastewater flows monitored at the Robert O. Pickard Environmental Centre (ROPEC) have been decreasing over the past 20 years, as seen in Figure 3-9**.** This same trend was observed in the water records and is primarily caused by a reduction in water consumption. Annual average rates exceeding 450 MLD generally occurred during wet years, where excessive rainfall and higher spring freshets caused increased rates of infiltration and extraneous inflows.

Figure 3-9: Average Daily Wastewater Flows Compared to Population

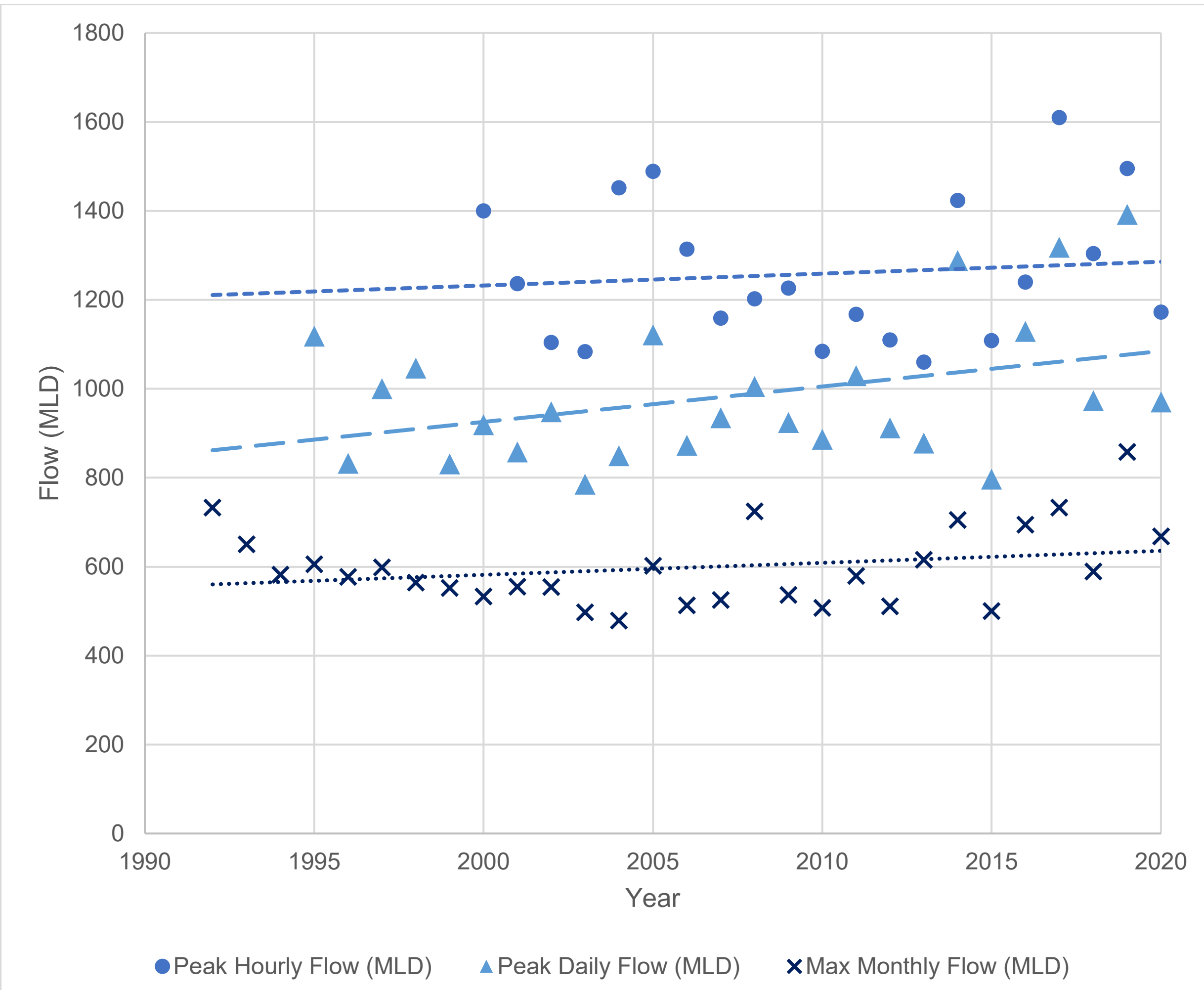


There are different types of sewer systems throughout the City—separated, partially separated and combined sewers—each of which have different functions during wet weather events. Combined sewers capture the most flow, as they capture all storm drainage as well as sanitary drainage. Partially separated sewers capture sanitary flow as well as foundation and roof drainage. Separated sewers receive the least amount of wet weather flow, from inflow sources like manhole covers and infiltration sources that enter through cracks along the sewer.

Annual peak flow rates to ROPEC occur during periods where infiltration and inflows are the highest. Peak groundwater infiltration typically arises during the spring freshet and during periods of high rainfall accumulation. Peak flows are often observed during these extreme events.

Figure 3-10 illustrates the annual peak hour and maximum day flows observed at ROPEC from 2002 to 2020. Some of the annual peak flows observed at ROPEC occurred during the snowmelt period accompanied by a rainfall event, while the remaining occurrences were observed during extreme rainfall events or periods with high soil moisture conditions. Therefore, any trend that would have otherwise been observed based on water demands only are not visible. The variable nature of large wet weather flow events over the years explains the lack of a significant trend in either the peak hourly, daily or monthly flows.

Figure 3-10: Annual Peak Hour, Day and Monthly Flows at ROPEC



3.4 Climate Change Trends and Planning for Growth

Climate change presents an evolving negative externality in the planning of water, wastewater and stormwater infrastructure. Increases in the amount and intensity of precipitation, frequency and/or severity of droughts, and changes to the freeze-thaw cycle are all examples of climate change impacts to water and wastewater infrastructure. Careful consideration of climate change is crucial in infrastructure planning to confirm that water, wastewater and stormwater systems are resilient to future climactic conditions, and that existing levels of service are maintained.

The following section discusses the projected climate trends for the City of Ottawa, how those trends may impact the City's water and wastewater infrastructure assets, and ways in which the IMP seeks to address the risk of climate change.

3.4.1 Projected Climate Trends

The Climate Projections for the National Capital Region Study, issued in 2020, was commissioned by the National Capital Commission and City of Ottawa to assist in planning climate change resiliency initiatives. The report summarizes projected climate change trends based on two potential greenhouse gas emission scenarios. Based on the findings of the study, several notable projections were established:

- Warming is expected to occur in all seasons with more periods of extreme heat in summer;
- An increase in precipitation is expected during all seasons except summer which will become warmer and drier;
- Rainfall volume and intensity are expected to increase;
- The timing of seasons is projected to shift, with shorter winters and less snowfall; and
- Conditions favorable for extreme events such as freezing rain, tornadoes and wildfires are anticipated to become more common.

Figure 3-11 summarizes the key climate change projections from the June 2020 study based on the high greenhouse gas emissions scenario.

Figure 3-11: Climate Projections in the National Capital Region (High Carbon Emission Scenario)

	What to expect*	2030s	2050s	2080s
Temperature	Average temperature	↑ 1.8°C	↑ 3.2°C	↑ 5.3°C
	Very hot days (above 30°C)	2.5 times more	4 times more	6.5 times more
	Very cold days (below -10°C)	20% less	35% less	63% less
Seasons	Winters shorter by	4 weeks	5 weeks	8 weeks
	Springs earlier by	2 weeks	2 weeks	4 weeks
	Winter freeze-thaw	↑ 13%	↑ 33%	↑ 54%
Precipitation	Fall-winter-spring precipitation	↑ 5%	↑ 8%	↑ 12%
	Intense precipitation	↑ 5%	↑ 14%	↑ 19%
	Snowfall	↓ 10%	↓ 20%	↓ 44%
Extreme events	Possible increases in freezing rain			
	Warming favours conditions conducive to storms, tornadoes, wildfires			

More certainty → Less certainty (down the rows)

More certainty → Less certainty (across the columns)

* For a high carbon emission scenario (RCP 8.5)

3.4.2 Climate Change Impacts on Water and Wastewater Systems

The projected climate trends discussed in the previous section may have significant impacts on the City's existing water and wastewater assets. To address this, the City issued a Climate Change Vulnerability and Risk Assessment Report in 2022, which identifies the City's vulnerability to climate change impacts and outlines ways to increase resiliency.

Vulnerability information contributes to better, more informed decision-making and policy development. The Climate Change Vulnerability and Risk Assessment will be used to inform modification to existing programs, update asset management strategies and future asset management plans, and can be updated over time as new information is obtained. All of this is part of an on-going risk management process that helps to establish and update priorities for risk reduction.

Though the Climate Change Vulnerability and Risk Assessment's focus is existing infrastructure systems, there are connections between its recommendations and the development of this IMP. The assessment identifies the importance of the following:

- Upgrades to infrastructure capacity at the time of lifecycle renewal
- Maintaining infrastructure in a state of good repair
- Storm drainage system modelling to identify ways to improve performance

- Protection of existing overland drainage system flow paths
- Consideration of climate change in the planning and designing infrastructure to perform in future climate conditions
- Assessment of neighbourhood ditch studies to evaluate risks and inform design improvements
- Implementation of on-site stormwater management for individual private properties through the development approvals process

Based on the findings of this report, the following is a high-level review of anticipated climate change impacts on municipal water and wastewater infrastructure and the natural environment, grouped into the four main climate hazard categories.

1. Extreme heat, drought, and humidity

- Increased occurrence of shallow dry wells and reduced aquifer recharge
- Reduced water system pressure from increased outdoor water demand
- Increased treatment demands due to contamination by wildfires
- Disruption of natural stormwater systems such as wetlands, watercourses and stormwater management ponds
- Compromised wastewater collection and treatment systems as a result of increased wastewater temperatures

2. Seasonal variability and change

- Damage to water distribution systems as a result of changes to the freeze-thaw cycle
- Compromised water treatment systems due to increases in frazil ice
- Reduced water quality in shallow wells
- Disruption to natural stormwater and drainage systems from increased spread of invasive species
- Damaged or compromised stormwater and wastewater systems from winter freeze-thaw cycles

3. Increased precipitation volume and intensity

- Damaged and/or compromised water systems as a result of riverine or inland flooding (including private wells and septic systems)
- Reduced access to critical infrastructure, such as water purification plants
- Reduced water quality in local watercourses from increased stormwater runoff
- Shoreline erosion and bank destabilization as a result of increased stormwater runoff
- Stormwater management systems and facilities may be overwhelmed by increased stormwater runoff, resulting in increased frequency and/or severity of flooding, surcharging, basement flooding, and erosion

- Damaged and/or compromised wastewater systems and infrastructure assets as a result of increased inflow and infiltration and extreme flooding events

4. Extreme weather events

- Electrical outages from significant weather events may impact water, wastewater and stormwater collection, treatment and/or distribution systems
- Damaged and/or compromised stormwater systems as a result of freezing rain and ice accretion or windborne debris

3.4.3 Climate Change Considerations in IMP

Adaptation, mitigation and resiliency to the climate change impacts discussed in Section 3.4.2 will primarily be addressed through updates to the City's Asset Management Plans, as well as through the Climate Resiliency Strategy. However, a number of these impacts are relevant to growth and are key components considered in the development of the IMP. Numerous projects, programs and policies are discussed throughout this document, as summarized below:

- Key policies related to Level of Service, Intensification, Riverine Flood Hazards, Low Impact Development and Monitoring, Modelling and Forecasting, which address climate change-related impacts, are discussed in Section 4;
- Discussion on climate change adaptation strategies for the City's water purification plants and wastewater treatment center is provided in Section 5.2.3 and Section 5.3.4, respectively;
- Discussion on water and wastewater infrastructure resiliency, adaptation and mitigation is provided in detail in Section 6.8 and Section 7.9, respectively;
- The Stormwater Management Strategy and stormwater system performance criteria in Section 9;
- Stormwater retrofits in existing built-up areas in Section 10; and
- Details on the proposed On-Site Stormwater Management Program, which is intended to mitigate the impacts of increased stormwater runoff resulting from intensification, are provided in Section 13.4.1.

The Water and Wastewater Master Plans (Sections 6 and 7) have considered key climate change impacts on the performance of the system in extreme events in order to identify any infrastructure or operational recommendations to mitigate these impacts.

For the central water system, the City conducted sensitivity analyses of existing water system performance based on increased outdoor water demand. Design criteria were also reviewed to ensure that the system will continue to meet performance objectives under major failure and power outage scenarios.

For the central wastewater system, the City utilized monitored flow records from an actual recent extreme wet weather event (Hurricane Frances) that aligns with modelled climate projections for an extreme weather event. This event was used to evaluate the robustness of the collection system and pumping facilities.

To support the planning and design of stormwater systems for new development areas, the local Intensity-Duration-Frequency (IDF) rainfall curves, as derived from historical records, are increased by 20% to evaluate the robustness of existing and proposed stormwater systems (sewers and overland flow systems) under extreme rainfall event. This current approach was re-evaluated through the Climate Change Vulnerability and Risk Assessment Report and results are discussed in detail in Section 9.

PART II – INFRASTRUCTURE POLICY

4 Infrastructure Policy

4.1 Overview

This section contains the policy intended to guide infrastructure planning at the Citywide level. It begins by describing the relationship of the IMP to the Official Plan and sets out supplementary infrastructure policy to address key issues including climate change, intensification, and Master Servicing Studies, among others. The objective is to provide supporting detail for key policies within the Official Plan and to establish additional technical policies to support the infrastructure planning and approvals process.

4.2 Context for Infrastructure Policy

The main purpose of the IMP is to support the planning objectives and policies of the Official Plan. To meet the planning objectives, the IMP identifies the backbone water and wastewater system projects and the capacity management programs needed to support the 2046 growth projected in the Official Plan. The IMP also provides supporting detail to inform the implementation of infrastructure policy found in Section 4.7 in the Official Plan.

The Official Plan proposes five broad strategic policy directions or “Big Policy Moves” that underlie the vision of becoming the most livable mid-sized city in North America over the next century. The five strategic directions pertain to growth management, mobility, urban and community design, resiliency, and economic development.

Growth Management | Mobility | Urban and Community Design | Climate, Energy and Public Health | Economic Development

While each of these five strategic directions have implications for infrastructure planning, Big Policy Moves 1 and 4, regarding intensification and resiliency are particularly relevant. Big Policy Move 1 is to achieve more growth by intensification than by greenfield development. Intensification is an important topic that has been considered in this IMP, and supplemental policy is proposed to complement policies within the Official Plan to guide infrastructure planning for intensification. Big Policy Move 4 is to “Embed environmental, climate and health resiliency and energy into the framework of our planning policies.” This is also highly relevant to the IMP, and climate change has been considered in the development of the IMP policies, programs, projects, and other recommendations. The IMP also supports Economic

Development (Big Move 5), where such development aligns with the Official Plan, by facilitating the provision of infrastructure capacity needs.

The Official Plan also identifies six major cross-cutting issues that affect policies throughout the plan. The two issues of greatest relevance to IMP policies and programs are Intensification, and Energy and Climate Change. To support the intensification projected in the Official Plan, specific policies and programs are required to ensure that sufficient infrastructure capacity will be available. These policies are described in Section 4.3.7.

Climate change is an important cross-cutting issue that is considered throughout the IMP as noted above. Direction to prepare for a changing climate is also provided in the Provincial Policy Statement (which informs the approval of infrastructure that supports development), and Asset Management Regulations (which inform the preparation of the City's Asset Management Plans).

The IMP policies have been also drafted to ensure that infrastructure required for growth is cost-effective and can be assessed and incorporated into future updates of the Long-Range Financial Plan and Asset Management Plans.

4.3 Policies

4.3.1 Overview

City policies governing drinking water, wastewater and stormwater servicing for development are found in Section 4.7 of the Official Plan, as approved in November 2022. The purpose of this part of the IMP is to provide supporting detail to critical policies within the Official Plan and to establish additional technical policies to support infrastructure planning and approvals processes. Each policy section includes a preamble followed by a numbered list of policies. As noted above, climate change is a cross-cutting issue throughout many aspects of the IMP, and related policies are embedded throughout the IMP policy sections.

For the purposes of discussion, the "backbone" systems generally include treatment facilities, pumping facilities, storage facilities, and large diameter pipes. The backbone systems support small-diameter sewer and watermain networks in local neighbourhoods. The term "trunk" system is generally used to describe large sanitary systems.

As noted in other sections of this plan, City-led projects are typically termed "off-site" projects in the Development Charges context and are essential to the delivery of adequate service to both existing and future residents over large areas. Conversely, the development industry is responsible for any projects that occur on developer lands or are needed to connect these lands to the existing systems. These developer-led projects are typically termed "on-site" projects in the Development Charges context.

4.3.2 Level of Service

For the purposes of the IMP, Level of Service is generally equivalent to quantifiable system design criteria that govern the identification and sizing of projects needed to support growth. These criteria are applied to models of the City's water, wastewater, and stormwater systems. Existing City systems do not necessarily meet these criteria, as they have been built over many decades. Design criteria for municipal systems have changed significantly over time, becoming more stringent to address evolving level of service and public health and safety expectations. Based on current practice, the City's general objective for existing assets is to increase existing Level of Service to today's standards through the renewal program. However, this is typically impractical or impossible to achieve for water resource networks that are constrained by topography or other system characteristics. As such, the intent of the IMP is to ensure that, as a minimum, existing levels of service in each neighbourhood across the City do not degrade as a result of growth. The City's Comprehensive Asset Management program addresses existing system issues such as the need to renew aging infrastructure and existing system performance problems. Subsequent versions of the Asset Management Plans will define target Levels of Service that will apply to existing systems as part of the Comprehensive Asset Management program.

POLICY HIGHLIGHTS

1) For intensification in existing development areas, the minimum target level of service is the better of the original or existing level of service
2) Developers subject to *Planning Act* approvals must reduce fire flow requirements to match what is available locally or pay for local upgrades

An example of a system design criterion is minimum watermain pressure in local water distribution networks. The City's distribution system is planned to ensure that minimum pressures are maintained. When incremental demands associated with projected growth are applied to the City's central system model, simulation of future hydraulic performance based on the existing infrastructure will identify specific areas that do not meet pressure targets. Alternative infrastructure projects are tested to determine what is most effective at addressing these pressure shortfalls. Hence the selection of design criteria is of critical importance in developing the IMP. The criteria align with the City's existing design guidelines, but some criteria are specific to system level planning, where the scale of analysis is much larger than a single development project.

Reliability is a particularly important consideration in system planning. A major failure of a component of the backbone system has the potential to interrupt service to large areas of the City unless reliability features are built into the system. Standard pumping facility design requirements include a range of reliability elements such as redundant pumps and back-up power. Sanitary pumping systems are also designed with overflows to surface water to reduce likelihood of basement flooding under an extreme wet weather or complete station failure event. The water supply system includes entirely redundant pumping stations and feedermains to reduce the likelihood that the system does not depressurize due to a catastrophic failure. Critical failure scenarios are tested using the City's central system models as part of the planning process to identify appropriate reliability projects.

Further information related to Level of Service is available in the following Comprehensive Asset Management program documents:

- Comprehensive Asset Management Policy
- Strategic Asset Management Plan; and
- Service-based Asset Management Plans.

As noted above, these and future plans created and updated under the Comprehensive Asset Management program will provide further direction on Levels of Service as the City's asset management practices evolve.

The following level of service and reliability policies apply to the planning of growth-driven infrastructure:

1) System design criteria established in the IMP is intended to ensure that current City design and level of service guidelines can be met in future neighbourhoods. They are not intended to achieve improvements to levels of service in existing development areas.
2) In light of affordability, topographic, and existing infrastructure systems constraints, the minimum City objective for existing development areas is to maintain the original as-designed levels of service, or the current level of service (whichever is higher). This means that system capacities in existing development areas will be managed such that intensification will not have a significant impact on current levels of service.
3) The City will consider the impacts of climate change on capacity requirements when planning for intensification and infrastructure renewal.
4) Drinking water system planning is based on a design fire flow capacity that may not meet all site-specific development expectations. It is ultimately the responsibility of development proponents to incorporate site-specific fire protection measures as needed to ensure that demands do not exceed available capacities.
5) The City will continue to apply a risk-based approach to planning for potential major infrastructure failures, incorporating redundancies into system and facilities design and/or preparing and maintaining contingency plans, as appropriate. Affordability, operability, and sustainability are fundamental considerations in this approach.

Further Level of Service policies related to intensification are found in Section 4.3.7.

4.3.3 Public Service Areas

Public Service Areas (PSA) are defined areas of the City that are serviced or may be permitted to be serviced by a City water and/or wastewater system.

POLICY HIGHLIGHTS

1) New mapping will identify public service areas and those areas with no or partial services
2) For proposed development abutting areas with no or partial services, servicing studies must consider additional capacity needed to bring services to those areas

Appendix A, Schedule 3 shows the coverage area of PSAs. Interpretation of the precise limits of PSAs are defined by the City and the terms of service provisions are based on existing agreements and by-laws. Section 4.7.2 of the Official Plan addresses Public Service Areas.

Except for certain circumstances as defined in the Official Plan, all development inside the Public Service Area is to be serviced by City-operated water and wastewater systems.

There are historic development areas inside the Urban Boundary that continue to sustain private services. Mapping of these Private Service Enclaves is provided on Appendix A, Schedule 3. Additional Information on Private Service Enclaves is provided in Appendix K. The Official Plan encourages the extension of municipal water and wastewater services to Private Service Enclaves. Servicing of these neighbourhoods is generally through the Local Improvement Process, with costs recovered from benefitting property owners.[1]

There are also several Federal facilities located within the Greenbelt that form part of the Public Service Area, as shown in Appendix A, Schedule 5. The City acknowledges the rights of Federal departments to develop these areas in accordance with the Greenbelt Master Plan. Such development would nonetheless be subject to the Public Service Area policies in the Official Plan and IMP.

Consideration of PSA expansion proposals will be governed by the polices outlined in both the IMP and the Official Plan. Each proposal will be evaluated on its own merits, based on local conditions, and without setting a precedent. The direction which follows provides further clarification to the Official Plan policies. Policies related to the transfer of rural estate subdivisions including potential expansion of any associated Public Service Areas are covered in Section 4.3.5 (Greenfield Infrastructure Planning and Design).

[1] The City updated its Local Improvement Policy in 2021.

1) This Plan permits service extensions outside of the Public Service Area as shown on Schedule 3 (Appendix A), subject to compliance with Official Plan policies 4.7.2.4 (a), (b), c), or (d), or their successors thereto.
2) Notwithstanding Official Plan policies that require proposed development within a PSA to be on the public services available, exceptions may be granted where the PSA is in the Rural Countryside area and insufficient capacity is available in the public system. An example of this would be the Carlsbad Springs area, where limited capacity exists in the trickle feed system.
3) Any Master Servicing Study (MSS) prepared to support development on lands immediately adjacent to existing rural estate development on private services (full or partial) must consider potential future public servicing of the existing development, regardless of whether or not it is located within the PSA, and allow sufficient time for consultation by the City with the existing community on this issue prior to MSS approval by Council. Where the privately serviced land is contained within an urban expansion area, the development proponent will be responsible for coordinating the consultation process.
4) The City shall be pre-consulted regarding development plans involving any existing Greenbelt Facilities (see Official Plan Section 8.1) to confirm that sufficient off-site capacities are available in the City's water and/or sanitary infrastructure, irrespective of whether the plans are contained within the Built Area Footprint identified in the Greenbelt Master Plan. Where insufficient capacity is available, a Master Servicing Study is to be prepared by the proponent to the City's satisfaction. A Master Servicing Study is also required to support the creation of a new Greenbelt Facility that is intended to be developed based on public services. The MSS must consider build-out of the Greenbelt Facility.
   Where new off-site infrastructure is recommended that would be subject to a Municipal Class Environmental Assessment approval under Ontario's Environmental Assessment Act, the MSS must be approved by City Council.

4.3.4 Capacity Planning

One of the key objectives of the IMP is to ensure that capacity is available in the City's water supply, sanitary sewage collection, and storm drainage systems to support the growth projected in the City's Official Plan. The IMP achieves this by:

- Identifying the major water and sanitary projects and associated timing needed to ensure that the backbone systems have sufficient capacity to accommodate the cumulative impacts of greenfield and intensification development;

POLICY HIGHLIGHTS

1) Backbone projects planned to meet 2046 growth but sized for a longer-term projection
2) Available capacity to be allocated to zoned land first
3) Remaining capacity to be allocated at time of Draft Plan of Subdivision approval on a first-come-first-served basis

- Providing direction on the preparation of MSS generally prepared by the development industry for future neighbourhoods; and
- Establishing new policies and programs needed to manage capacity in existing local systems that will service the projected intensification.

The following polices, which build on policies in Section 4.7.1 of the Official Plan, address issues related to backbone infrastructure capacity, planning horizons, infrastructure oversizing, and capacity allocation:

1) Through the IMP, the City will be responsible for identifying “off-site” backbone water and wastewater projects needed to support growth, however, “on-site” infrastructure located within future neighbourhoods may also be identified in some areas where it is needed to support system-level performance requirements.
2) Through the IMP, the City will only identify backbone-level projects needed to meet the 2046 growth requirements, however, given that the life cycle of infrastructure can extend well beyond the City’s Official Planning horizon, the City will consider longer-term projections for the purposes of sizing these projects. Through Council approval of the IMP, the City is making no commitment to development beyond the Official Plan horizon.
3) Further to Official Plan policy 4.7.1.15, as part of preparing area-specific Terms of Reference for MSSs, proponents will consult with the City on opportunities for over-sizing of infrastructure to allow for potential extension of public servicing into adjacent existing privately serviced development.
4) Where infrastructure system capacity is limited, and is unable to meet all future development related demands, the available capacity will be allocated in the following order of priority:
    a. All developments with Draft Plan of Subdivision Approval, subject to conditions of approval, or Site Plan Approval
    b. Zoned land not requiring a Site Plan Control approval
    c. Zoned land requiring a Site Plan Control approval
    d. Zoned land where the applicant is seeking a Consent to Sever

    Any remaining capacity will be allocated at the time of draft approval on a first-come-first-served basis unless an agreement is otherwise reached between all property owners who may potentially benefit. If draft approval for a specific development expires, the associated capacity allocation will also expire.

    Draft Plan of Subdivision applications in such areas may be subject to conditions requiring development phasing, with associated phasing of capacity allocation, to ensure fair and orderly development that addresses the needs of other developers subject to the same constraints. Where proposed development exceeds the available capacity, the City may use other measures, such as Holding Zones, that would apply until such time as the available capacity is increased.
5) The IMP identifies Development Charge-funded off-site projects that will allow future developments to achieve guideline service levels through standard servicing plans. However, in exceptional circumstances at the City’s discretion, developments may be

required to incorporate non-standard measures to achieve guideline service levels in localized areas. For example, oversized water services, oversized plumbing, on-site pumping and/or on-site fire protections measures may be needed to compensate for localized areas of low drinking water system pressure.

4.3.5 Greenfield Infrastructure Planning and Design

This subsection outlines the planning process for greenfield infrastructure and the relevant policies. Large new infrastructure projects are identified in the Infrastructure Master Plan (IMP). Projects are based on the City's Growth Management Plan which considers growth in existing urban and village areas and identifies new growth areas in a Future Neighbourhood Overlay (see Schedule C17 of the Official Plan). Before greenfield development can proceed in these areas, the Future neighbourhood Overlay must be removed following Council approval of secondary planning and associated servicing studies.

POLICY HIGHLIGHTS

1) Clarification of greenfield infrastructure planning process
2) Identification of the servicing studies needed to inform decisions regarding transferring undeveloped rural estate subdivision rights to areas abutting

Funding for greenfield infrastructure projects typically comes from a mix of direct developer funding, Development Charges (DCs) and City rate budget funding and are implemented by the City. However, projects to support greenfield development may also be front-ended by developers. Infrastructure planning in Future Neighbourhood areas is conducted through the preparation of new Secondary Plans and supporting master studies such as Environmental Management Plans (EMPs) and Master Servicing Studies (MSSs).

EMPs and MSSs are critical components for new community infrastructure planning, aligning with other plans in the Local Planning Framework, such as Community Design Plans and Community Energy Plans. EMPs will normally be informed by an approved Subwatershed Study (SWS). The City may permit an EMP to be prepared in the absence of a SWS, depending on the community planning area's scale and location within the subwatershed. In such cases, the EMP must cover the necessary information and assessments typically found in an SWS.

The EMP and MSS are coordinated efforts to ensure that infrastructure is located appropriately, and the stormwater management elements effectively mitigate the impacts of post-development runoff on existing environmental features such as watercourses and wetlands. Depending on the environmental and servicing complexities of the planning area, Master Drainage Plans may also be needed to establish a preferred conceptual drainage solution prior to preparing a more detailed MSS.

MSS requirements are discussed in Section 2.6. EMP requirements are covered in a Standard Terms of Reference prepared by the City.

Proposed deviations from an approved MSS may require an amendment to the MSS and associated Class Environmental Assessment, as needed. Once draft plan approval of the subdivision is granted, detailed design of the infrastructure can proceed. Servicing design approval is granted following clearance of the conditions of draft plan approval, and once it has been demonstrated that design conforms with City guidelines and standards. Any required infrastructure that is not adequately covered by these guidelines and standards will require evaluation of design options and acceptance by the City. The City will determine if the infrastructure is acceptable based on various factors including cost, life expectancy, and any applicable requirements under the City's asset management plans.

Under the Official Plan some historically approved country lot (rural) subdivisions may be transferred geographically to another development location abutting a Village. Where applicable, the feasibility of public must be assessed and revisions to any approved Master Servicing Study for the village may be required.

All infrastructure plans, designs and approvals are also subject to relevant Provincial and/or Federal regulations, approvals and permits.

The following policies apply:

1) Infrastructure in Future Neighbourhoods shall be planned, engineered and designed through a secondary planning process and will additionally be consistent with the watershed-based planning goals and policies in the *Provincial Policy Statement*.
2) Applications to transfer a country lot subdivision to a new location that abuts a Village without municipal water and wastewater services will demonstrate the appropriateness of development on private individual services in accordance with the OP.
3) Where applications to transfer a country lot subdivision to a location abutting a Village with full or partial municipal water and wastewater services are considered, the feasibility of municipal servicing is to be determined based on available system capacity and/or life cycle costs associated with existing system capacity upgrades. If municipal servicing is permitted, Area Specific Development Charges will apply for off-site works and front-ending of associated costs and/or works by the proponent will be required.

4.3.6 Master Servicing Studies

Official Plan Policy 4.7.1.13 requires that Local Plans for Future Neighbourhoods be supported by a Master Servicing Study (MSS). Official Plan Annex 4 outlines the framework for the preparation of the Local Plan and other elements to be included in the community planning. The MSS must align with and be informed by relevant aspects of these other plans or studies.

In exceptional cases, unanticipated greenfield development opportunities could arise within an urban area that were not anticipated as part of the original planning of the area (for example, the Barrhaven Conservancy project). The City will require that such opportunities be supported by an MSS.

POLICY HIGHLIGHTS

1) Standard Terms of Reference for MSSs will be provided with the IMP
2) Clarification when/where MSSs are required, their scope, and the process to be followed
3) Evaluation of servicing alternatives shall factor the full life cycle cost of the future City assets
4) MSSs shall identify how the recommended servicing is to be funded, financed, and implemented

In some instances, such as for small areas that are not contiguous to other greenfield development areas, a scoped MSS is acceptable. As per Official Plan policy 4.7.1.13, a scoped MSS must include identification and evaluation of servicing alternatives and demonstrate that sufficient capacity exists (or will be provided through planned off-site infrastructure) to support the development.

Master planning of infrastructure generally requires a comprehensive analysis on a watershed / sewershed / network basis, that considers the cumulative impact of development on alternative servicing solutions. This analysis contributes to an overall evaluation of the alternatives against an accepted set of criteria to identify a preferred servicing solution that optimizes system performance objectives and supports or aligns with other relevant community planning objectives (per Official Plan Annex 4). The completion of an MSS is intended to streamline the review and approval of individual development applications within the area of the local plan by ensuring site-specific decision-making supports broader system planning objectives and avoids potential servicing conflicts. Standard Terms of Reference for an MSS will be appended to the IMP.

MSS policies are as follows:

1) The complexity and corresponding scope of an MSS can vary depending on area specific conditions, and the *Planning Act* approvals required to support development. For the purpose of implementation of Official Plan Policy 4.7.1.13, the scope of a complete MSS will be informed by the following three categories of local plans:

a) Previously approved Local plans in Annex 5, 6, or 7 of the Official Plan, where changes to land use are proposed or a change in the environmental setting require existing servicing policy to be updated; or

b) Local plans in the Future Neighbourhood Overlay which require a Community Design Plan; or

c) Local plans in the Future Neighbourhood Overlay which require a Concept Plan.

2) Further to implementation of Official Plan Policy 4.7.1.13, local plans prepared to support re-development or intensification in existing communities or along transit corridors, will require completion of a MSS.

3) Where no MSS and/or EMP exists to support a greenfield development application in the existing urban area, the City will determine how site-specific design criteria are to be established and confirm what MSS and/or EMP requirements must be satisfied prior to submission of an application for Draft Plan of Subdivision approval.

4) Completion of an MSS requires fulfilling the following five study steps:

a) Pre-consultation will be conducted with the landowner group or proponent of Municipal Class EA undertakings required in the local plan area;

b) Preparation of a study-specific Terms of Reference consistent with the City's Guidelines for preparing MSS Terms of Reference (Appendix C) and to the satisfaction of the City;

c) Completion of an MSS consistent with the approved study-specific Terms of Reference;

d) Completion of the Municipal Class Environment Assessment process, including the required public consultation; and

e) Approval of the MSS concurrent with approval of the local plan. MSSs supporting local plans identified in IMP policy 4.3.6.1 a) will require Council approval concurrent with approval of a CDP or Concept Plan and EMP.

5) The implementation of policies set out in Section 11 of the Official Plan includes reliance on specific and detailed implementation tools including design guidelines. In this regard:

a) Terms of Reference for master planning of water, wastewater and stormwater infrastructure are to be guided by current City Design Guidelines and Hydrogeological and Terrain Analysis Guidelines.

b) MSS recommendations for local plans subject to the Future Neighbourhood Overlay are to be consistent with current City Design Guidelines and Hydrogeological Guidelines. Subject to approval by the City, exceptions to these guidelines in local plan areas identified in Official Plan Annex 5, 6, or 7 may be considered where existing constraints inhibit construction of new infrastructure consistent with City Design Guidelines.

6) The MSS is to be supported by an EMP that: establishes stormwater management criteria and development limits; provides input to evaluation of alternative servicing solutions; and identifies mitigation of residual impacts on downstream watercourses. Where a study area is exempt from an EMP, the scope of the MSS may need to complete additional assessments and analysis that would otherwise be completed through the EMP.

7) Diversions between watershed boundaries will generally not be permitted. Any proposed diversions between watershed boundaries remain subject to other applicable agency approvals and permits including applicable federal approvals where federal agencies are riparian landowners within the watersheds. Where the MSS identifies this to be a critical constraint to the overall infrastructure servicing, the MSS is to document the full scope of potential impacts to all affected watercourses and identify any necessary mitigation measures.
8) Evaluation of servicing alternatives shall
   a) factor the full life cycle cost of the future City assets, including operation and maintenance costs, and future renewal and replacement, based on current data provided by the City for the purposes of the MSS; and
   b) support or align with other relevant community planning objectives.
9) Planning of infrastructure systems shall evaluate performance under extreme operating conditions and consider a range of options to mitigate impacts on system performance.
10) All MSSs shall identify how the recommended servicing is to be funded, financed, and implemented.

4.3.7 Intensification

Existing infrastructure systems have a finite capacity based on standards that governed design at the time of development. Engineering principles dictate that calculations be based on conservative parameter values to ensure that performance objectives are met or exceeded. Furthermore, actual per capita water demand (and therefore sanitary sewage generation) has dropped significantly over time. For these and other reasons, available system capacities are often greater than what is actually being used.

All stormwater systems are designed for a particular scale of rainfall event. As such, the capacity of any storm system will inevitably be exceeded following an extreme rain event that exceeds the design assumptions. Storm systems are also designed for a particular level of imperviousness, and therefore development intensification can increase the risk of flooding due to net increases in imperviousness beyond the original design assumptions. Intensification project proposals also sometimes involve alteration or filling of open drainage ditches, which can have a negative impact on existing storm system capacities if not

POLICY HIGHLIGHTS

1) Policies that support the recommended new programs
2) Minimum target levels of service for existing neighbourhoods will be based on the better of the original design assumptions or the existing level of service
3) Any project that involves a significant net increase in impervious area shall be subject to on-site SWM
4) City to seek to protect overland flow paths and adjacent structures through development approvals process
5) City to review funding and financing of intensification-driven local infrastructure upgrades to ensure a fair allocation of costs
6) City generally responsible for completing all system analyses needed to support intensification

properly planned and designed.[2] Furthermore, intensification has the potential to disrupt existing overland flow routes that function during large events, which could also create flooding problems.

All wastewater systems are designed for a particular population and employment level plus a certain level of wet weather influence, such as infiltration of groundwater flow through pipe cracks. Older wastewater systems also allowed for direct connection of foundation drains and/or roof drainage connections. As for stormwater systems, there is a risk that system capacities will be exceeded under extreme wet weather conditions, which are expected to increase due to climate change. The risk of capacity exceedance may increase as population and employment increase above the system's original design allocation.

The impacts of intensification are cumulative and may not be apparent until years after re-development has occurred. They are also difficult to remedy after re-development. As such, the potential impacts of intensification must be addressed through existing system analysis and planning of infrastructure upgrades based on growth projections, as well as through development approval processes. It is also important to note that intensification can often improve existing system performance in several ways, including via removal of foundation drains from the sanitary system and opportunities for regrading. New programs and approval processes are needed to ensure that the net impacts of intensification are adequately addressed.

The policies in this section have been established to ensure that infrastructure capacity in neighbourhoods is appropriate and sufficient to meets the needs of the future, considering the levels of service that were intended to be provided through the original development of these neighbourhoods. Some of these policies build on Official Plan policies 4.7.1.4 and 4.7.1.6, which require that:

- Impacts of additional runoff from increased imperviousness as a result of redevelopment be identified and mitigated;
- Various measures be implemented to protect new development from urban flooding; and
- The City implement new intensification-related programs and policies to manage stormwater capacity, including new regulatory mechanisms to impose on-site stormwater management more broadly than is currently the case.[3]

Intensification policies are as follows:

[2] The City updated its Ditch Alteration Policy in 2022.

[3] The proposed requirement for on-site stormwater management to mitigate the impacts of intensification is unrelated to the City's Rain Ready Ottawa program. The former is intended to avoid increases in *peak runoff rates* from individual properties to minimize drainage system impacts. The latter is focussed on mitigating water quality and erosion impacts on local watercourses, mainly through the reduction of runoff *volume* from existing development.

1) The minimum target levels of service for existing neighbourhoods will be based on the infrastructure design assumptions for the original development, or the current level of service (whichever is higher). City capacity management programs will apply a risk management approach intended to limit any temporary impacts of intensification on these original levels of service that might occur prior to implementation of any local infrastructure upgrades that may be required.
2) Intensification projects that involve a net increase in impervious area for a property compared to existing conditions shall be subject to on-site stormwater management requirements to address drainage infrastructure capacity constraints.
   - The City will develop a guide and other tools for on-site stormwater management for small residential redevelopment projects that are currently not subject to a Site Plan Control process. The guide will define when on-site stormwater management (SWM) is required, present practical options for on-site SWM, and sizing and design information needed to support a building permit application.
3) The City will identify where overland flow from municipal drainage systems cross private property and establish development approval processes and requirements that will ensure maintenance of existing overland flow routes and protection of adjacent structures, while minimizing landowner encumbrance.
4) The Comprehensive Zoning By-law will implement provisions to require adequate servicing, including water, sewer, and on-site stormwater management.
5) Secondary planning processes will determine limitations to servicing capacity, and will allow the City to better manage risks to service. New secondary plans and revisions to existing secondary plans will coordinate planned densities with required infrastructure upgrades, including financial plans that are needed to support implementation.
6) Outside of secondary planning processes, assessments for development will be done on a site-by-site basis through the development approvals process and supported by the new ICMP processes. The City will also conduct area-based studies to evaluate the cumulative impacts and potential local system upgrade requirements to support future growth.
7) The City's Ditch Alteration Policy defines the process by which ditch filling may be approved. This policy is applicable to development approvals.
8) The City will develop a new permanent program to manage capacity in support of intensification. This program will:
   a) identify upgrades to existing local infrastructure that are needed to support intensification in advance of the expected year of renewal;
   b) manage risks to level of service by scheduling any needed local projects so as to avoid apparent impacts without freezing local development;
   c) prioritize upgrades in key intensification areas such as in the vicinity of transit stations;
   d) be funded independently of the renewal program to ensure that existing systems are maintained in a state of good repair; and
   e) address expected increases in precipitation due to climate change.
9) Notwithstanding Policy 8b, development approvals may be refused if it is determined by the City that there is insufficient local capacity available. The developer could be

responsible for funding any immediate upgrades needed to allow the development to proceed.

10) The City will review funding and financing of intensification-driven local infrastructure upgrades to ensure a fair allocation of costs to development and existing rate payers.
11) The City is generally responsible for completing all existing drinking water and sanitary system analyses needed to support intensification. However, this responsibility may be permitted to be completed by the proponent in the following circumstances:
    a) major campus redevelopment projects;
    b) area intensification plans driven by the private sector; and
    c) intensification of subdivisions built post-amalgamation.

4.3.8 Legal Stormwater Outlets

Stormwater plans prepared in support of development must respect Common Law Rights of landowners along downstream major channel outlets. Under Ontario Common Law, no landowner has the right to collect surface or subsurface water in artificial channels and discharge such waters on the lands of another, with the exception of riparian landowners discharging to a natural watercourse. Statutory approvals are required to establish stormwater outlets for proposed development areas that are both legal and sufficient.

POLICY HIGHLIGHTS

1) Development applications must demonstrate a legal and sufficient outlet exists or that adequate progress has been made towards achieving this requirement
2) MSS approval will be contingent on sufficient notification and opportunity for input from affected property owners regarding the need for legal outlets

Except for private drainage systems, there are two primary forms of legal stormwater outlets available: i) natural watercourses; and ii) petition drains, or other drains (commonly referred to as municipal drains). Under Common Law, a legal stormwater outlet to a natural watercourse exists, provided it is for natural drainage which originates within the natural watershed of the watercourse and outlet to the natural watercourse is provided without requiring artificial collection and drainage through private property. However, a legal outlet to a natural watercourse may otherwise be established if the potential impacts are evaluated and sufficiently mitigated to achieve a sufficient outlet.

Under Ontario's *Drainage Act*, a municipal drain may be established to provide legal outlet for lands requiring drainage. Legal stormwater outlet to a municipal drain exists for those lands that have been assessed for outlet to the drain. A sufficient outlet is defined in the *Drainage Act* as "a point at which water can be discharged safely so that it will do no damage to lands or roads".

In instances where a proposed drainage outlet discharges to a watercourse that crosses Federally owned land, the City will work collaboratively with Federal agencies by conducting a cumulative impact assessment, as appropriate, to ensure that the ecologic and hydrologic integrity of the receiving watercourses is maintained.

Development applications under the *Planning Act* are guided by the *Provincial Policy Statement*, which requires that erosion and changes in water balance be minimized, and that the effective management of stormwater be leveraged to prepare for the impacts of a changing climate. To support proposed changes that will affect drainage, the sufficiency of available stormwater outlets is typically determined through an engineering study. This is followed by a sewage works approval under the *Ontario Water Resources Act*, which is required before the stormwater outlet can be constructed. Stormwater plans that require modifications to existing approved sewage works will trigger the need for amendments to secure the right to discharge to an existing outlet. Any proposed work under the *Drainage Act* remains subject to other applicable agency approvals and permits.

Policies 4.7.1.7 and 4.7.1.8 in the Official Plan address requirements related to Legal Outlets. Further direction is provided in the following policies:

1) Further to Section 4.3.5, the EMP shall identify where legal stormwater outlets are required and functional design of any work required to achieve sufficient outlet. The MSS must identify the process through which legal outlets are to be established for each of the outlets identified. Where drainage through Federal lands is required, this process must consider applicable federal approvals. MSS approval will be contingent on sufficient notification and opportunity for input from affected property owners regarding these outlets.
2) Further to Official Plan Policy 4.7.1, as part of a complete application, new development applications must demonstrate that:
    a) a legal and sufficient outlet for the project already exists through a previous process; or
    b) the existing downstream drainage system is sufficient to accommodate post-development flows and volumes without adversely impacting downstream flooding and erosion; or
    c) a process to establish a legal and sufficient outlet has been initiated by confirming that Council has appointed a Drainage Engineer to establish a legal outlet through the appropriate Drainage Act process; and that proposed works on the downstream drainage system would be sufficient to accommodate the post-development flows and volumes without adversely impacting downstream flooding and erosion; or
    d) all affected downstream property owners have consented to the need to enter into formal agreements with the proponent and the City to carry out works on their properties to achieve a sufficient outlet.

4.3.9 Riverine Flood Hazards

POLICY HIGHLIGHTS

1) Siting and design of new infrastructure located in proximity to a watercourse shall consider available 1:350 riverine flood hazard maps

The Ontario Ministry of Natural Resources and Forestry (MNRF) defines the regulatory flood event standard for different regions of Ontario. For Eastern Ontario, the 1 in 100-year flood event is the regulatory standard for floodplain mapping and does not capture potential changes to flood magnitude or frequency that are anticipated to occur with climate change. Local climate projections indicate trends that suggest increased risk of extreme riverine flooding that exceeds the 1 in 100-year flood event.

The Provincial Policy Statement prohibits development in natural hazard areas, including the regulatory flood plain. Sections 10.1.1 through 10.1.4 of the Official Plan include policies regarding development within natural hazard areas. The Provincial Policy Statement also requires municipalities to reduce the risks associated with climate change. The City has introduced new policies in the Official Plan to mitigate the effects of more severe flooding and improve resiliency to climate change and defines a climate change flood vulnerable area as the area between the 1 in 100-year floodplain and the 1 in 350-year floodplain.

New development in these areas will be required to assess riverine flood risks and include mitigation measures to reduce or avoid identified flood risks where an approval under the *Planning Act* is required to permit the development.

Existing infrastructure planning and design practices do include considerations for extreme rainfall events; however, they have not historically included considerations for the risks and impacts of increased riverine flood hazards as this data has only been generated over recent years. Section 10.1.3 of the Official Plan introduces policies regarding areas vulnerable to flooding under climate change.

The development of flood plain mapping in Ontario is guided primarily by the 2002 Ministry of Natural Resources and Forestry (MNRF) Technical Guide – River and Stream Systems: Flooding Hazard Limit. Policies within this guide disregard the attenuation of flood flows provided by existing and planned Storm Water Management Facilities (SWMFs) when preparing floodplain mapping studies. While this was historically accepted as a conservative assumption for defining flood hazard areas, modern SWM facilities are built to higher standards for the purpose of attenuating urban runoff and managing flood flows to existing conditions.

To fulfill public health and safety, and fiduciary responsibilities, it is critical to consider the value of properly designed municipal SWMFs toward effective flow attenuation within urbanized areas. Accounting for flow attenuation by modern SWMFs when undertaking flood plain mapping studies allows the City to plan development and infrastructure in a manner that would protect the interests upstream and downstream stakeholders, while meeting provincial and municipal obligations and goals. The City will develop a framework that requires consideration of design, operation, maintenance and ownership of a SWMF. The framework will be used to support decision making regarding how SWMFs are to be considered in a flood plain mapping study.

The following policies shall apply to the planning and design of infrastructure and flood plain mapping studies:

1) The siting and design of new infrastructure located in proximity to a watercourse shall consider available 1:350 riverine flood hazard mapping and include appropriate measures to avoid or mitigate impacts and risks from riverine flooding.
2) Flood plain mapping studies will apply a City framework for stormwater management facilities when defining regulatory flood plain limits.

4.3.10 Groundwater Resource Protection

Groundwater sources of drinking water must be protected to support public health, and the continued usability of these sources from an aesthetic perspective (e.g. elevated salt). To accomplish the goals of groundwater resource protection, the City applies Provincial legislation and guidelines, as well as its own hydrogeological and terrain analysis guidelines. The City takes a proactive approach by raising public awareness and managing threats to drinking water resources as part of its Source Water Protection Program. This includes development of risk management plans for activities that may be a threat to drinking water sources, screening all new development applications within drinking water protection zones, monitoring City infrastructure such as treatment facilities and sanitary sewers, and outreach to impacted residents.

POLICY HIGHLIGHTS

1) Potential impacts on local groundwater systems and wells shall be considered as part of the development planning process
2) Policy requiring well water sampling in advance of development in vicinity of existing wells
3) City to conduct groundwater characterization studies in Villages and other privately serviced enclaves to identify potential risks to public health

In addition to its Source Water Protection mandate, the City has implemented groundwater resource protection programs, including:

- groundwater characterization studies in villages and other privately serviced areas;
- a monitoring well network covering privately serviced subdivisions; and
- performing studies of major groundwater aquifers.

Private wells are regulated by the Province. However, the City that risks to groundwater due to development are mitigated. Particular attention is given to potential contamination sources (for example sanitary sewers, road salt application, and stormwater management facilities) in areas where groundwater has a drinking water function.

Furthermore, where a development on public services is proposed, the developer is required to assess the risks to nearby private drinking water wells and assume responsibility for impacts on these wells.

The following groundwater resource protection policies apply:

1) Potential impacts on local groundwater systems and wells shall be considered in the preparation of EMPs, MSSs, and may also be required for Draft Plans of Subdivision and Site Plans, subject to site-specific circumstances.
2) Where construction activities will occur in the vicinity of drinking water wells, City approval of a pre-construction sampling program will be required. This program will establish a baseline of water levels and water quality in existing wells, in order to respond to water quality and quantity complaints from residents in the area. Program requirements, including public communications and securities, are to be established as part of MSS approval where applicable, or as a condition of Draft Plan of Subdivision or Site Plan approval.
3) The City will conduct and periodically update (as required) groundwater characterization studies in Villages and other privately serviced enclaves that rely on local groundwater systems in order to identify potential risks to public health.

4.3.11 Low Impact Development

Low Impact Development (LID) is a stormwater management strategy that seeks to mitigate the impacts of increased runoff and stormwater pollution by managing runoff as close to its source as possible. LID comprises a set of site design strategies that minimize runoff through distributed, small scale structural practices that mimic natural or predevelopment hydrology through the processes of infiltration, evapotranspiration, harvesting, filtration and detention of stormwater. Measures may be designed to manage stormwater at source (at the property parcel level where rain falls) and along linear systems that convey runoff to an end-of-pipe facility or an outlet to a watercourse. Typically, these measures are intended to reduce runoff volume, but they may also be designed to

POLICY HIGHLIGHTS

1) MSSs to include a conceptual LID plan that is aligned with approved SWS or equivalent
2) In the absence of an approved SWS or equivalent, development must meet the criteria defined by the MECP
3) Downsizing of end of pipe facilities based on LID approach not permitted unless supported by MSS
4) Until local LID design guidelines are available, requirements established at

provide quality treatment before discharge to an outlet. Runoff volume control objectives can include criteria for water balance, water quality, and/or mitigation of in-stream erosion impacts. LIDs generally provide limited benefits in terms of peak flow control during large storm events.
LID requirements stem in part from the City's Stormwater Retrofit Program, which was a recommendation of the Ottawa River Action Plan. Further, new Consolidated Linear Environmental Compliance Approvals issued by the Ministry of Environment, Conservation and Parks (MECP) for the City's infrastructure systems under the *Ontario Water Resource Act*, identifies new stormwater system performance criteria that includes requirements for runoff volume control as part of residential growth and renewal projects.

The provincial direction allows for area-specific runoff volume control targets to be established through subwatershed level studies. The Official Plan policies are aligned with this direction, requiring that SWSs and EMPs define the targets to be implemented in stormwater management plans for development applications. More detailed direction is provided in the following policies:

1) MSSs shall include a conceptual LID plan, where LID measures are feasible and expected to be effective, for integration with the proposed land use plan and conceptual stormwater management plan. MSSs shall demonstrate that the concept meets applicable targets identified in the corresponding SWS or EMP. Where an MSS is completed without a SWS or EMP, the MSS must review and define runoff volume control targets.
2) Changes to planned infrastructure in an approved EMP or MSS that involve elimination or downsizing of end-of-pipe facilities in favour of LIDs are not permitted.
3) Development applications must implement applicable LID concepts of an approved MSS and demonstrate that targets identified in subwatershed scale studies (SWSs or EMPs) will be achieved through the proposed stormwater management plan.
4) Where no runoff volume control criteria guidance is available in an approved SWS, EMP or MSS, the proposed stormwater management plans must meet the runoff volume control criteria defined by MECP. In these cases, downsizing/elimination of end-of-pipe facilities will not be permitted in favour of LIDs.
5) Until local LID design guidelines and standards are available, the City will confirm at the time of development pre-consultation, what information is to be used to guide the design of any LID infrastructure as well as commissioning and monitoring requirements.

The above policies will be reviewed when new City LID and/or provincial guidelines are implemented.

4.3.12 Monitoring, Modelling, and Forecasting

This section describes the purpose of capacity-related monitoring and modelling of water resource systems. This section also describes expectations and policies related to monitoring and modelling when required to support development.

Monitoring and modelling are required to support the planning, design, operation, and upgrade of stormwater, sanitary, and drinking water systems. It is essential in order to optimize capacity utilization and identify infrastructure needed to support growth, and thus is central to the development and implementation of the IMP.

Monitoring is generally focused on flow rates in existing watercourses or sewer systems, water levels in storage facilities, and pressures within the drinking water distribution system. Monitoring takes place over a period of time to capture a sufficient range of wet weather events and system operating conditions. Monitoring is needed to demonstrate performance of developer-built facilities and LID installations (per Section 4.3.11) prior to assumption by the City. Monitoring is also generally needed to support the development of SWSs, EMPs, and MSSs. Monitoring in this context may be associated with confirming available wastewater capacity in the receiving systems, or with characterizing pre-development flow conditions in existing watercourses.

Modelling is intended to simulate the operation of existing and proposed drinking water, wastewater, and stormwater systems under a range of operating conditions, including extreme weather events and major failure scenarios. Where modelling of existing systems is required, models that are calibrated using current monitoring data generally improve representation of actual operating conditions, lowering risk in decision making that relies on model results.

Modelling of proposed infrastructure systems is required to support the planning of infrastructure recommended in MSSs, and the detailed design of infrastructure for subdivisions and site plans, with consideration for potential impacts of a changing climate. Information that supports the modelling of infrastructure systems is available in City design guidelines.

The following policies apply to the monitoring and modelling required to support development:

1) The timing and duration of existing conditions monitoring should capture a range of representative conditions (seasonal or other) to inform system modelling and analysis, including sufficiently large rainfall and/or snowmelt events. Monitoring must meet the minimum requirements identified in the relevant study Terms of Reference, as approved by the City.
2) Monitoring and associated reporting to support specific development or capital project triggers under interim development conditions is to be defined and approved as part of preparing an EMP or MSS and will be the responsibility of the developer.
3) To help verify that EMP and MSS objectives are being achieved, these documents are to identify future monitoring requirements and strategies, adaptive measures, and management options (as well as associated responsibilities) to be applied if monitoring indicates that objectives are not being achieved.
4) Modelling approaches and methodologies, including climate change considerations, needed to support an EMP or MSS are to be defined in Terms of Reference for these studies or supporting studies such as Water Budget Assessments. The modelling software

selected for the study should be accessible and available to all relevant participants and stakeholders.

4.3.13 Affordability and Financing

POLICY HIGHLIGHTS

1) Any oversizing of projects proposed by a greenfield developer in a MSS will have no effect on eligibility for DC funding
2) Policies regarding the funding of new infrastructure programs required to support intensification
3) Review of front ending agreement policies, to be updated and appended to the IMP as needed

This section provides an overview of how growth-related infrastructure projects are funded and financed. In general, backbone level capital projects are funded by DCs collected and applied in accordance with Ontario's *Development Charges Act*. Payments in Lieu of Development Charges are also received from federal departments based on development on federal properties that benefit from these projects. Local services that are required for specific development projects are planned, built and funded entirely by the benefiting property owner.

The DC capital program for water, wastewater and stormwater services are initially identified in various citywide or area-specific master planning documents, such as the IMP or a MSS. Many of the growth-driven projects also provide a benefit to existing development. The "benefit to existing" (BTE) cost component is paid for by contributions from ratepayers. Project-specific funding requirements are subsequently listed in the City's Development Charges Background Study, which is required to be updated every 10 years in accordance with new legislation passed by the province. The *More Homes Built Faster Act, 2022* (Bill 23) has diminished the City's ability to collect DCs, placing added pressure on the City's rate budget.

IMP capital projects are identified to meet the demands associated with the City's Official Planning Horizon. The IMP's planning horizon is to 2046, in accordance with the Official Plan. Some projects may involve the expansion of servicing capacity that exceeds the requirements of the planning period. This is due to the fact that infrastructure cannot be expanded on a gradual ongoing basis to service growth. As such, various projects may be oversized based on longer-term growth projections prepared by the City. The longer-term projections are not Council-approved, and the oversizing does not imply any intent to approve new development areas beyond the 2046 planning horizon. The incremental oversizing costs could be initially front-funded by development, debt, or rate-based funding sources, with potential recovery through future updates to the DC By-law and Background Study should post-2046 development benefits from this excess capacity.

Currently, very limited funds are recovered from intensification growth to cover servicing costs. In general, intensification has leveraged excess capacity available in local infrastructure systems, and through the City's renewal program there have been opportunities to oversize the replacement of aging infrastructure at minimal additional cost. In rare cases, intensification projects have triggered upgrades to existing local infrastructure in advance of renewal needs. However, as intensification continues, the City anticipates that more intensification-driven replacement of infrastructure will be needed. Therefore, the City is studying alternative funding mechanisms to ensure that development pays for its fair share of the cost of replacing existing infrastructure.

As part of the annual budgeting process, departmental staff will prioritize (based on affordability) the funding of various growth-related capital projects for the upcoming fiscal year. Current estimates of the required timing of infrastructure to meet development needs in conjunction with the available DC funding is a primary consideration. Recommendations will be made as to which projects will be included in the annual capital budget. In addition, there are policies in place related to the front-ending of growth-related projects by developers, prior to City funding being available to pay for the projects. As of the time of writing, these detailed policies are being reviewed by the City. A key objective of the front-ending policy review is to ensure that repayment by the City is more closely tied to the collection of sufficient DCs associated with the benefitting development area.

The following policies related to funding of growth-related infrastructure are in addition to the related policies in the Official Plan.

1) Allocation of costs to the City for oversizing growth-related IMP infrastructure projects shall be based on the difference between the cost of the project if sized only to meet the 2046 servicing requirements and the cost of the project identified in the IMP.
2) Any oversizing of projects proposed by a greenfield developer in a MSS (if approved subject to Official Plan Policy 4.7.1.15) to accommodate possible future urban expansion will have no effect on eligibility for DC funding. In all cases, the proponent will be responsible for the incremental cost of such oversizing.
3) The City will periodically reassess average renewal program oversizing costs attributed to intensification and implement adjustments to cost allocations through the appropriate funding mechanism.
4) The City will establish a new program that will identify and plan intensification-driven upgrades of existing infrastructure that are required to support infill and redevelopment in advance of any plans for renewal.
5) The City will establish funding and financing formulae to attribute the bulk of costs for intensification-driven projects to development, subject to legislative constraints and accounting for any benefits to existing development. This is critical to ensure that the City is able to maintain the existing system in a state of good repair through an adequately funded, condition-based renewal program.
6) Cost overruns for DC-funded projects will be recovered from development through subsequent updates to the City's Development Charges By-law.

7) Upgrade of existing infrastructure to provide a higher level of service than originally designed will generally be subject to a Local Improvement process, in accordance with the City's Local Improvement Policy. The City will recover the majority of the costs from the benefiting property owners. This would include projects such as:
   i. Upgrade from rural to urban local road cross-section including replacement of ditch with storm sewer system;
   ii. Extension of public services (watermains and/or sewers) to privately serviced properties within the Public Service Area; and
   iii. Ditch Alteration.
8) Further to Policy 6, the City may also consider extension of services within the Public Service Area under a private servicing agreement, with a single property owner, where the full cost of the project is funded by the property owner.

PART III – BACKBONE SYSTEM MASTER PLAN

5 Water Purification Plant and Wastewater Treatment Development Plans

5.1 Overview

This section provides an overview of the Water Purification Plants (WPPs) Comprehensive Development Plan and the Robert O. Pickard Environmental Centre (ROPEC) Master Plan project. Reliability driven upgrades and plant capacity expansions are discussed for the WPPs, and preliminary recommendations to address capacity growth needs for ROPEC are identified. Climate change adaption is discussed with respect to both the WPP Comprehensive Development Plan and the ROPEC Master Plan.

5.2 Water Purification Plants Comprehensive Development Plan

The City initiated the 2022 Water Purification Plants Comprehensive Development Plan to develop a consolidated capital investment plan for both the Britannia and Lemieux Island Water Purification Plants (WPPs). These two facilities supply water to the City's entire central water distribution system, serving a population of approximately 1 million.

The Development Plan addresses growth, process enhancements, and renewal needs for the next 25 years. As Ottawa experiences population and economic growth and climate change, and assets deteriorate over time, infrastructure requirements for the WPPs need to be assessed periodically to schedule capital works in a timely manner. The development plan was last updated in 2012 and an update was therefore required for the upcoming planning horizon. The 2022 Comprehensive Development Plan provides a roadmap for capital investment through the 2046 planning horizon, which clearly identifies and describes projects, capital budgets, triggers, implementation schedule and additional planning and coordination requirements.

Based on the demand projections and system level analysis completed as part of the Water Master Plan project, major expansion at either WPP is not required within the current planning period to meet future peak summer demands, assuming additional storage is built in the City's water distribution system, as recommended in the Water Master Plan. However, from a reliability perspective, plant upgrades are needed within the 25-year planning horizon.

5.2.1 Reliability Driven Upgrades

The current rated capacities of the Britannia and Lemieux Island WPPs are 360 MLD and 400 MLD, respectively, with a combined production capacity of 760 MLD. However, during colder temperatures, the WPPs cannot produce their rated capacities. This is because temperature effects floc formation and cold water is denser, making settling of solids in colder temperatures less effective. Table 5-1 summarizes the existing summer and winter capacities for each plant.

This reduced winter capacity is generally not an issue, however, as population grows, additional treatment capacity will be required to meet the reliability requirements established in the Water Master Plan. More specifically, when one plant is out of service, the other plant, supplemented by storage in the distribution network, is expected to meet the City's basic day (BSDY) and fire flow (FF) demands for a minimum 24-hour period.

Table 5-1: Existing Treatment Capacities

Facility	Existing Capacity (MLD)	
	Summer	Winter
Lemieux Island	400	250
Britannia	360	320

Table 5-2 presents the years when demand will equal the available BSDY + FF capacities with one of the two plants out of service; these are referred to as "reliability triggers". With current winter treatment capacities, should the Lemieux Island WPP be out-of-service for 24 hours, the Britannia WPP would not be able to meet forecasted BSDY + FF beyond year 2048 with existing storage. The need for winter capacity upgrades at Britannia can be deferred with additional storage in the distribution network. Based on initial testing, the City has found that hydraulic improvements to convey water from Settling Basins 4 and 5 to Filters 1-12 will likely be needed at the Britannia WPP to meet its rated capacity.

Should the Britannia WPP be out-of-service in the winter, the Lemieux Island WPP would not be able to provide forecasted BSDY + FF demands for a duration of 24 hours beyond year 2030 with the existing emergency storage available in the distribution system.

These triggers should be reviewed as part of more detailed project planning efforts.

Table 5-2: Reliability Triggers

Facility	Current Winter Capacity	Year upgrade required (with existing emergency storage)
Lemieux Island in operation (Britannia out-of-service)	250 MLD	2030
Britannia in operation (Lemieux Island out-of-service)	320 MLD	2048*

**Adding future storage would defer trigger year for winter capacity upgrade at Britannia*

The upgrades needed at the Lemieux Island WPP to satisfy the reliability requirements consist of adding inclined plates to the existing settling basins 1, 2, and 3. This project had previously been identified in the 2012 Development Plan. The project description including timing is provided in Table 5-3 below. The updated total capital estimate for the project is provided in Section 15.

Table 5-3: Growth-driven Plant Reliability Projects

Project Name	Project Location	Project Details	Timing
Lemieux Winter Capacity Upgrade	Settling Basins 1-3	Adding Incline Plates	2029-2034

5.2.2 Plant Capacity Expansions

For the purposes of evaluating future plant expansions, it has been assumed that the upgrades needed for the plants to achieve their rated capacities year-round have been implemented (as described in Section 6.3.1) and that recommended storage (as proposed in the WMP) has been constructed. Based on the information from the WMP, the next plant expansion to meet future peak demands would be needed by 2076, when the required treatment capacity is expected to reach 760 MLD.

For planning purposes, it was assumed the capacity increase should be on-line 5 years before it is forecasted to be required, and that 8 years should be planned to complete the environmental assessment, design, and construction of the plant expansion. This would mean that the expansion project should be initiated in 2063. Based solely on the expected costs per unit of capacity, it is anticipated that the next plant expansion will be at the Lemieux Island WPP.

5.2.3 Climate Change Resiliency

As part of the Comprehensive Development Plan project, a climate vulnerability and risk assessment was conducted for each WPP, based on the climatic trends documented by the Climate Projections for the National Capital Region (City of Ottawa & National Capital Commission, June 2020). The assessment followed the Public Infrastructure Engineering Vulnerability Committee Protocol approach, and documented potential climate interactions, vulnerability, risk, and initial solutions to mitigate risks for the various asset elements of the WPPs.

Changes to seasonal temperature characteristics were identified as a high risk to the raw water intake at the Lemieux Island WPP, since this has been known to cause issues with frazil ice formation at the existing intake. An existing project (Lemieux Island Intake Improvements) is already underway to design a deeper intake to mitigate this risk. The existing intake at Britannia WPP is deeper and has been much less prone to frazil impacts.

Another risk identified in the climate vulnerability and risk assessment for both WPPs is riverine flooding due to increase in total precipitation and more intense spring freshets. The two WPPs experienced significant flood events both in 2017 and 2019. These events resulted in flooding of several plant buildings and access roads were at risk of being cut off. Significant efforts were required to establish temporary pumping and flood control barriers while maintaining plant operations. The City has since prepared a Contingency Plan to manage risks associated with spring freshet periods. The Contingency Plan provides direction on how and when to mobilize short-term, temporary demountable flood protection measures based on specific trigger Ottawa River water levels. In addition to the aforementioned measures, a permanent flood defense system is recommended at both WPPs.

The proposed conceptual solution is a permanent sheet pile wall. The wall would consist of a concrete flood wall complete with floodgates for access points and buried sheet piles to prevent seepage under the walls. The project would be fully funded by the City's water rate budget. Due to funding limitations, and because a contingency plan is in place, the implementation of the permanent flood protection solution is not currently included within the City's water rate budget. Implementation will be considered when funding becomes available, or if the risk increases.

5.3 Robert O. Pickard Environmental Centre Master Plan Project

The Robert O. Pickard Environmental Centre (ROPEC) provides wastewater treatment to a service population of approximately 1 million, and discharges treated effluent to the Ottawa River. ROPEC was originally constructed in 1962, and has been expanded, rehabilitated and upgraded over the years, with the last major work completed in 1993. ROPEC has an approved rated average day flow capacity of 545 megaliters per day (ML/d) and peak flow capacity of 1,362 ML/d. The plant provides wastewater treatment through screening, grit removal, chemical phosphorus precipitation, conventional activated sludge and disinfection via chlorination/de-chlorination. Waste activated sludge (WAS) is thickened, and raw sludge and thickened WAS are anaerobically digested. Dewatered biosolids are hauled offsite for beneficial use while digester gas is used to generate electricity and heat via combined heat and power engines, both of which are used within the plant.

The City initiated the ROPEC Master Plan project to develop a consolidated capital investment plan for ROPEC. The Master Plan defines and prioritizes projects to reliably maintain existing levels of service for performance and capacity compatible with the growth projected in the City's Official Plan and peak flows projected in the Wastewater Master Plan.

The primary purpose of the project is to prepare a ROPEC Master Plan that will be a roadmap for capital investment through the 2046 planning horizon, which clearly identifies and describes projects, capital budgets and funding sources, operating and maintenance costs, triggers, implementation schedule and additional planning, coordination and approval requirements. The ROPEC Master Plan will integrate projects to: improve reliability (state-of-good-repair and redundancy); provide additional capacity to service growth; meet performance requirements, improve energy efficiency, and reduce GHG emissions; and build resiliency to future climate conditions. The projects that will meet these needs were identified through systematic evaluation using decision-making and risk assessment frameworks developed to reflect City mandates and priorities.

The ROPEC Master Plan project is currently underway, and completion is anticipated in October 2024. Work completed to date includes development of planning considerations and design basis, climate change resilience assessment, process and hydraulic capacity assessments, energy use and greenhouse gas (GHG) study, condition assessment of ROPEC's assets (including a life-cycle cost model for asset renewals), options analysis to identify preferred solutions to meet capacity and/or performance requirements, and summary of infrastructure needs. Future work still to be completed for the project includes conceptual design of short-listed infrastructure needs, capital implementation and financial plan, and the final master plan report.

The following sections provide a summary of the plant process and hydraulic capacity assessment findings, and preliminary recommendations to upgrade capacity to service growth.

5.3.1 Process and Hydraulic Capacity Findings

A Plant Capacity Analysis was completed to assess the process capacity of individual unit processes within ROPEC, and to identify constraints and gaps in providing future capacity. This analysis included development and calibration of a whole plant process model. Historical data from 2016 to 2020 was reviewed to establish the parameters for model input and calibration. Flows, loadings, aeration demand, sludge and biosolids generation rates for the planning period to 2046 were developed, and capacity of each unit process was assessed in terms of flows, loadings, equivalent population, and equivalent average day flow capacity to identify when capacity is projected to be exceeded.

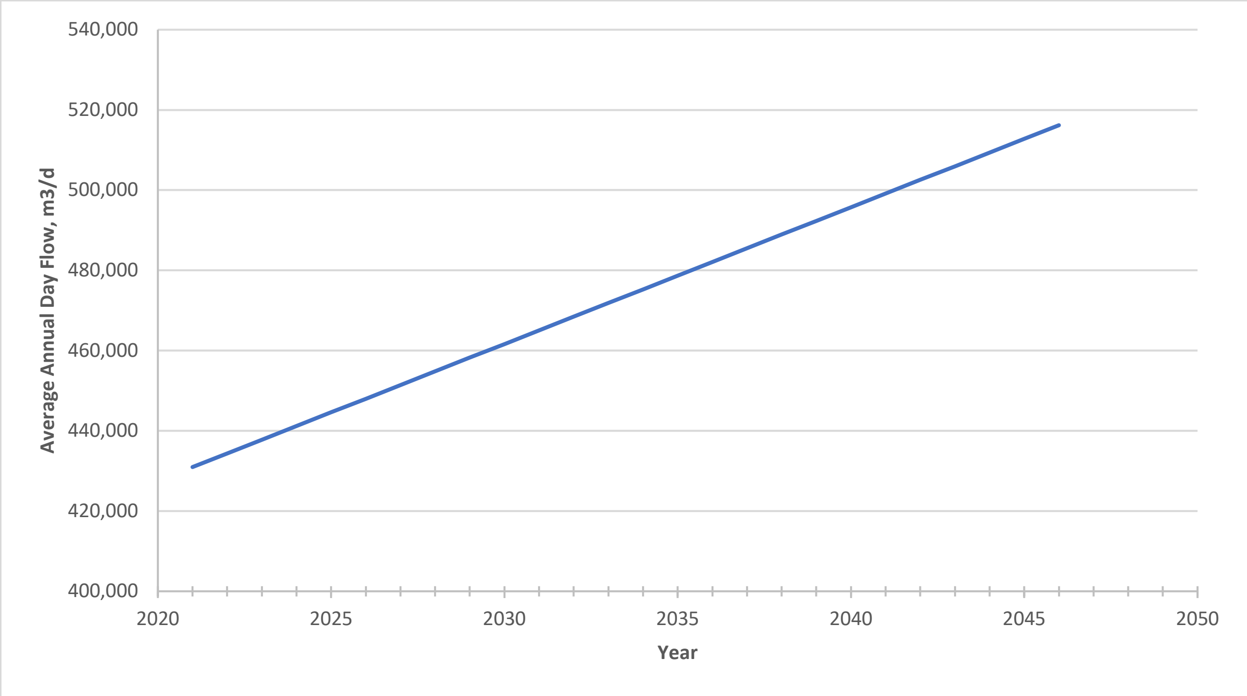
Historic flows to ROPEC between January 2016 and December 2020, based on hourly flows recoded in plant SCADA systems are summarized below.

- Annual Average Day Flow (ADF) (ML/d): 424
- Peak Day Flow (ML/d): 1,392
- Peak Hour Flow (ML/d): 1,495

ROPEC has an average day flow rated design capacity of 545 ML/d per the existing Environmental Compliance Approval (ECA). Based on the Plant Capacity Analysis, not all unit processes provide adequate capacity at the design flow.

Projected annual average day flows at ROPEC to 2046, based on population growth, are presented in Figure 5-1.

Figure 5-1: Projected ROPEC Flows Based on Population



The effluent limits and treatment objectives for ROPEC are established under the existing plant ECA issued by the Ministry of Environment and Climate Change (now Ministry of the Environment, Conservation and Parks (MECP)). Changes to the effluent limits are not expected the next expansion (beyond the current ECA rated average day flow capacity of 545 ML/d) is required at the plant.

The analysis confirmed that all processes have adequate total capacity, except disinfection (specifically, the chlorine contact tanks), anaerobic digestion, and biosolids storage. Firm capacity is not adequate for preliminary treatment (specifically, the grit removal process) and biosolids dewatering.

In addition, the existing primary clarifiers surface overflow rate (SOR) at design flow exceeds capacity (based on industry standards); however, historically the primary clarifiers have been achieving good performance when operating as SORs higher than industry standard. Actual capacity needs verification via stress testing. Stress testing is used to identify the loading rate at which the process performance approaches the design value. Hydraulic, organic and solids loading rates to the unit processes are increased by varying the number of units in service, biasing the flow to the test unit.

The total and firm (where relevant) capacities for treatment processes within ROPEC are presented in Figure 5-2. For solids and biosolids treatment processes, the capacities are also expressed in equivalent population capacity, as shown in Figure 5-3.

Figure 5-2: ROPEC Process Capacities (in Equivalent Plant Average Day Flow)

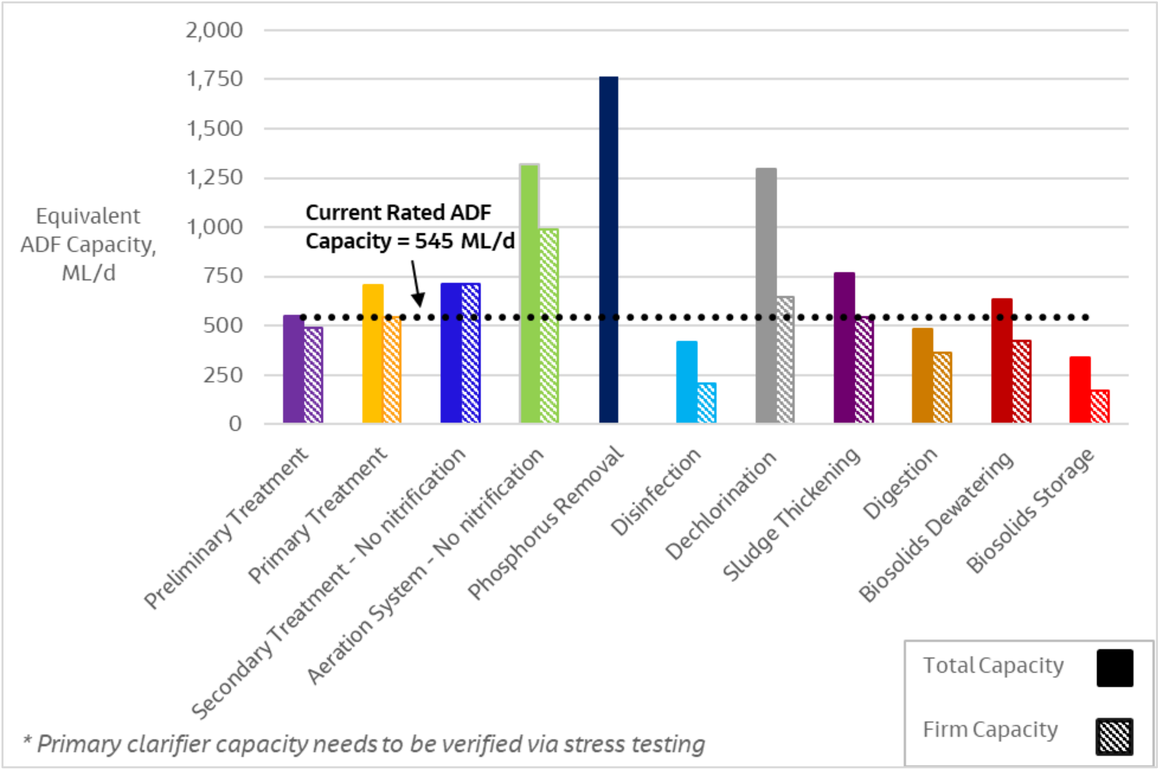
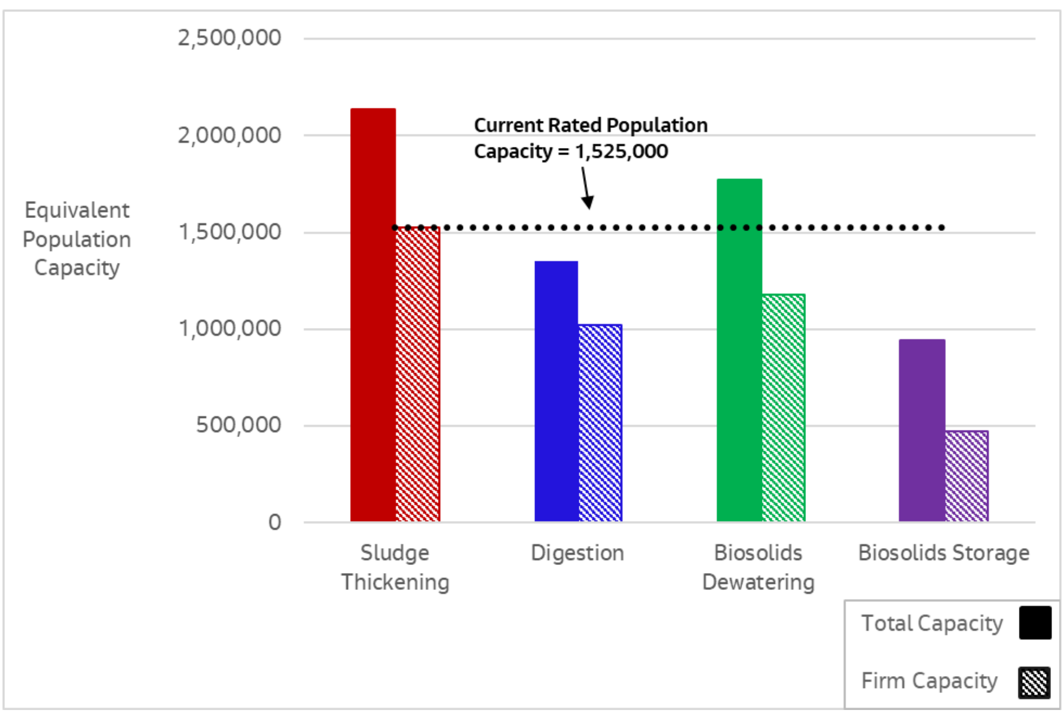


Figure 5-3: Solids and Biosolids Treatment Capacity Assessment (in Equivalent Population)



ROPEC's hydraulic capacity was analyzed to identify hydraulic bottlenecks. Seven hydraulic scenarios were simulated using a combination of flows and Ottawa River levels.

The following points summarize the findings of the ROPEC hydraulic assessment:

- There are no hydraulic concerns under average flow and Ottawa River water level conditions.
- Secondary treatment hydraulic capacity is limited to design peak day flow of 1,362.5 ML/d when Ottawa River water level is equal to or below 42.21m (the average Ottawa River water level in spring).
- The existing outfall does not have capacity to accommodate the design peak flow at water levels above 42.21m.
- The plant can accommodate a peak flow of 1,210 ML/d through primary and secondary treatment with the Rideau Valley Conservation Authority (RVCA) regulated 100-year flood level of 45.45m.
- Two potential hydraulic bottlenecks were identified within the 2046 period: the raw wastewater influent conduits (downstream of the Raw Sewage Pumping Station (RSPS)) and the outfall.

5.3.2 Preliminary Recommendations to Address Capacity Growth Needs

The following are the preliminary recommendations to address capacity growth needs within the planning horizon. Recommendations are based on a multi-criteria evaluation. Additional detailed analysis of the raw wastewater pumping and outfall is underway to determine the optimal long-term strategy. Functional designs and implementation plans are being developed. It is recommended that 90 percent of the ECA rated capacity (average day flow of 491 ML/d) be used as the trigger to plan for future expansion at ROPEC. ROPEC is projected to exceed 90 percent of the ECA rated capacity between 2033 and 2038; a planning study (e.g., Master Plan update or environmental assessment) should be completed during this period to re-assess the plant capacity considering the actual flow and loads at that time, and to confirm the expansion needs and timing.

Raw Wastewater Pumping

The raw wastewater pumping at ROPEC consists of the RSPS, the Orleans Cumberland Collector Pumping Station (OCCPS), and the South Ottawa Tunnel (SOT) Riser Shaft.

The rated firm capacity of the existing OCCPS is not considered as part of the firm raw wastewater pumping capacity of ROPEC in the ECA, as it does not meet the Ministry of Environment (MOE) Design Guidelines for Sewage Works (MOE 2008). It is recommended to upgrade the OCCPS to meet MOE Guidelines, as utilizing the rated capacity of the OCCPS would defer the first RSPS process expansion.

The SOT Riser Shaft, consisting of a wet well, pumping infrastructure, and a shaft, is located at the downstream end of the SOT to conveys flows into the Screening and Degritting building on an intermittent basis. The SOT was originally designed to be operated under wet weather events and it operated adequately for large flows. Recently, it has operated more frequently under lower flow conditions, however at lower velocities the tunnel behaves as a settling tank resulting in sediment accumulation in the tunnel and at the bottom of the shaft. Upgrades to the SOT Riser Shaft pumps are required to address increased average day flows.

Screening and Degritting Facility

The Screening and Degritting Facility does not have adequate firm capacity for grit removal for the 2046 planning period. Expansion of the aerated grit tanks is recommended to provide the required firm capacity.

Secondary Treatment

Capacity increase for the secondary treatment aeration system is recommended to provide redundancy for biochemical oxygen demand removals. Inadequate air flow is expected to occur if one of the existing three multi-stage centrifugal blowers is offline during maximum month peak flow conditions.

Disinfection

Currently, disinfection is achieved via chlorination followed by dechlorination using sodium bisulphite. The existing chlorine contact tanks have a firm capacity of 260 ML/d, based on providing 30 min contact time at design average day flow and 15 min contact time at design peak hourly flow. Chlorine Contact Tank expansion is required now to provide the required firm capacity, and to allow existing tanks to be taken offline for major rehabilitation.

The preliminary design concept for Chlorine Contact Tanks expansion is based on constructing two new Chlorine Contact Tanks.

Outfall

The hydraulic capacity assessment determined that the existing plant outfall has capacity for conveying a peak flow of 1,822.5 ML/d with the overflow sewer, provided that flow exceeding 1,362.5 ML/d bypasses plant treatment when the Ottawa River level is at or below the spring average water level of 42.21 m. However, an outfall capacity expansion is needed now to minimize the risk of bypassing plant treatment in anticipation of more frequent wet weather events and higher Ottawa River levels. Further assessment is currently underway to determine the preferred solution to providing outfall expansion.

Anaerobic Digestion

The anaerobic digesters do not have adequate capacity for the planning period and for the plant rated capacity. It is estimated that the firm capacity will be reached by 2027, and the total capacity limit will be reached by 2038. The anaerobic digesters have insufficient firm capacity for the planning period based on maintaining a 15-day hydraulic retention time at maximum month loadings with one of the largest digesters offline.

The recommended upgrade to provide digestion capacity is based on expansion with the same technologies and includes adding two additional silo digesters the same size as existing Digesters 5 and 6.

Biosolids Dewatering and Storage

The capacity of the biosolids storage at maximum month loading is limited to an equivalent population of 942,000 based on 3-day storage. The capacity assessment is based on the assumption that the hoppers are emptied when unplanned storage is required, however, this may not always be possible. As plant loadings approach capacity, storage times will be reduced, increasing the need for haulage. Based on 2-day storage, the biosolids storage can accommodate an equivalent population capacity of 1,413,000 at maximum month loading. Expansion of the biosolids storage capacity will be required within the 2046 planning horizon.

Currently, biosolids dewatering is provided by six centrifuges; the firm capacity (with 2 centrifuges offline) is projected to be exceeded by 2037. There is limited space within the existing Thickening & Dewatering building to install additional centrifuges, and building expansion is difficult given the current configuration of the cake hoppers and truck loading facility. Therefore, the recommended approach is to provide additional dewatering and storage capacity in a new facility with a dedicated truck loading area.

Total Ammonia Nitrogen Limits

Although currently not required, ROPEC could expect a future effluent total ammonia nitrogen (TAN) limit to meet the non-toxic effluent criteria, which is set by the MECP at 0.1 mg N/L unionized ammonia. ROPEC was not originally designed for nitrification or nitrogen removal, and major expansion (beyond the current ECA rated capacity) is not expected in the short term.

Preliminary consultation with the MECP indicated that an effluent TAN limit is not expected for ROPEC within the 2046 planning period for this Master Plan, as expansion beyond the current rated average day flow capacity of 545 ML/d is not required. However, MECP recommended that the ROPEC Master Plan identify the upgrades needed to provide partial nitrification, such that the City can be prepared when called upon.

5.3.3 Preliminary Project Requirements for Capacity Expansions

Table 5-4 summarizes the required capacity expansion projects and associated timing within the planning horizon. Additional analysis, functional design and refinement of cost estimates is still being completed as part of the ROPEC Master Plan, which is anticipated to be completed in October 2024. Costing and funding sources for these projects are discussed in Section 15.

Table 5-4: Preliminary Growth-driven ROPEC Expansion Projects

Project Name	Project Location	Project Details	Timing
Raw Wastewater Pumping – SOT Pumping Expansion	SOT Riser Shaft	New SOT pump station	2024-2029
Raw Wastewater Pumping – OCCPS Upgrade	OCCPS	Upgrade OCCPS in compliance with MOE Guidelines	2024-2029
Screening and Degritting Facility Expansion	Aerated grit tanks	One new grit tank	2034-2039
Secondary Treatment Expansion	Blower Building	One new multi-stage centrifugal blower	2024-2029
Disinfection Expansion	CCT	Two new CCT	2024-2029
Outfall Expansion	Outfall	Replace outfall pipe	2024-2029
Anaerobic Digestion Expansion	Anaerobic digesters	Two new silo digesters	2024-2029
Biosolids Dewatering and Storage Expansion	Biosolids	Additional dewatering and storage capacity in a new building	2034-2039

5.3.4 Climate Change Resiliency

As part of the ROPEC Master Plan, a Climate Change Resilience Assessment was completed to assess the current state of ROPEC with respect to climate change adaptability and vulnerability, following the framework established in *Canadian Standard Association, Standard S900.1:18 – Climate Change Adaptation for Wastewater Treatment Plants*.

Seventeen risks were identified for adaptation consideration (including 2 high risks and 15 medium risks), which can be categorized into the following ROPEC areas:

- Site accessibility and biosolids management (haulage offsite) vulnerable to extreme weather events.
- Incoming power supply (single overhead line) and diesel stacks (for standby power) vulnerable to extreme weather events, affecting the overall site power resiliency.

- Potential of extreme heat waves damaging electrical equipment for critical process areas and affecting plant serviceability and capacity.
- High temperature increasing long-term Operations and Maintenance requirements for buildings and process areas with high HVAC and/or odour control requirements, reducing the life expectancy of affected equipment.
- High temperature increasing the air demand (for the same oxygen demand) required for biological treatment.
- Chlorine Contact Tanks and outfall subject to riverine flooding risk (high river level combined with high flows).

Potential adaptation measures were developed for each of the identified risk areas, and synergies with other ROPEC Master Plan components were identified (e.g., recommendations to address capacity limitations or improve energy efficiency could also improve the climate change resilience of affected assets).

The capacity expansion projects to address growth will mitigate some of the risks identified, including:

- Biosolids management (haulage offsite) will be partially mitigated through biosolids storage expansion.
- Design of the expansion of the Chlorine Contact Tank and outfall will take into consideration potential mitigation of riverine flooding risk.

Other identified climate change adaptation measures and emission reductions are being considered and incorporated into recommended renewal and enhanced level of service projects within the ROPEC Master Plan.

6 Water Master Plan

6.1 Overview

This section summarizes the City's future planning and implementation of drinking water infrastructure projects to support the City's growth projections. It outlines objectives for water infrastructure planning; identifies the core water infrastructure components; presents performance criteria and demand forecasts for the water system; discusses loss prevention and consumption reduction strategies; and outlines resiliency, mitigation, and adaptation opportunities. New proposed water infrastructure projects are identified, along with a review of active, completed and modified projects from the 2013 IMP. Detailed supporting information is provided in the Water Master Plan study report (WMP 2024, referenced in Appendix B). Associated policies are documented in Section 4.

6.2 Water Infrastructure Planning Objectives

The primary objective of the WMP is to identify the projects needed to support growth to 2046. The WMP evaluated the system's performance under existing, 2046 and long-term (2101) future conditions. Key major failure scenarios (complete pump station, storage and major watermain shutdowns) under future conditions were tested. The WMP also reviewed design criteria and level of service and compared them against industry best practices. A framework was established to address the impacts of climate change in the WMP.

6.3 Core Water Infrastructure Components

Approximately 935,000 customers[4] in the urban area within the City of Ottawa are currently serviced with potable water and provided with fire protection services through a water supply and distribution system that is owned and operated by the City. This system is supplied with source water from the Ottawa River, which is first treated at the Lemieux Island and Britannia Water Purification Plants (WPPs). From these facilities, treated water is pumped through a piping network comprising approximately 3,250 km of watermains (250 km of backbone watermains and 3,000 km of smaller diameter distribution piping). The distribution system includes 17 high-lift and booster pumping stations, five at-grade storage reservoirs and four elevated water storage tanks. There are some locations where the central supply system has been extended to serve areas outside of the City's urban boundary, including the Village of Manotick, Russell Township and Carlsbad Springs. The City also operates five communal well systems, fed by groundwater, that supply the communities of Vars, Richmond, Munster Hamlet,

[4] Customer count as reported in the Technical Memorandum - Water System Supply and Demand Characteristics (City of Ottawa, 2019; *Water Characterization Study*).

Carp and Shadow Ridge. A map showing the existing backbone water infrastructure is provided in Appendix A, Schedule 6.

6.3.1 Water Purification Plant

Purification is required to treat the Ottawa River water to potable water standards before delivery to customers. The City currently treats its water to meet or exceed applicable provincial and federal standards for water quality. Chloramine, which decays at a slower rate than chlorine, is currently used to maintain adequate disinfection residuals throughout the distribution system. The nominal capacities of the WPPs are given in Table 6-1. The capacities in the summer and winter differ, as winter operational capacities are reduced due to settling tank limitations in cold weather. As described in Section 5, the Lemieux Island WPP winter capacity will be upgraded to support the City's basic water demands under winter conditions when the Brittania WPP is out of service. Additional details regarding each WPP are provided in Section 5.

Table 6-1: Nominal WPP Capacities

Facility	Existing Summer Treatment Capacity (MLD)	Existing Winter Treatment Capacity (MLD)[1]
Lemieux	400	250
Britannia	360	320
Total	***760***	***570***

Notes:
[1] Winter operational capacities are reduced due to settling tank limitations in cold weather.

6.3.2 Storage and Pumping Facilities

Water storage facilities are strategically located throughout the distribution system to augment water supply rates during high water demand periods and fire flow conditions, and to increase the reliability of water supply during system outages. Generally, water in the storage facilities is used during peak daily demand periods and replenished during off-peak usage periods, generally overnight. The key characteristics of each of the storage facilities are provided in Table 6-2. The location of each storage facility is shown in Appendix A, Schedule 6.

Table 6-2: Existing Reservoir Storage Capacities and Maximum Levels

Zone	Storage Facility	Facility Type	Total Volume (ML)	Overflow Elevation (m)
3W	**Stittsville**	Elevated Tank	4.5	161.5
2W	**Glen Cairn**	Reservoir	34.0	131.1
3SW	**Moodie Drive**	Elevated Tank	6.8	156.0
	Fallowfield (Barrhaven)	Standpipe	18.1	131.0
1W	**Carlington Heights**	Reservoir	109.0	112.6
	Lemieux Clearwell	WPP Clearwell[1]	3.4	-
2C	**Conroy Tank**	Elevated Tank	9.5	131.3
	Ottawa South	Reservoir	8.0	103.9
1E	**Orleans**	Reservoir	81.8	114.7
2E	**Innes**	Elevated Tank	4.5	131.0

Notes:
(1) Per Delcan (2012), the Lemieux WPP can provide balancing storage, whereas the Britannia WPP should not contribute to any summation of storage for system-wide planning purposes.

Since water pressures in the distribution system decrease as one moves further from the treatment plants (due to friction losses in the watermains) and as the ground elevations increase, booster pumping stations are required in the distribution system to provide customers across the City with adequate water pressures.

These pumping stations (PSs) feed the different water pressure zones to provide an appropriate range of pressures within each zone. The location of each PS is shown in Appendix A, Schedule 6. Pressure zones with elevated storage are considered “open” zones, where the pump operations and the pressures are normally determined by the water level in the storage facility (sometimes referred to as “floating” storage). “Closed” pressure zones have no elevated storage and system pressures are normally regulated through pressure control at the pump stations. The key characteristics of each of the pump stations within each pressure zone are provided in Table 6-3.

Table 6-3: Existing Potable Water Pumping Stations

Zone	Facility	Open/ Closed	HGL (m)	Rated Capacity (MLD)[1]	
				PS Total	Zone Firm[2]
MG	**Morgan's Grant**	Closed	148	17.7	12.3
3W	**Glen Cairn**	Open	159	148.0	205.0
	Campeau		159	100.0	
3SW	**Fallowfield**	Open	151	14.0	14.0
	Barrhaven-3SW		151	7.0	
2W	**Britannia-2W**	Open	129	330.0	345.0
	Carlington Heights-2W[3]		129	120.0	
ME	**Carlington Heights-ME[3]**	Closed	155	18.0	12.0
1W	**Lemieux**	Open	112	426.0	895.8
	Britannia-1W		112	285.8	
	Fleet Street		112	320.0	
2C	**Hurdman Bridge-2C**	Open	129	55.0	89.6
	Billings Bridge		129	129.6	
SUC	**Ottawa South-SUC[3]**	Closed	147	90.0	120.0
	Barrhaven-SUC		147	90.0	
YOW	**Ottawa South-YOW[3]**	Closed	157	36.4	14.4
LEIT	**Leitrim-LEIT**	Closed	164	4.7	2.4
RUSSELL[4]	**Leitrim-Russell[4]**	N/A[4]	N/A[4]	28.6	14.3
MONT	**Brittany**	Closed	147	30.0	42.7
	Montreal		147	44.2	
1E	**Hurdman Bridge-1E**	Open	114	320.0	230.0
2E	**Orleans**	Open	131	80.6	124.6
	Forest Ridge		131	84.0	

Notes:

HGL = Hydraulic Grade Line (a number that reflects both the elevation of the pump station, and the station discharge pressure)

MLD = Million Litres per Day

MONT = Montreal

ME = Meadowlands

MG = Morgan's Grant

LEIT = Leitrim

SUC = South Urban Community

(1) The nominal capacity of the station with all pumps in operation.
(2) Total capacity of the station less the capacity of the largest pump. Typically, pump stations are designed to provide a firm capacity that is at least equal to the expected water system demand at the planning horizon. Refer to 2024 WMP report for further details on the definition of firm capacity.
(3) Recently upgraded PS or PS currently undergoing upgrades; individual pumps' operational capacities assumed equal to rated capacity.
(4) While Russell is not a pressure zone of the City of Ottawa analyzed as part of the WMP, the pumping capacity dedicated to Russell at the Leitrim PS is reported for completeness.

6.3.3 Water Transmission and Local Distribution

There is a total of approximately 3,250 km of watermain in the City's water distribution system, illustrated in Appendix A, Schedule 6. The oldest pipes were constructed in the 1870s, while most pipes were constructed after 1950. Until 1970, cast iron (unlined and then lined) was the primary pipe material. From 1970 to 1990, ductile iron was the prevalent pipe material installed and since 1990, polyvinyl chloride (PVC) is the prevalent pipe material. Other pipe materials that have been used are polyethylene, steel, concrete and copper. Pipe diameters of 152mm and 203mm represent the majority of diameters in the existing distribution system, followed by 305mm and 406mm.

There is approximately 250 km of backbone watermain in the network. Backbone watermains are mostly concrete pipes, but also ductile iron, PVC, steel, cast iron and polyethylene have also been used for some sections. Backbone watermains mostly consist of pipes with diameters of 406 mm to 2,550 mm.

6.4 Water System Performance Criteria

The water system characteristics; design and level of service criteria; and existing and projected future water demands form the basis upon which the performance of the City's water distribution infrastructure is assessed, and infrastructure needs to meet future demands are identified. The WMP design and level of service criteria are presented in detail in the WMP Report. The following section provides a summary of the criteria, and the main changes from the 2013 WMP.

6.4.1 Assessment Criteria and Triggers

Water system performance was assessed based on growth, reliability, and backup power requirements. Each of these assessments is summarized in this section, and details are provided in the WMP. In each case, capacity trigger years are identified when demand reaches or exceeds the available capacity.

Growth capacity needs are based on an assessment of firm capacity within each pressure zone. The target level of service for the assessment is to supply the higher of maximum day + fire flow (MXDY+FF) or peak hour (PKHR) demand at or above minimum pressure criteria.

The reliability assessment considers scenarios involving major failures or planned outages. Examples include complete pump station failure, storage out of service, large diameter watermain failure, and WPP upset. The target level of service for the reliability assessment is to supply basic day + fire flow (BSDY+FF) under each of these scenarios.

The backup power assessment is based on an assessment of available backup power for pumping at each pump station. The target level of service for the backup power assessment is to supply BSDY+FF.

6.4.2 Design Criteria

To assess future demand conditions, the WMP established parameters to estimate future demands in pressure zones based on the total number of projected residential units and employees in the pressure zones. Unit demand values at the system or pressure zone level are less than the City's design guideline values that are used for individual development projects. This is because peak demands tend to be attenuated when assessed at a macro scale. These values are therefore used in the planning and design of major system infrastructure including pumping stations, storage tanks and large diameter transmission lines.

Non-revenue water (NRW) is water that is not billed to an end user and comprises leakage, unmetered service lines, hydrant flows, and other unaccounted for water use and loss. Non-revenue water is determined by comparing Supervisory Control and Data Acquisition (SCADA) data (production) to meter data. NRW is considered as a component of basic day demand (BSDY).

Maximum day (MXDY) demand is calculated as the sum of basic day (BSDY) demand and a design outdoor water demand (OWD) allocation. OWD statistics are evaluated on a pressure zone level, based on a frequency analysis of operational data at pumping stations and reservoirs. The selected design frequencies for the WMP are discussed in Section 6.5, with further details also available in the WMP report.

Minimum fire flow objectives are used for both the planning and design of major potable water infrastructure including pumping stations, storage facilities and transmission lines. Since planned growth is trending towards higher density development, an increase in the minimum fire flows used in the 2013 WMP was recommended. A citywide objective of 13,000 L/min has been established to evaluate existing infrastructure and to identify needs based on existing and future demand conditions. Fire flow requirements are further discussed in the WMP report.

Along with the water demand and fire flow design criteria, operational criteria are also needed to assess the performance of the system and to plan infrastructure to meet the future requirements of the system. These criteria include operating pressures, watermain velocity and water age. These criteria remain unchanged from the 2013 WMP.

6.5 Water System Demand Forecasts

Total demands per pressure zone were established based on operational data for the year 2018. Projected growth for the year 2046 (2018 to 2046) and for the year 2101 (2046 to 2101), were estimated by the City's planning department as part of the Official Plan process. Using the projected growth and water demand design criteria established in the WMP, future water demands were calculated. The following demand conditions are considered:

- Basic Day (BSDY) Demand: demand expected every day of the year, including all normal indoor water use in all City households and businesses. BSDY also considers non-revenue water (NRW).
- Maximum Day (MXDY) Demand: Combination of BSDY demand and high rates of outdoor water demand (OWD). Different return periods for the OWD are considered.

The use of each demand condition as the basis for water system performance assessment is summarized in Section 6.4.1.

Table 6-4 summarizes the 1-year maximum day (MXDY) demands and the estimated peak MXDY demands (1-year MXDY x 1.30), used for the WPP treatment capacity assessment.

Table 6-5 summarizes the basic day (BSDY) and 5-year MXDY demands for existing conditions (2018) and for 2046 and 2101 growth projections for each pressure zone within the central distribution system. The 5-year MXDY demands are used for assessing and planning the pumping and storage capacities for each pressure zone.

A Major reconfiguration of existing pressure zones has been planned for the South Urban Community (SUC), involving the communities of Barrhaven, Riverside South, Leitrim, and Manotick. Two demand conditions are shown in Table 6-4 for the existing conditions (2018), pre and post SUC zone reconfiguration. The demands are based on water meter data. For the 2018 post-zone reconfiguration demand condition, the demands for pressure zones 3SW, 2W2C and SUC were adjusted to reflect the post-SUC reconfiguration.

These demands do not include the projections for the Tewin Lands, which are presented and addressed separately in Section 8.2.3.

The Township of Russell currently has an allocation of up to 11.8 MLD, with a 4-hour daily blackout period during peaks demands in the central system, where it may not draw water from the central system. The Township has recently expressed interest in renegotiating its agreement with the City to increase its allocation and eliminate the blackout period. However, insufficient information was available at the time of writing to assess the implications of increasing the water demand allocation for the Township.

Table 6-4: Demand Projections by Pressure Zone for Total System Planning and Assessment

1-Year Maximum Day (MXDY) and Peak 1-Year Maximum Day (MXDY x 1.30) Demand Projections (MLD) per Pressure Zone and Total (Central Supply System) – For Total System Treatment Planning and Assessment.

Zone	2018 Pre-Zone Reconfiguration(1)		2018 Post-Zone Reconfiguration(2)		2046(3)		2101(4)	
	MXDY(5)							
	1-Year	1-Year x 1.30	1-Year	1-Year x 1.30	1-Year	1-Year x 1.30	1-Year	1-Year x 1.30
	(MLD)							
1E	55.7	72.4	55.7	72.4	68.0	88.5	79.9	103.8
1W	104.2	135.4	104.2	135.4	121.3	157.8	136.7	177.7
2C(2)	43.8	56.9	38.7	50.3	43.8	56.9	48.2	62.7
2E	30.6	39.8	30.6	39.8	53.1	69.1	62.4	81.2
2W(2)	63.0	81.9	55.7	72.4	71.1	92.4	102.3	133.0
3SW(2)	23.9	31.1	8.7	11.4	9.8	12.8	17.5	22.7
3W	41.8	54.3	41.8	54.3	69.5	90.3	97.8	127.2
LEIT	0.3	0.4	0.3	0.4	0.5	0.7	4.3	5.6
ME	4.1	5.4	4.1	5.4	4.7	6.1	5.2	6.7
MG	1.0	1.3	1.0	1.3	1.0	1.3	1.1	1.4
MONT	3.5	4.6	3.5	4.6	5.6	7.3	7.5	9.8
RUSSELL	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8
SUC(3)	6.1	8.0	33.7	43.9	88.1	114.5	157.8	205.1
YOW	1.3	1.7	1.3	1.7	1.7	2.2	1.9	2.5
Totals(5)	***391.3***	***505.1***	***391.3***	***505.1***	***550.1***	***711.6***	***734.4***	***951.1***

Notes:

1. New demands for 2018 provided by the City in September 2021. The zonal demand distribution for 2018 is based on water meter data prior to the SUC pressure zone reconfiguration.
2. The total demands following the SUC pressure zone reconfiguration are the same as the 2018 demands provided by the City (with minor discrepancies due to rounding). However, the 3SW, 2W2C and SUC demands have been adjusted to reflect the post-SUC reconfiguration demand ratios, as determined using the hydraulic model (based on junction pressure zone allocation).
3. Growth projections for 2046 provided by the City in September 2021; obtained by adding growth to existing conditions (2018) total demands.
4. Growth projections for 2101 (from 2046 to 2101) provided by the City in March 2022; obtained by adding growth to 2046 total demands.
5. Based on a review of water purification plant (WPP) treatment data, it was determined that the 1-year MXDY multiplied by a peaking factor of 1.30 was representative of the treatment processes and is therefore used for assessing and planning the WPP's treatment capacity.

Table 6-5: Demand Projections by Pressure Zone for Zone Planning and Assessment

Basic Day (BSDY) and 5-Year Maximum Day (MXDY) Demand Projections (MLD) per Pressure Zone (Central Supply System) – For Pressure Zone Pumping and Storage Planning and Assessment.

Zone	2018 Pre-Zone Reconfiguration(1)		2018 Post-Zone Reconfiguration		2046(3)		2101(4)	
	BSDY	MXDY	BSDY)	MXDY	BSDY	MXDY	BSDY	MXDY
		5-Year(5)		5-Year(5)		5-Year(5)		5-Year(5)
	(MLD)	(MLD)	(MLD)	(MLD)	(MLD)	(MLD)	(MLD)	(MLD)
1E	41.4	62.3	41.4	62.3	51.5	75.7	61.0	88.6
1W	84.2	113.4	84.2	113.4	100.8	130.9	115.5	146.5
2C(2)	35.7	55.0	30.5	48.1	35.5	53.3	39.7	57.9
2E	21.4	37.5	21.4	37.5	36.0	65.6	42.4	76.6
2W(2))	45.3	79.2	38.7	69.2	51.9	87.0	75.6	126.1
3SW(2)	16.0	28.5	6.2	10.9	7.2	12.0	12.4	21.2
3W	24.7	50.0	24.7	50.0	40.0	83.6	59.4	116.3
LEIT	0.2	0.3	0.2	0.3	0.4	0.5	2.5	5.2
ME	3.3	4.7	3.3	4.7	3.9	5.2	4.3	5.7
MG	0.7	1.4	0.7	1.4	0.7	1.4	0.7	1.4
MONT	2.8	3.9	2.8	3.9	4.3	6.2	5.6	8.4
RUSSELL	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8
SUC(2)	3.9	7.3	25.5	41.9	59.3	111.1	100.8	189.6
YOW	1.4	1.3	1.4	1.3	1.8	1.7	2.0	1.9

Notes:

1. New demands for 2018 provided by the City in September 2021. The zonal demand distribution for 2018 is based on water meter data prior to the SUC pressure zone reconfiguration.
2. The total demands following the SUC pressure zone reconfiguration are the same as the 2018 demands provided by the City (with minor discrepancies due to rounding). However, the 3SW, 2W2C and SUC demands have been adjusted to reflect the post-SUC reconfiguration demand ratios, as determined using the hydraulic model (based on junction pressure zone allocation).
3. Growth projections for 2046 provided by the City in September 2021; obtained by adding growth to existing conditions (2018) total demands.
4. Growth projections for 2101 (from 2046 to 2101) provided by the City in March 2022; obtained by adding growth to 2046 total demands.
5. The 5-year MXDY demands are used for assessing and planning the zones' pumping and storage capacities.

6.6 Water System Performance

This section provides an overview of the water system performance under existing demand conditions and future demand conditions, assuming no capacity improvements.

6.6.1 Existing Level of Service

The WMP identified that existing treatment, storage and pumping can provide the required level of service to satisfy existing demands. While pump stations feeding smaller closed pressure zones were identified as deficient (mainly due to increased FF requirements under the updated WMP), existing operational practices such as interzone valving can supplement these deficiencies, and hence upgrades are not required.

6.6.2 The Do Nothing Scenario

The "do nothing" scenario is first considered in the capacity analysis of treatment, storage and pumping facilities. Existing capacities are compared against increasing demand projections, and trigger years for capacity upgrades to meet the future demands are identified. Without these upgrades, decreased level of service under growth conditions are expected.

A "do nothing" scenario was simulated in the City's hydraulic model, where 2046 growth demands were imposed on the system, and existing pump stations, storage facilities and feedermains were assumed to supply the system. As summarized in Table 6-6, the results show that under the "do nothing" scenario, tanks and reservoirs empty at peak hour and residual service pressures decrease below 40 psi. This confirms the need for future infrastructure by 2046, to maintain the required level of service in the system.

Table 6-6: Overview of "Do Nothing" Scenario

Infrastructure Type	"Do Nothing" Existing Infrastructure Performance under 2046 Growth Conditions	"Do Nothing" Level of Service under 2046 Growth Conditions
Treatment Plants	• Increased flows through treatment processes, water quality impacts and faster storage drawdown.	• Shortage in water supply • Lower pressures in downstream areas.
Storage Facilities	• Faster storage drawdown, and increased pumping requirements to fill storage.	• Lower pressures in zone.
Pumping Stations	• Higher flows and lower discharge pressures.	• Lower pressures in downstream service areas.
Watermains	• Increased flows within existing watermains, resulting in increased velocities and higher pressure losses.	• Lower pressures in downstream service areas

6.7 Water Loss Prevention Initiatives

The City of Ottawa continues to demonstrate its commitment to best practices in water use management through water loss prevention initiatives. Since 2006, the City has been conducting a water audit following the standard American Water Works Association approach to determine its Infrastructure Leakage Index (ILI). The ILI is the industry-wide key performance indicator in the field of water loss that compares the amount of water loss in the water distribution system to the amount that is theoretically unavoidable. After years of improvement and achieving a low ILI of 3.3 in 2015, the ILI has increased in recent years. In 2022, the ILI was 3.9, which translates to a cost of $7,000,000 annually based on the 2022 water production cost of $332/ML. A recent industry study (El-Diraby, 2021) indicates that the median ILI of 33 Canadian municipalities is 2.7, indicating that Ottawa's ILI performance is below average. This further highlights the importance of the City's water loss prevention initiatives, as the benchmark of 2.7 as an ILI would result in approximately $2,300,000 in operational savings annually.

The recent operational developments in advanced metering have permitted the City to identify, evaluate and prioritize pressure zones with the most leakage. As a result, the City can focus its leak detection surveys and water loss studies to these zones in order to identify and eliminate specific points or areas of high water loss. Pressure zone flow monitoring with advanced metering infrastructure will continue to be used to proactively detect and eliminate leaks.

Along with advanced metering infrastructure, the City continues to explore and invest in innovative technologies such as Artificial Intelligence and Machine Learning to monitor the water system and detect leaks with even more accuracy. The City will continue to support ongoing and new strategies to reduce water lost due to leakage in the water system.

6.8 Water Infrastructure Resiliency, Mitigation and Adaptation Opportunities

The following section provides a summary of climate change resiliency, mitigation and adaptation considerations for the City's water infrastructure. This was achieved by establishing a framework specific to the WMP, which is presented in detail in the 2024 WMP.

Given current downward trends in OWD observed by the City's recent water characterization study (City of Ottawa 2019), the current 5-year return frequency of OWD established by the City for the WMP update is considered to be conservative. Nonetheless, a sensitivity analysis was performed to assess infrastructure requirements under higher demand projections. This assessment was representative of potential climate change impacts, where outdoor water demands could increase with increasing temperatures. The analysis considers an increase in OWD of approximately 10%. This increase was selected based on statistical analysis of operational data. Based on this analysis, increased demands could accelerate the need for WPP treatment upgrades or additional storage by 13 years. Pumping upgrades would be required earlier. Future updates to the IMP will consider updated data and assess the need to advance projects compared to the plan presented herein.

Emergency scenarios were modelled as part of the WMP, which may be correlated to climate parameters (e.g., pipe breaks from cold extremes or freeze-thaw cycles, power outages impacting pumping stations). The WMP identified that current reliability and backup power needs are met with existing pumping capacities, storage and operational measures (e.g., interzone valving), and that growth (increased demands) is the main driver for upgrades. To increase its resilience to climate change, the City give further consideration to the following:

- Adopt strategies for demand management (to reduce demand-induced impacts on infrastructure capacity);
- Consider strategies for water supply management (to build resilience to drought/low water supply conditions); and/or,
- Incorporate findings from the recent Climate Change Vulnerability and Risk Assessment in future revisions of its design guidelines for local distribution systems.

The WMP also considered opportunities for climate change mitigation through energy efficiency in the City's water distribution system. This was done by optimizing pump station projects based on service area elevations and identifying opportunities for reducing pressure losses in the existing watermain network as part of growth-driven projects. To further contribute to climate change mitigation, the City will give further consideration to the following:

- Upgrades to heating and ventilation systems in water distribution buildings (e.g., pumping stations), in line with Energy Evolution, i.e.,
  - First improve building envelopes and ventilation systems to reduce heating and cooling demand as specified in the Energy Evolution model then,
  - Switch to non-combustion based HVAC / domestic hot water systems (e.g., use of waste heat or free cooling);
- An energy audit, including an inventory of pump equipment, particularly to evaluate the feasibility of adding Variable Frequency Drives;
- Inventory and evaluate sources of high head losses within the distribution system;
- Energy recovery technologies for new facilities or when replacing existing infrastructure; and/or,
- Zero emissions fleet vehicles or other equipment where feasible in its water services operations.

6.9 Proposed Water Infrastructure Projects

This section identifies the individual water infrastructure projects required to meet the projected 2046 demands. Information on the individual projects is found in Appendix E, Water Infrastructure Project Sheets. Additional supporting analyses is provided below.

Based on the capacity and hydraulic assessment of the City's water infrastructure, preliminary project recommendations for growth or reliability were identified, and compared with the previous 2013 IMP recommendations. This section summarizes the projects in 3 categories:

- Active or completed projects from the 2013 IMP
- Planned projects from the 2013 IMP and updates on their status based on the 2024 WMP
- Newly identified projects from the 2024 WMP

The future water distribution system, including future infrastructure projects, is illustrated in Appendix A, Schedule 7. Project costs are tabulated in Section 15.

6.9.1 Active and Completed Projects From 2013 IMP

Completed or ongoing projects recommended in the 2013 IMP were considered in the existing conditions assessment. These projects consist of pumping and watermain upgrades, shown in Table 6-7 and Table 6-8, respectively. There are no active or completed storage or treatment upgrade projects that would impact this assessment. The location of each project is illustrated in the 2013 IMP Annex A.2

Table 6-7: Active or Completed Pumping Upgrades from the 2013 IMP

Zone	Pump Station	Total Rated Pumping Capacity (MLD)	Project Status
2W	Carlington Heights-2W	120	Tendered
ME	Carlington Heights-ME	18	Tendered
SUC	Ottawa South-SUC	90	Tendered
YOW	Ottawa South-YOW	14.4	Tendered
MONT	Brittany	30	Under Construction
1E	Hurdman Bridge PS-1E	320	In Design
2C	Hurdman Bridge PS-2C	55	In Design
SUC	Barrhaven PS-SUC	30	Tendered

Table 6-8: Active or Completed Watermain Upgrades from the 2013 IMP

Project Name	Diameter (mm)	Length (m)	Status
Manotick Feedermain Phase 1	610	2,250	Completed
Manotick North Island Link	406	600	Completed
	305	230	Completed
	610	430	Completed
Strandherd Dr Watermain	406	2,650	Completed
Manotick Feedermain Phase 2	406	3,560	Under Construction

6.9.2 Modifications to 2013 Planned Projects

Projects originally identified in the 2013 WMP were reviewed against the updated growth projections of the 2024 WMP. Projects were carried forward if needed to provide capacity to meet 2046 needs. Project timing and capacity was revised to accommodate the required capacity to meet 2046 needs. Those projects are presented in Table 6-9 (storage), and Table 6-10 (watermains).

Table 6-9: Updates to the 2013 IMP Storage Recommendations

Zone	Storage	Existing Volume (ML)	2013 IMP Recommendations		2024 WMP Updates
			Add (ML)	Total Capacity (ML)	Timing
SUC	**Riverside South**	-	+9.0	9.0	2024-2029
2W	**Glen Cairn**	34.0	+17.0	51.0	Post-2046
2C	**Ottawa South**	8.0	+16.0	24.0	2024-2029

Table 6-10: Updates to the 2013 IMP Watermain Recommendations

Project Name	2013 IMP Recommendations		2024 WMP Updates
	Diameter (mm)	Length (m)	Timing
Brittany Dr PS Suction Upgrade	406	420	2039-2044
Kanata West Feedermain Phase 2	610	230	2029-2034
Kanata West Feedermain Phase 3 & Phase 4	406	860	
		900	
Limebank Rd Feedermain Phase 2	610	1,460	2024-2029
Limebank Rd Feedermain Phase 3 & Phase 4		1,040	2029-2034
Greenbank Rd Watermain	610	920	2029-2034
		1,000	
	406	290	
March Rd Upgrades	610	300	2024-2029
		330	

6.9.3 New Projects

New projects were identified in the 2024 Water Master Plan. These consist of projects identified in the 2013 IMP but recommended for implementation past 2031 (year of eligibility for Development Charges), as well as new projects identified in the 2024 WMP. The sizing and timing of the 2013 IMP's projects were reviewed. Newly identified projects are presented in Table 6-11 (storage), and Table 6-12 (watermains), and illustrated in Appendix A, Schedule 7.

The new projects consider the planned reconfiguration of pressure zones in the South Urban Community, creating the new large zone SUC as described in Section 3.5. The reconfiguration will be implemented once the current upgrade of the Ottawa South PS is commissioned.

The pressure zone SUC and other downstream zones (SUC+) are located downstream of pressure zone 2W/2C. Pressure zone SUC is expected to experience significant growth, which will add pressure onto the existing infrastructure from zone 2W to the Barrhaven PS, from zone 2C to the Ottawa South PS, and further downstream within zone SUC itself. The WMP identified the need to expand capacity across the Greenbelt. Considering the planned development of the Tewin Lands, there is an opportunity to utilize the recommended Tewin infrastructure as a new supply facility to zone SUC+, to alleviate the growth pressures on the existing infrastructure. Projects to service the Tewin Lands are presented in Section 8, where the recommended infrastructure was sized considering the WMP demand projections for SUC+.

Table 6-11: New Storage Projects

Zone	Storage	Existing Volume (ML)	Add (ML)	Total Future Capacity (ML)	Timing
1E	**Orleans Storage Upgrade**	81.8	+54.6	136.4	2029-2034

Table 6-12: New Watermain projects

Project Name	Diameter (mm)	Length (m)	Timing
New Watermains for Urban Expansion Area E-4 & E-5	406	990	2039-2044
New Watermains for Urban Expansion Area S-1	406	800	2029-2034
New Watermains for Urban Expansion Area S-3	610	1980	2029-2034

7 Wastewater Master Plan

7.1 Overview

This section summarizes the future planning and implementation of wastewater infrastructure to meet the City's growth needs to 2046 as identified in the Wastewater Master Plan (2024, referenced in Appendix B). This section outlines objectives for wastewater infrastructure planning; identifies the core wastewater infrastructure components; and presents performance criteria for the wastewater system. Also discussed are demand forecasts, wet weather flow management initiatives, as well as resiliency, mitigation, and adaptation opportunities. New proposed wastewater infrastructure projects are identified, along with a review of active, completed and modified projects from the 2013 IMP. Associated policies are documented in Section 4.

7.2 Wastewater Infrastructure Planning Objectives

The overall aim is to update the City's Plan for Trunk Sewer Infrastructure. The objectives of the Plan are as follows:

1. Establish hydraulic performance criteria for assessing the capacity of the City's wastewater trunk sewer collection system;
2. Establish design criteria for projecting future wastewater flows associated with greenfield and intensification population growth up to 2046;
3. Develop future conditions hydraulic models by reviewing and loading future growth-related demands (both projected dry weather and wet weather flows);
4. Assess existing and future system capacity using hydraulic models to identify system upgrades and infrastructure needs to support population growth;
5. Develop additional hydraulic model scenarios to assess wastewater collection system climate change resiliency and strategic infrastructure oversizing needs for post-horizon population growth (up to 2101);
6. Develop Class D cost estimates for all newly identified infrastructure projects aimed at supporting growth and update cost estimates from the 2013 Infrastructure Master Plan for project still required and not implemented; and
7. Provide high-level conceptual servicing recommendations for new growth expansion areas.

7.3 Core Wastewater Infrastructure Components

The City of Ottawa's wastewater collection system covers a catchment area of approximately 3,000 km^2, servicing a current population of approximately 1 million. The system is comprised of the following key infrastructure components:

- Robert O. Pickard Environmental Centre (ROPEC) wastewater treatment plant, which has an average treatment capacity of 545 million litres per day (MLD);
- Sanitary sewers, which collect sewage from homes and businesses by gravity (more than 3,000 km total length);
- Combined sewers, which collect a combination of sewage and rainwater runoff by gravity (more than 110 km total length);
- Maintenance holes (approximately 53,000 total);
- Pumping stations, which lift wastewater flow from low points in the City into the gravity sewer system;
- Real-Time Controls to operate multiple regulating structures throughout the wastewater collection system; and,
- The newly constructed Combined Sewage Storage Tunnel, which is 3 metres in diameter and 6.2 km in length and was built to capture Combined Sewer Overflows (CSOs), preventing their discharge to the environment.

The following sections summarize key wastewater infrastructure components by geographic area within the City's wastewater Public Service Area.

7.3.1 Robert O. Pickard Environmental Centre

The Wastewater Master Plan focuses primarily on the City of Ottawa wastewater collection system, rather than the City's wastewater treatment system. However, the following presents a brief description of how sewage reaches the Robert O. Pickard Environmental Centre (ROPEC). Flows arrive at ROPEC via four key inlet sewers:

- **Interceptor Outfall Sewer**, which collects all wastewater flows from the Central-East and Central-West areas of the City;
- **Orleans-Cumberland Collector**, which collects all wastewater flows from the East Urban Community;
- **Greens Creek Collector**, which collects wastewater flows from the South Urban Community, West Urban Community, and areas of Gloucester within the Greenbelt regulated by flow controls at the Walkley Diversion Chamber; and,
- **South Ottawa Tunnel**, which also collects wastewater flows from the South Urban Community, West Urban Community, and areas of Gloucester within the Greenbelt regulated by flow controls at the Walkley Diversion Chamber.

Details on modelled wastewater flows from each of these inlet sewers to ROPEC can be found in the Wastewater Master Plan.

7.3.2 Trunk Services

Trunk sewers, which are defined as large diameters sewers which receive flows from smaller, local sewers, are categorized by geographic area in Table 7-1. Figures of the trunk sewer infrastructure for each geographic area can be found in the Wastewater Master Plan. The existing wastewater collection system is shown in Appendix A, Schedule 8.

Table 7-1: Key Trunk Services (by Geographic Area)

Geographic Area	Key Trunk Sewer Infrastructure	
West (Watts Creek Relief)	• Watts Creek Relief • Tri-Township Collector • March Ridge Collector	• Glen Cairn Trunk • Stittsville Trunk • Marchwood Trunk
South West (Lynwood Collector)	• Viewmount Drive Trunk • South Woodroffe Trunk • Greenbank Trunk • Barrhaven Trunk	• West Rideau Collector • South Nepean Trunk • Riverside Drive Trunk • Rideau River Crossing
South East (Greens Creek/South Ottawa Tunnel)	• Green Creek Collector North • Green Creek Collector South • South Ottawa Tunnel	• South Ottawa Collector • Innes Road Trunk • Cyrville Road Collector • Maxime Relief Trunk
East (Orleans-Cumberland Collector)	• Orleans-Cumberland Collector • Orleans Collector • Cumberland Collector • Forest Valley Trunk	• Gloucester-Cumberland Trunk • Ottawa River Sub-Trunk • Trim Road Trunk • Esprit Drive Trunk
Central West (West Nepean Collector)	• West Nepean Collector • Crystal Beach Collector • Graham Creek Collector • Cave Creek Collector	• Pinecrest Collector • Woodroffe Collector • Mooney's Bay Collector
Central East (Interceptor Outfall Sewer)	• Interceptor-Outfall Sewer • Booth Trunk • Rideau Canal Interceptor • Kent Street Trunk • Rideau River Collector	• Rideau River Interceptor • McArthur Road Collector • Montreal Road Collector • Clegg Street Trunk

7.3.3 Pump Stations and Forcemains

Pumping Stations and Facilities are categorized by geographic area in Table 7-2. Figures of the existing and future conditions for the pumping stations and facilities for each geographic area can be found in the Wastewater Master Plan.

Table 7-2: Key Pumping Stations & Facilities by Geographic Area

Geographic Area	Pumping Stations & Facilities	
West (Watts Creek Relief)	• Acres PS • Briarridge PS • March PS • Hazeldean PS • Kanata West PS	• Signature Ridge PS • Stittsville PS • Richmond PS • Munster PS • Carp PS
South West (Lynwood Collector)	• Manotick PS • Tartan PS	• Mahogany PS
South East (Greens Creek/South Ottawa Tunnel)	• Walkley Flow Diversion Chamber	• Leitrim PS
East (Orleans-Cumberland Collector)	• Forest Valley PS	• Tenth Line PS
Central West (West Nepean Collector)	• Crystal Beach PS	• Woodroffe PS
Central East (Interceptor Outfall Sewer)	• Hemlock PS • Sandy Hill Storage & PS	• RCAF PS • RCMP PS

7.3.4 Local Services

While the Wastewater Master Plan primarily focuses on large diameter trunk sewer assets (450mm diameter or greater), approximately 85% of the City's sewer assets are local wastewater sewer services (diameter less than 450mm). Local sewer pipes convey wastewater flows to downstream trunk sewers, and in the future will be primarily impacted by intensification population growth where existing urban area become more densely populated.

The City has undertaken the development of a wastewater program for intensification to assess the capacity of the City's local sewer services and identify program-level activities to manage sewer capacity within the local sewer network and effectively plan for intensification growth. Further information on the wastewater program development for intensification projects is provided in Section 13.

7.4 Wastewater System Performance Criteria

To support a capacity assessment of the wastewater collection system, the City reviewed and updated its performance criteria, considering risks to public health and private property, extreme events, and climate change impacts.

7.4.1 Assessment Criteria and Triggers

Well-defined assessment criteria are essential in evaluating hydraulic conditions (both existing and future) and identifying locations within the wastewater collection system which have capacity constraints.

The aim of the review was to adopt appropriate criteria to consistently evaluate the capacity of the trunk sewer system. To achieve this aim, the following key steps were identified:

1. Review hydraulic performance criteria applied in the previous Infrastructure Master Plan (2013).
2. Conduct an industry best practice review for performance criteria.
3. Establish trigger threshold requirements for trunk sewer improvements.
4. Identify extreme event performance indicators to test flood risk sensitivity.

The selection of a design rainfall storm event appropriate for the Ottawa area is a critical step in analyzing the existing sewer system as well as future growth scenarios. While the sanitary collection system is generally not intended to convey stormwater, major storm events do result in significant increases in sanitary flows as a result of infiltration through leaks, as well as inflows from foundation drains and roof connections in older areas of the City. The combined sewer area of the City also collects all stormwater runoff with the sanitary flows. Common design storms include the Chicago Design Storm, Soil Conservation Service (SCS) Type II Design Storm and the Atmospheric Environmental Service (AES) Design Storm. Actual historic events are also used and can be modified to represent specific return periods. An example of a commonly used historic event is Hurricane Frances (2004). Longer duration rainfall is used, usually to assess volumetric impacts; a typical year of rainfall based on historical statistical assessment is also commonly considered. Further information on the characteristics of the most common design storms and their suitability for sanitary sewer infrastructure analysis can be found in the *Wastewater Master Plan*.

For the 2024 Wastewater Master Plan, the June 24th, 2014 rainfall event distribution was applied, with total rainfall depth for the observed event scaled to match 1-in-5-year, 1-in-25-year, and 1-in-100-year return period rainfall depths and the Hurricane Frances rainfall event distribution with total rainfall depth for the observed event scaled to match 1-in-100-year rainfall depth. These events were considered ideal for assessing system capacity due to its significant rainfall depth, rainfall distribution (multiple peaks of rainfall), and due to the event's recency.

Previous approaches and industry best practices for assessing hydraulic performance were reviewed as part of the 2024 Wastewater Master Plan. The methodology adopted for evaluating existing sewer system performance is similar to the approach used in the 2013 Wastewater Master Plan. Key hydraulic performance indicators are generally described as follows:

- Sewers should operate under free flow conditions for 1-in-5-year June 2014 event.
- Hydraulic Grade Line (HGL) should remain 2.1m or more below ground level for 1-in-25-year June 2014 event.
- The 1-in-100-year June 2014 and Hurricane Frances rainfall events were used to test the sensitivity of the trunk sewer system; in this scenario, sewers with HGL less than 1.8m below ground level will be flagged for basement flood risk.

7.4.1.1 Climate Change Considerations

The Hurricane Frances rainfall event that took place on September 9, 2004 was used as the Climate Change "stress test" event for the existing and future wastewater collection systems. The one-day rainfall volume of 140mm recorded during the Hurricane Frances event aligns with climate model projections for the Ottawa area across two distinct emission scenarios and time periods. The likelihood of this event taking place is estimated at a 1-in-700-year occurrence. Since climate change impacts were considered as part of a risk assessment scenario within the 2024 trunk-level Wastewater Master Plan, it was important to quantify capacity in the event of an extreme wet weather event and assess the system's flood resiliency. Further details on climate change considerations can be found in the *Wastewater Master Plan*.

7.4.1.2 Design Criteria

Design criteria for future wastewater flows from new developments are necessary to estimate future system demands. The aim of the design criteria review was to adopt appropriate criteria to estimate future wastewater flows. To achieve this aim, the following objectives were identified:

Design Criteria (Future Conditions):

1. Review design flow estimation criteria for future growth applied in the previous City of Ottawa Infrastructure Master Plan.
2. Conduct industry best practice review of design criteria used in other municipalities.
3. Establish criteria for sanitary flow and inflow & infiltration (I&I) for both greenfield and intensification development.
4. Demonstrate the triggers and assumptions that are to be applied when determining strategy, timing, and sizing of new wastewater infrastructure.

Design criteria are used to estimate future wastewater flows from new development and for design and sizing of new wastewater infrastructure. Design criteria are a "one size fits all" approach applied across the entire sewer system; therefore, they require conservative flow estimates to provide adequate infrastructure sizing for a broad range of flow conditions. It is important that design values consider variability and long-term trends, including climate change, in order to remain applicable throughout the full asset lifecycle.

As part of the development process for design criteria for future wastewater flows, the previously established design criteria were reviewed. This includes residential sanitary flow rates, Industrial, Commercial, & Institutional sanitary flow rates, and wet weather flow allowance rates. Compared to the previous Wastewater Master Plan (2013), a revised set of design criteria were identified, considering the following:

- Apply a typical diurnal pattern to future sanitary flows based on recent monitoring;
- Reduce residential and ICI sanitary design flow rates, and increase I&I design allowance to represent recently observed trends;
- Discretize the infiltration and inflow allowance into two separate components; and
- Continue the use of an effective "contributing" area for runoff from greenfield growth areas.

Similar to the development process for hydraulic performance criteria, an industry review was completed of design criteria used in other municipalities. This review indicated that the City's design criteria are consistent with other municipalities.

It was noted that the COVID-19 impacted water consumption and sanitary flow production trends, as discussed in Section 3.3.3. Reductions have been noted in sanitary flows from industrial, commercial and institutional customers in some locations due to changes in operation and usage. Similarly, changes are seen in the shape of diurnal patterns for residential flows.

At this time, post-pandemic wastewater flow trends are expected to continue to mostly return to pre-pandemic conditions; long-term planning considerations like design criteria have therefore been relatively unaffected by the effects of COVID-19.

The revised design criteria are summarized in Table 7-3.

Table 7-3: 2024 Wastewater Master Plan Design Criteria

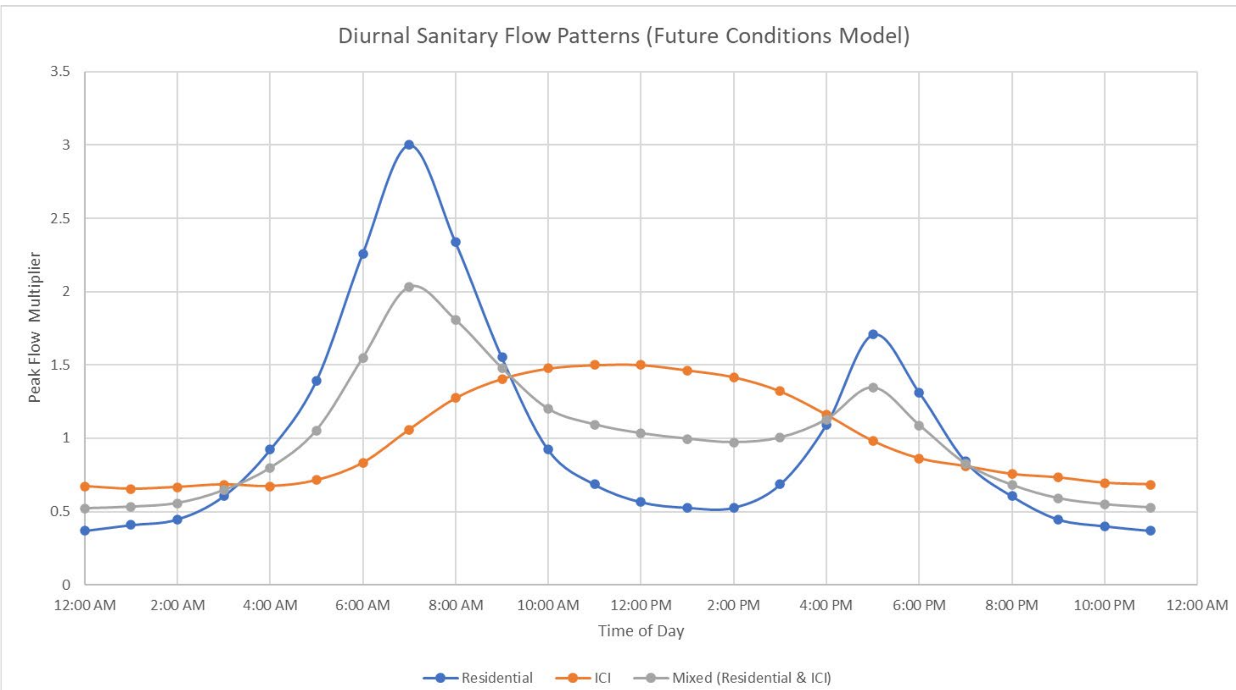
Design Criteria Parameter	Design Criteria Value	Units
Residential Sanitary Flow	280	L/person/day
ICI Sanitary Flow (Inside Greenbelt)	103	L/employee/day
ICI Sanitary Flow (Outside Greenbelt)	138	L/employee/day
Wet Weather Flow (Inflow)	0.28	L/second/ha
Wet Weather Flow (Infiltration)	0.05	L/second/ha
Wet Weather Flow (Total I&I)	0.33	L/second/ha

7.5 Wastewater System Demand Forecasts

2046 population growth projections were used to develop a future hydraulic model scenario, with the aim of assessing future collection system performance and identifying necessary infrastructure improvements to accommodate increased demands from population growth.

A hydraulic model was developed using the design criteria established in Section 7.4.2 and the population growth projections shown in Figure 7-2. Typical sanitary diurnal flow patterns were applied to average sanitary flows based on each future growth area's predominant land use type. The three diurnal patterns used to represent residential, ICI and mixed uses are shown in Figure 7-1.

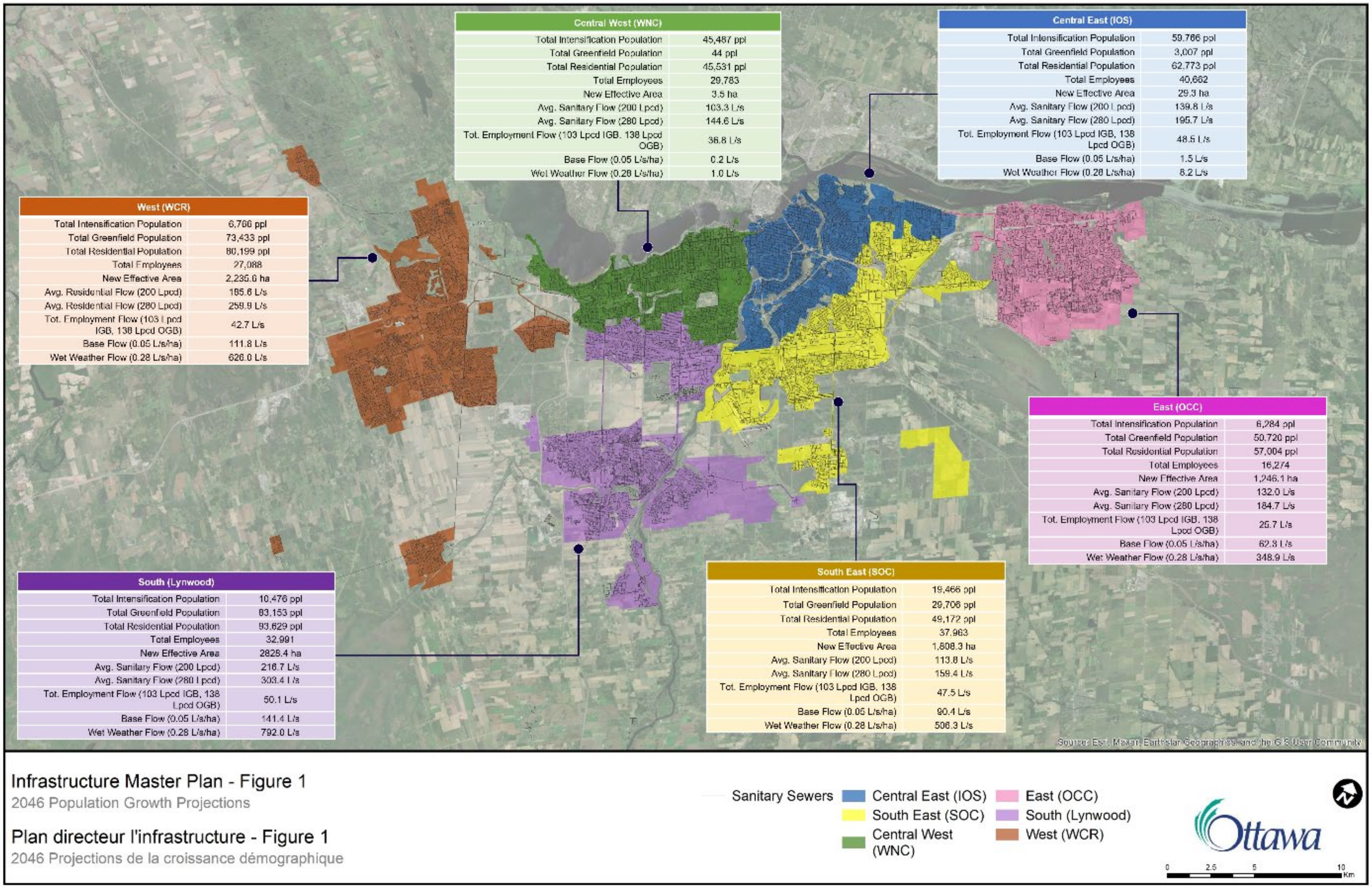
Figure 7-1: Diurnal Sanitary Flow Patterns Applied to Future Conditions Hydraulic Model



Future wet weather design criteria flows (0.33 L/s/ha) are considered for greenfield growth areas only; intensification growth areas do not to contribute any additional wet weather flows as they are already developed. Future infiltration is accounted for using a static base flow rate (0.05 L/s/ha), applied to the new effective area of each greenfield growth area. Future inflow is calculated dynamically through the use of a unit hydrograph, where a set of parameters are calculated for each design rainfall event such that the peak inflow rate from a greenfield growth area is equivalent to a 0.28 L/s/ha peak wet weather flow response, in accordance with design guidelines.

To better understand the distribution of population growth across the City, six main geographic areas were delineated. These areas have been used to summarize 2046 population growth as shown in Figure 7-2.

Figure 7-2: 2046 Population Growth Summarized by Geographic Area



7.6 Wastewater System Performance

The aim of the performance assessment was to use the existing conditions hydraulic wastewater model as a baseline to assess the impacts of future population growth and planned infrastructure improvements. To achieve this aim, the following main steps were followed:

1. Review hydraulic model results for existing conditions scenario (no growth, no planned infrastructure);
2. Develop and apply robust methodology for loading future growth areas into hydraulic model;
3. Review hydraulic model results for future conditions scenario (with population growth and planned infrastructure); and
4. Provide commentary on preliminary identification of infrastructure improvement solutions.

Future capital projects were proposed in the 2013 Wastewater Master Plan to mitigate predicted system capacity constraints as a result of future population growth. The projects still to be implemented were assessed as part of the 2024 Wastewater Master Plan update, to determine if any changes are required. Additionally, any infrastructure improvements or upgrades completed to-date were represented in the model and any capacity constraints which have arisen since the completion of the 2013 Wastewater Master Plan were identified.

7.6.1 Existing Level of Service

The existing conditions hydraulic model was simulated under the following rainfall event scenarios to compare hydraulic performance:

- 1-in-5-year June 2014 rainfall event (Lees Rain Gauge)
- 1-in-25-year June 2014 rainfall event (Lees Rain Gauge)
- 1-in-100-year June 2014 rainfall event (Lees Rain Gauge)
- 1-in-100-year Hurricane Frances rainfall event (Lees Rain Gauge)

The 1-in-25-year and 1-in-100-year June 2014 rainfall events were used as the primary triggers for the existing system capacity constraint assessment. The hydraulic model results have been reviewed to identify groupings or “clusters” of sewers within the same general location which show capacity issues and serve as the basis for comparison between existing system capacity issues and system capacity issues created as a result of future growth. The following sections summarize the results of the capacity assessment by geographic area.

7.6.1.1 West (Watts Creek Relief)

The West Watts Creek Relief area comprises the West Urban Community west of the Greenbelt, including Carp, Richmond, Kanata, Stittsville, Munster, and Bell’s Corners. The Watts Creek Relief sewer collects and conveys all flows from this area to the Acres Pump Station.

Under existing conditions, the West area showed only localized surcharging and capacity constraints. Of note were some surcharged pipes upstream of Carp PS and Richmond PS, as a result of insufficient pumping capacity. Additionally, some sewers showed surcharging under existing conditions in the March Ridge Tri-Township area, including the Watts Creek Relief pipe which is predicted to surcharge to ground level as a result of capacity constraints at Acres PS.

7.6.1.2 South West (Lynwood Collector)

The South West (Lynwood) area generally comprises the South Urban Community west of the Rideau River, which includes Manotick, Barrhaven, Riverside South and areas in Nepean that drain to the Lynwood Collector.

Under existing conditions, this area did not exhibit any trunk sewer capacity constraints. No significant clusters of HGL or bottleneck issues were noted.

7.6.1.3 South East (Greens Creek/ South Ottawa Tunnel)

The South East (Greens Creek/South Ottawa Tunnel) area mainly includes Findley Creek, the Ottawa Airport Authority, and areas in Gloucester that drain to the South Ottawa Collector and Greens Creek North and South trunk sewers. The South Ottawa Collector trunk sewer runs from west to east along the southern extent of the area inside the greenbelt and has substantial existing residual capacity. Two main clusters (Elmvale/Canterbury neighbourhood and East Industrial area at Walkley Road/Sheffield Road) of existing hydraulic capacity constraints were identified in this area, with the model showing surcharged sewer pipes as well as several groupings of maintenance holes with HGL depth less than 2.4m from ground.

7.6.1.4 East (Orleans-Cumberland Collector)

The East Orleans-Cumberland Collector area generally comprises the East Urban Community, which includes Gloucester, Orleans, and Cumberland. The Orleans Cumberland Collector conveys flows received from the entire East Urban Community to the Orleans-Cumberland Collector PS at ROPEC. Under existing conditions, the East Orleans-Cumberland Collector area did not exhibit any trunk sewer capacity constraints.

7.6.1.5 Central West (West Nepean Collector - WNC)

The Central West area generally includes neighborhoods in Ottawa West and Nepean which drain to the West Nepean Collector. The West Nepean Collector trunk sewer has known capacity issues under existing conditions. Several neighbourhood areas (Queensway Terrace North/South, Carling Avenue, Braemar Park/Bel Air Heights/Copeland Park Neighbourhoods, Cityview/Skyline/Fisher Heights & Borden Farm/Fisher Glen Neighbourhoods, and Qualicum-Redwood Park/Bayshore-Belltown Neighbourhoods) showed clusters of existing hydraulic capacity constraints in this area, with the model showing surcharged sewer pipes as well as several groupings of maintenance holes with HGL depth less than 2.4m from ground.

7.6.1.6 Central East (Interceptor Outfall Collector - IOC)

The Central East Interceptor Outfall Sewer area generally comprises the area inside the Greenbelt which drains to the Interceptor Outfall Sewer, including the Downtown Core, Vanier, and the Rideau-Rockcliffe Ward.

The Interceptor Outfall Sewer trunk sewer runs from west to east along the northern extent of the area inside the Greenbelt and has known existing capacity restrictions. Additionally, the Rideau River Collector showed extensive surcharging under existing conditions. Two main neighbourhood areas (Glebe/Dows Lake neighbourhood and Vanier/Kingsview Park neighbourhoods) showed clusters of existing hydraulic capacity constraints in the Central East area of the City, with the model showing surcharged sewer pipes as well as several groupings of maintenance holes with HGL depth less than 2.4m from ground.

7.6.1.7 Existing Conditions Pumping Station Capacity Assessment

The existing conditions hydraulic model results were reviewed to compare existing firm capacity with peak inflows at each key pumping station in the City's wastewater collection system. The results are summarized in Table 7-4.

Table 7-4: Pumping Station Capacity Assessment Results (Existing Conditions)

Pumping Station	Existing Rated Capacity (2019) (L/s)	1-in-25-year Event		1-in-100-year Event	
		Peak Flow (L/s)	Remaining Capacity[1] (L/s)	Peak Flow (L/s)	Remaining Capacity[1] (L/s)
Acres	2,100	2,203	(103)	2,341	(241)
Briarridge	55	30	25	33	22
Carp	55	40	15	47	8
Crystal Beach	280	338	(58)	426	(146)
Forest Valley	140	68	72	79	61
Hazeldean	1,225	494	731	568	657
Hemlock	150	200	(50)	245	(95)
Jackson Trails	121	28	93	32	89
Kanata West	631	404	227	466	165
Leitrim	133	131	2	149	(16)
Mahogany	43	21	22	24	19
Manotick	55	36	19	43	12
March	416	305	111	354	62
Munster	30	33	(3)	39	(9)
RCAF	33	6	27	7	26
Richmond	160	196	(36)	212	(52)
Shea Road	31	11	20	13	18
Signature Ridge	311	77	234	86	225
Stittsville	108	55	53	60	48
Tartan	210	86	124	97	113
Tenth	160	163	(3)	195	(35)
Woodroffe	420	741	(321)	882	(462)

[1] Pumping stations experiencing a capacity deficit can potentially result in basement flooding and untreated sewage being discharged into the environment.

7.6.2 The Do-Nothing Scenario

A high-level assessment was completed to evaluate the existing wastewater collection system with the addition of 2046 population growth: a "do-nothing scenario". This analysis focused specifically on infrastructure projects which have already been identified and planned, to quantify the impact on future capacity if no new infrastructure projects were implemented but upstream population growth were to proceed. The general conclusion determined negative results if system upgrades are not implemented. These negative results include surcharging, flooding, and failing of the existing system.

A description of the existing conditions for each studied area, the expected growth-related impacts for the area, and the results of the "do-nothing" analysis are summarized in Table 7-5.

Table 7-5: Do-Nothing Scenario Results Overview

Project Name	Existing Conditions	Growth-Related Impacts	"Do-Nothing" Result
Carp PS Capacity Upgrade & Forcemain	The existing inflow remains below the facility's existing rated capacity.	An additional 1,094 people and 20 employees are expected to be serviced by Carp PS by 2046.	With the addition of population growth, the peak inflow at Carp PS nears 71 L/s, which surpasses the existing rated capacity. As such, the "do nothing" scenario may cause flooding upstream of the pumping station.
Signature Ridge Forcemain	The existing inflow remains below the facility's existing rated capacity.	An additional 4,274 people and 4,587 employees are expected to be serviced by Signature Ridge PS.	The future peak inflow at Signature Ridge PS is close to 190 L/s. While this is does not exceed the station's existing capacity, the additional forcemain is required as it provides reliability to the system in the event of a failure in the existing forcemain.

Project Name	Existing Conditions	Growth-Related Impacts	"Do-Nothing" Result
Stittsville PS Decommissioning and Gravity Sewer	The existing inflow remains below the facility's existing rated capacity.	The proposed gravity feed is expected to see an additional 315 people and 21 employees.	If Stittsville PS was not decommissioned, the remaining facility capacity would be approximately 50 L/s. This implies the existing facility could only accommodate a maximum of approximately 50 L/s of growth-related flows. An opportunity was presented to convey flows from this area by the gravity feed, which benefits the City.
North Kanata Trunk Upgrade	The existing peak flow upstream of the proposed project is approximately 300 L/s.	An additional 13,200 people and 10,199 employees are expected to be serviced by the new project based on the 2046 growth projections. A large portion of this growth is Greenfield, with a total of 595 ha in new effective area.	Without the proposed upgrade, a total future peak flow of 756 L/s will be sent to the March Ridge Trunk which is already experiencing bottleneck issues in current conditions.
Tri-Township/March Ridge Collector Upgrade	The existing peak flow directly upstream of the proposed project is 491 L/s.	An additional 6,293 people and 6,528 employees are expected to be serviced by the new project based on the 2046 growth projections. A large portion of this growth is Greenfield, with a total of 288 ha in new effective area.	Without this upgrade, the City will need to continue the operation and maintenance of the "Watt's Creek" inverted siphon. The sewers upstream may be impacted significantly and result in surcharged pipes, which could lead to surface flooding in a "do nothing" scenario.

Project Name	Existing Conditions	Growth-Related Impacts	"Do-Nothing" Result
Kanata West PS Ultimate Upgrade	The existing inflow remains below the facility's existing rated capacity.	An additional 19,107 people and 6,782 employees are expected to be serviced by Kanata West PS based on the 2046 growth projections. A large portion of this growth is greenfield, with a total of 670 ha in new effective area.	With the addition of population growth, the peak flow at Kanata West PS nears 760 L/s which surpasses the existing rated capacity. As such, the "do nothing" scenario may cause a sanitary sewer overflow and possibly flooding upstream of the pumping station.
Acres PS Capacity Upgrade	The existing peak flow exceeds the existing rated capacity of the facility.	An additional 82,232 people and 35,945 employees are expected to be serviced by Acres PS based on the 2046 growth projections.	With the addition of population growth, the peak flow at Acres PS surpasses the existing rated capacity. As such, the "do nothing" scenario may cause a sanitary sewer overflow and possibly flooding upstream of the pumping station.
Manotick Main PS Capacity Upgrade	The existing inflow remains below the facility's existing rated capacity.	An additional 8,246 people and 144 employees are expected to be serviced by Manotick PS based on the 2046 growth projections. In addition to this, there are currently 2,789 residents unserviced that could be connected in the future.	With the addition of population growth and potentially the currently unserviced area, the peak flow at Manotick PS surpasses the existing rated capacity. As such, the "do nothing" scenario may cause a sanitary sewer overflow and possibly flooding upstream of the pumping station.
Conroy Road Trunk Sewer Twinning	This trunk sewer does not have existing capacity restrictions.	An additional 12,048 people and 1,538 employees are expected to be	Under existing conditions, the sewer where the proposed twinning begins is

Project Name	Existing Conditions	Growth-Related Impacts	"Do-Nothing" Result
		serviced by this upgrade by 2046. This additional growth results in an increase of 336 L/s peak flow to Leitrim PS. The majority of growth serviced by this upgrade is greenfield growth	flowing at approximately 50 percent capacity (approximately 120 L/s). With the addition of growth, future flows will exceed the theoretical capacity of this sewer. Without the proposed twinning, the 675mm existing Conroy Road sewer will surcharge and possibly result in HGL issues and/or flooding.
Leitrim PS Capacity Upgrade	The existing inflow remains below the facility's existing rated capacity.	An additional 11,977 people and 1,522 employees are expected to be serviced by Leitrim PS by 2046.	With the addition of population growth, the peak inflow significantly surpasses the existing rated capacity. As such, without the upgrade, it is expected that a sanitary sewer overflow and possibly flooding may occur upstream of the pumping station.
Rideau River Collector Twinning	There is surcharging in the Rideau River Collector under existing conditions.	An additional 7,713 people and 2,843 employees are projected in the area to be serviced by the twinning project for 2046. All growth is intensification.	The capacity of this section of the Rideau River Collector is with the existing flow already surpassing this. As such, if the project is not implemented, these pipes will surcharge as they are unable to meet capacity.
Rideau River Collector Upgrade	There is surcharging in the Rideau River Collector under	An additional 3,532 people and 55 employees are projected in the area serviced by the	Under existing conditions, the capacity of the sewer upstream of the upgrade is approximately 272 L/s,

Project Name	Existing Conditions	Growth-Related Impacts	"Do-Nothing" Result
	existing conditions.	twinning project for 2046. All growth is intensification.	with the pipe currently flowing over its capacity, resulting in surcharge.
Tremblay Road Upgrade	The existing peak flow into the Rideau River Collector at Trembley Road is 117 L/s.	An additional 110 people and 10,887 employees are projected to be serviced by the pipe on Trembley Road by 2046, with all growth being intensification.	Under existing conditions, the capacity of the pipe along Tremblay Road is approximately 194 L/s and flowing at 30 percent capacity. With the addition of growth, if the upgrade was not implemented, then the increase in flow into the Rideau River Collector may result in sewers surcharging further downstream where increased employment growth is noted.
Forest Valley PS Capacity Upgrade	The existing inflow remains below the facility's existing rated capacity.	An additional 9,195 people and 458 employees are expected to be serviced by Forest Valley PS by 2046. This additional growth results in an increase of 151 L/s peak flow to Forest Valley PS. All growth serviced by Forest Valley PS is greenfield growth, with a combined area of approximately 207 ha.	With the addition of population growth, the peak flow at Forest Valley nears 229 L/s which surpasses the existing rated capacity. As such, the "do nothing" scenario may cause a sanitary sewer overflow or possibly flooding upstream of the pumping station.
Tenth Line PS Capacity Upgrade	The existing peak flow exceeds the existing rated	An additional 23,932 people and 8,319 employees are expected to be	With the addition of growth, the pumping station sees a significant increase in flow. Even

Project Name	Existing Conditions	Growth-Related Impacts	"Do-Nothing" Result
	capacity of the facility.	serviced by Tenth Line PS 2046. This results in a peak flow of 562 L/s at Tenth Line.	with the upgrades, the peak flow into the pumping station surpasses the future rated capacity. In a "do-nothing scenario" flooding may occur.
O'Connor Flood Control Works	Existing level of service issues in existing combined sewer area inside greenbelt	Growth impacts will further worsen existing level of servicing issues.	Under the do-nothing scenario, the project is still required to improve the overall level of service for existing and future demands in the O'Connor catchment area.

7.6.3 Future Conditions Assessment with 2013 Planned Infrastructure Projects

Similar to the existing conditions hydraulic model, the 1-in-25-year and 1-in-100-year June 2014 events were the primary triggers to identify a future system capacity constraint. The hydraulic model results were reviewed to identify groupings or clusters of sewers within the same general location which showed capacity issues and served as the basis for comparison between existing system capacity issues and system capacity issues caused as a result of future growth. The following sections provide a summary of the future system capacity assessment with planned infrastructure results by geographic area.

7.6.3.1 West (Watts Creek Relief)

Under future conditions, hydraulic model results were generally consistent with existing conditions in the West Watts Creek Relief area, with no evident trunk sewer surcharging or capacity constraints. There are planned infrastructure improvements at Carp PS, Acres PS, March Ridge Trunk, Tri-Township Collector, and the North Kanata Trunk which resolve surcharging shown in the model under existing conditions.

The planned capacity expansion and forcemain twinning at Richmond PS was updated in the model; however, the future modelled flow at Richmond PS generated from the village of Richmond exceeds this planned expanded capacity. Section 7.7.2 provides details on how inflow & infiltration (I&I) investigation and reduction may be deployed in areas like the Richmond PS sewershed, to reduce future wastewater flows to within the ultimate rated capacity of the facility. Localized flow monitoring and hydraulic model updates are recommended as a starting point for I&I investigation.

Capacity expansions are required at Kanata West PS, Shea Road PS and March PS to service future population.

Flow monitoring is recommended on the East March trunk sewer, near Shirley's Brooke Drive at Sandhill Road as this trunk sewer has a shallow depth near this location.

7.6.3.2 South West (Lynwood Collector)

Under future conditions, the Southwest (Lynwood) area continued to show the same localized surcharging and capacity constraints shown under existing conditions. A cluster of sewer capacity issues was noted in the Spratt Road sanitary sewer, as a result of significant greenfield population growth with service connections at the sewer's upstream end. A large expansion area is planned to connect to the existing sewer on Spratt Road via a new gravity sewer connection, which may trigger the need for upsizing of the Spratt Road sewer to service buildout growth.

Both Mahogany PS and Manotick Main PS have the potential to exceed their interim rated capacity by 2046. Further investigation is required to consider future connections for residences which are currently privately serviced.

7.6.3.3 South East (Greens Creek/South Ottawa Tunnel)

A hydraulic constraint was identified in the South Ottawa Collector as a result of upstream growth. Additional localized surcharging issues were recognized in local sewer networks south of the South Ottawa Collector. The planned upgrade to the Conroy trunk sewer will accommodate growth in Leitrim. A new off-site trunk sewer is required to serve the Tewin expansion area.

7.6.3.4 East (Orleans-Cumberland Collector)

Under future conditions, the East Orleans-Cumberland Collector area did not show trunk sewer capacity issues. However, future flows at Tenth Line PS result in surcharging largely due to the new upstream expansion area.

The interim capacity at the Forest Valley PS is projected to be exceeded as a result of growth within its catchment area.

7.6.3.5 Central West (West Nepean Collector)

Under future conditions, there would be a general worsening of hydraulic performance in the Central West area inside the greenbelt. The surcharging within the West Nepean Collector trunk sewer would be made worse as a result of significant growth in the upstream sewershed. Hydraulic capacity constraints within the five main neighbourhood areas (Queensway Terrace North/South, Carling Avenue, Braemar Park/Bel Air Heights/Copeland Park Neighbourhoods, Cityview/Skyline/Fisher Heights & Borden Farm/Fisher Glen Neighbourhoods, and Qualicum-Redwood Park/Bayshore-Belltown Neighbourhoods) would remain and become worse as a result of intensification growth inside the greenbelt, with some clusters of maintenance holes showing HGL reaching a depth less than 2.4m from ground.

The capacity at the Crystal Beach and Woodroffe Diversion PSs has been exceeded, indicating that capacity upgrades would be required to alleviate the flow to the West Nepean Collector. Capacity constraints in the collectors servicing intensification hubs along Merivale Road and within the Pinecrest trunk sewer catchment need to be addressed.

Any infrastructure projects implemented with the aim of improving hydraulic conditions in the West Nepean Collector (WNC) to support growth while managing the sewer's already problematic hydraulic grade line (HGL) would have significant capital costs and technical complexity. Several alternative sewer servicing strategies were identified for evaluation, including upsizing or twinning the existing sewer, extending the Combined Storage Sewer Tunnel, and flow diversion opportunities which could reduce peak flows in the West Nepean Collector by redirecting them to the Lynwood Collector, which has significantly greater available capacity. Further information about the explored options and the recommended solutions are provided in Section 7.8.4.

In addition to the recommended diversions, it is recommended that a long-term improvement be considered for the West Nepean Collector, to provide redundancy and operational flexibility in this critical infrastructure. However, rather than being primarily triggered by population growth, these upgrades should be coordinated with the West Nepean Collector's asset renewal cycle. Further study would be required to assess the need and scope of such a project.

7.6.3.6 Central East (Interceptor Outfall Collector - IOC)

With the addition of 2046 population growth, existing hydraulic issues in the Central East area inside the Greenbelt would generally be made worse. Additional surcharging was noted in both the Interceptor Outfall Sewer and the Green Creek Collector North trunk sewers. Conversely, surcharging issues in the Rideau River Collector were shown to be significantly improved as a result of future infrastructure upgrades identified in the 2013 IMP.

7.6.3.7 Future Conditions Pumping Station Capacity Assessment

The future conditions hydraulic model results were reviewed to compare future rated capacity, with peak flows at each key pumping station in the City's wastewater collection system. The results are summarized in Table 7-6:

Table 7-6: Pumping Station Capacity Assessment (Future Conditions with Planned Infrastructure Projects)

Pumping Station	Future Rated Capacity	1-in-25-year Event		1-in-100-year Event	
		Peak Flow (L/s)	Remaining Capacity[1] (L/s)	Peak Flow (L/s)	Remaining Capacity[1] (L/s)
Acres	4,600	3,630	968	3,850	750
Briar Ridge	175	88	87	90	85

Pumping Station	Future Rated Capacity	1-in-25-year Event		1-in-100-year Event	
		Peak Flow (L/s)	Remaining Capacity[1] (L/s)	Peak Flow (L/s)	Remaining Capacity[1] (L/s)
Carp	95	64	31	71	24
Crystal Beach	280	580	(300)	620	(340)
Forest Valley	370	222	148	229	141
Hazeldean	1,225	865	360	944	281
Hemlock	150	280	(130)	280	(130)
Jackson Trails	121	52	69	56	65
Kanata West	1,250	690	560	760	490
Leitrim	361	335	26	348	13
Mahogany	170	138	32	138	32
Manotick	322	240	82	246	76
March	586	239	347	247	339
Munster	30	33	(3)	39	(9)
RCAF	32.5	8	24.5	10	22.5
Richmond	350	395	(45)	407	(57)
Shea Road	84	79	5	80	4
Signature Ridge	358	190	168	190	168
Stittsville	-	Decommissioned			
Tartan	210	65	145	73	137
Tenth	425	545	(120)	565	(140)
Woodroffe	420	768	(348)	900	(480)

7.7 Wet Weather Flow Management Initiatives

The following section discusses initiatives such as wet weather flow management and inflow & infiltration reduction initiatives are opportunities to further optimize capacity within the collection system, provide additional resiliency for future system demands, and reduce the impacts of combined sewer overflows to the environment.

7.7.1 Flow Monitoring

Flow monitoring is a highly effective strategy for collecting wastewater flow data and provides insight into the component wastewater flows by individual catchment (dry and wet weather flow responses). Flow monitor data can indicate locations of existing surcharging issues, and the data can be input into the hydraulic model and used to update the model calibration and improve accuracy.

The City currently has level and flow monitor devices installed throughout its wastewater collection system. It is recommended that the City continue with this practice through the creation of a dynamic "Level Monitoring Program", deployed throughout the City at key critical locations in the sewer network where surcharging and HGL issues are prevalent. These level sensors provide critical depth information to engineering and operations staff to reduce reaction times during wet weather events and other issues like mechanical failure at pumping stations.

As part of the Wastewater Program Development for Intensification, the City's entire wastewater collection system was assessed and a total of 138 temporary flow monitoring sites are recommended. The purpose is to fully discretize the system into smaller catchment areas based on sewer locations and drainage characteristics. The 138 sites should each have a flow monitor installed for a period sufficient to capture a minimum of 4 significant rainfall events. This is needed to support detailed wet weather flow analysis and to provide adequate flow data to calibrate the hydraulic model at each site.

Additionally, the Wastewater Master Plan identified 6 trunk sewer sites which would benefit from permanent level and flow monitoring.

Proposed flow monitor locations to support capital projects and intensification program are shown in the Wastewater Master Plan.

7.7.2 Extraneous Flow Removal

Extraneous flow is defined as rainwater which enters the wastewater system. There are many alternatives to extraneous flow removal, each with varying efficacy and cost. Recommended approaches to extraneous flow identification and removal include the following:

- **Public Education & Survey*:*** Public education and surveying can be an effective tool for improving public awareness for efficient water usage, property connections and flood protection. Approaches include door to door visits, mailed newsletters, information on the municipality's website, school education programs, community event presence and social marketing campaigns. This approach is a relatively easy way to promote strategies for residents and business owners and has a relatively low cost for implementation compared to other initiatives. The City has existing educational content hosted on its website, including the Water Efficiency Strategy, information on sewer backups and basement flooding, and a Wastewater Education site for information on Fats, Oils, and Grease (FOG) disposal and other guidelines. This material should continue to be promoted to foster public engagement and participation.

- **Catchment-Specific Hydraulic Model Update:** Detailed wet weather flow analysis for the collected flow monitoring data will support the identification of catchments with high rates of inflow and infiltration. The hydraulic model can be updated on a catchment-by-catchment basis, including topology and data updates (sewer diameters, invert elevations, slopes, etc.) and model calibration updates. Catchment-specific hydraulic model updates will help the City to efficiently increase model accuracy and improve predictions of hydraulic capacity issues.
- **Field Inspections:** Field inspections provide an opportunity to fill data gaps which can be used to enhance system understanding and create more accurate hydraulic models. Inspections can be prioritized, for example, to focus on catchments which have been assessed as a high inflow & infiltration contributors. Common inspections include maintenance hole chamber inspections and closed-circuit television (CCTV) sewer and lateral inspections.
- **Sewer and Lateral Repair:** Improved data collection (flow monitoring, field inspections) will help inform the City's State of Good Repair program for asset renewal. The repair or replacement of sewer assets with operational and structural defects can significantly reduce the amount of extraneous flow entering the sewer system.
- **Smoke & Dye Testing:** Smoke and dye testing are effective and economical methods of investigating the likeliest sources of I&I within the wastewater collection system. These testing methods should be targeted to areas which are identified as having a high likelihood of I&I contributors (through flow monitoring and CCTV inspection).
- **Private Connection Removal:** Removing private connections to the sanitary sewer system like downspouts (roof leaders) and foundation drains can be a highly effective approach to reducing private-side I&I contributions. Public education is a key component of private connection investigation and removal, as this strategy requires the participation of individual customers.

7.7.2.1 Inflow and Infiltration Reduction Targets

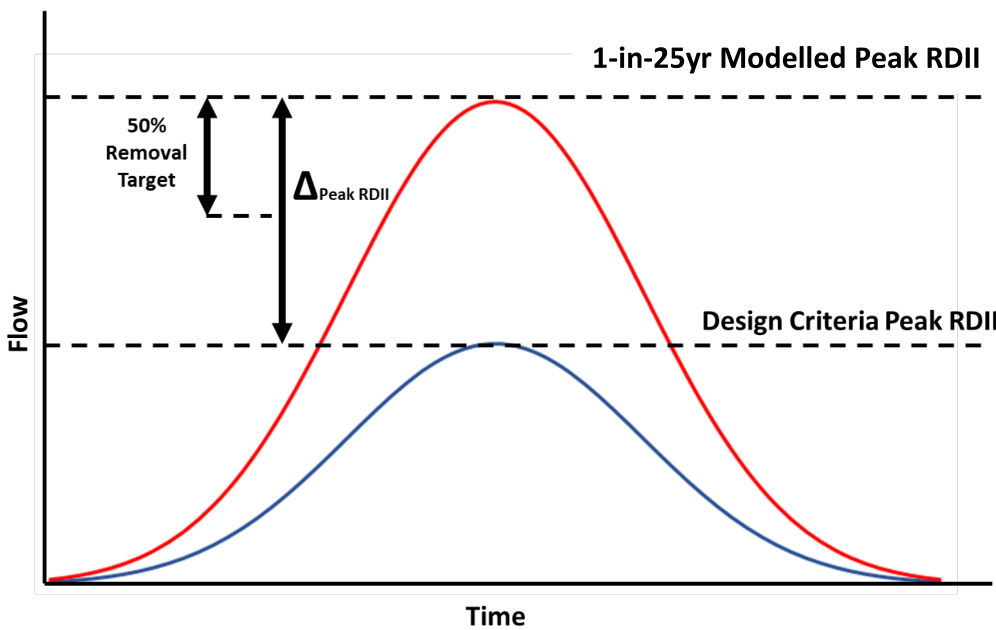
It is difficult to accurately identify the amount of rainfall-derived inflow & infiltration (RDII) that can be removed from any given catchment. However, for the purposes of cost estimation and Master Plan-level infrastructure planning, it is helpful to identify a reasonable and achievable amount of RDII that can be removed for a given estimated cost. The following approach is recommended:

1. Priority areas targeted for RDII removal would be identified primarily through flow monitoring.
2. The design RDII rate would be compared to the modelled RDII rate.

   a. The design RDII rate for a given catchment would be determined using the estimated contributing area of that catchment and the City's design criteria.
   b. The modelled RDII rate would be determined using the wastewater hydraulic model, calibrated using available flow monitor and rain gauge data. The peak flow would be derived from an established design rainfall event. For the City of Ottawa, a 1-in-25-year design event is recommended.
3. The modelled and design RDII rates would be compared to estimate the amount of RDII that could be reasonably targeted for removal from the system. For catchments where the modelled RDII rate is greater than design criteria, the difference between the two peaks would be the total amount of RDII eligible for removal (overage above the design criteria rate). Based on industry practice a removal of 50% of this amount is generally achievable for reasonable cost.
4. The City will ultimately determine a reasonable amount of the peak RDII overage which could feasibly be removed from the system using methods including downspout disconnection, foundation drain removal, sewer and maintenance hole lining, and the identification and resolution of storm sewer cross-connections.

The process to estimate a reasonable RDII removal target is shown graphically in Figure 7-3.

Figure 7-3: Inflow & infiltration Removal Target Estimation



It is recommended that the City initiates its extraneous flow removal program through one or more pilot I&I reduction projects in key high priority areas of the collection system (e.g., in the West Nepean Collector and Rideau River Collector catchment areas). The Pinecrest area has been identified as a viable candidate for detailed I&I investigation, not only to reduce peak flows entering the West Nepean Collector, but also to manage sewer capacity in the Pinecrest trunk sewer itself.

7.7.3 Combined Sewage Overflow Management

The City of Ottawa's wastewater collection system includes combined sewers in some areas inside the Greenbelt. These sewers discharge to Combined Sewer Overflow (CSO) facilities to provide hydraulic relief to the upstream sewer network, protect residents and business owners from the risk of basement and surface flooding under extreme wet weather conditions, and protect the Ottawa River from contamination. Monitoring the performance of the Combined Storage Sewer Tunnel, which became operational in the fall of 2020, is recommended to determine if additional measures are required to support intensification within the Greenbelt.

7.8 Proposed Wastewater Infrastructure Projects

This section identifies the individual wastewater infrastructure projects required for growth. Information on the individual projects is found in Appendix F, Wastewater Infrastructure Project Sheets. Additional supporting analyses and information are provided below. Appendix A, Schedule 9 shows the 2024 Wastewater Master Plan capital projects. Project costs are tabulated in Chapter 15.

Based on the future conditions assessment of the City's wastewater collection system, key wastewater infrastructure projects were identified with the objective of providing adequate wastewater servicing to service the 2046 population growth, while maintaining the target level of service for the existing serviced population.

Due to the iterative nature of the infrastructure master planning process, key projects identified in the previous 2013 Wastewater Master Plan have been carried forward into the 2024 Wastewater Master Plan. Several of these capital projects have already been constructed or are currently under construction. Other new wastewater infrastructure projects have been identified for the first time in the 2024 Wastewater Master Plan, based on the latest hydraulic modelling tools and the most up-to-date planning projections for future growth.

7.8.1 Consideration for Sizing of New Planned Projects

The City recognized the need to consider sizing requirements for identified capital projects which that are intended to provide service to population growth beyond the 2046 growth horizon (2101). The two main considerations that have been accounted for in terms of oversizing requirements to meet long-term infrastructure needs are: 2101 population growth, and an increased wet weather flow allowance for areas in the system which that currently show inflow & infiltration (I&I) rates which that are below design criteria.

7.8.2 Active and Completed Projects From 2013 IMP

Since the completion of the 2013 Wastewater Master Plan, the following major infrastructure improvement projects have been completed or are under construction, as shown in Table 7-7.

Table 7-7: Active and Completed Projects From 2013 IMP

Recently Constructed Capital Projects	Capital Projects Under Construction or Detailed Design
• Combined Sewage Storage Tunnel • Kanata West Pumping Station (Interim Capacity) • Stittsville Interceptor Trunk Sewer • South Nepean Collector Phase 2, Phase 3, and Extension • Tri-Township/March Ridge Collector Replacement • March Pump Station Conversion (Interim Capacity) • North Kanata Trunk Phase 2 • Kanata West Sewers	• Briar Ridge PS Upgrade • Richmond PS Upgrade and Forcemain Twinning Phase 2 • Tenth Line PS Capacity Upgrade • Acres PS Interim Capacity Upgrade • Leitrim PS Capacity Upgrade • Manotick Main PS Interim Capacity Upgrade • Carp PS Interim Capacity Upgrade

7.8.3 Modifications to 2013 Planned Projects

Some of the planned projects identified in the 2013 Wastewater Master Plan required modifications based on updated planning projection estimates as well as revisions made to the hydraulic models since the 2013 Master Plan. These projects and the required changes are summarized below in Table 7-8 and Table 7-9.

Table 7-8: Modifications to 2013 Planned Projects – Wastewater – Collector Sewer Upgrades

Project Name	Description	Timing
Rideau River Collector Twinning	Twinning the Rideau River Collector by 2.4 km was scaled back to 1.2 km following the identification of a new project to redirect the upper Rideau River Collector at the Airport Parkway to the South Ottawa Collector (refer to Section 7.8.4.3). This project is needed to provide capacity in the Tremblay, Hurdman, and St Laurent intensification areas.	2034-2039
Rideau River Collector Upgrade	This project was replaced by the Airport Parkway Diversion Sewer (refer to Section 7.8.4.3)	N/A

Project Name	Description	Timing
Trembley Sewer	Based on the 2046 growth projections, this project, initially intended to support intensification, is no longer required. The necessity for this project should be re-evaluated as part of future servicing studies for the Hurdman, Tremblay, and St. Laurent Transit Oriented Development Areas.	Timing and project scope to be determined in future servicing study
Conroy Road Trunk Sewer Twinning	Twinning the Conroy trunk sewer (1 km at 675mm diameter) was replaced with the Conroy Trunk Sewer Upgrade Project (refer to section 7.8.4.1)	2029-2034
O'Connor Flood Control Works	Modifications to the proposed works were made to effectively manage wet weather flows in a combined sewer area in the downtown core.	2034-2039

Table 7-9: Modifications to 2013 Planned Projects – Wastewater – Pumping Station Upgrades

Project Name	Description	Timing
Carp PS Capacity Upgrade and Forcemain	The capacity of Carp PS should be increased from its interim capacity of 75 L/s to its ultimate planned capacity of 95 L/s. New pumps and a second forcemain will be required with a total length of 9.5 kilometers.	2029-2034
March Pump Station Capacity Upgrade	The capacity of March PS should be increased to its ultimate planned capacity of 586 L/s to accommodate growth in Kanata North.	2039-2044
Signature Ridge Forcemain	A second 400mm forcemain will be required with a total length of 800 meters. Some modifications may be required to the existing forcemain discharge chamber at the outlet of the Signature Ridge PS forcemains.	2029-2034
Stittsville PS Decommissioning and Gravity Sewer	Stittsville PS is planned for decommissioning and will be replaced with a new gravity sewer from the decommissioned Stittsville PS site to the Fernbank Collector trunk sewer.	2024-2029
Richmond Forcemain Twinning (Phase 4)	The capacity of Richmond PS should be increased to its ultimate planned capacity of 350 L/s along with the construction of a second twinned forcemain (6.1 kilometres) beginning at Fallowfield Road and terminating at the intersection of Hazeldean Road and Eagleson Road. However, it was noted through the	2024-2029

Project Name	Description	Timing
	future conditions assessment that the ultimate capacity of Richmond PS will not be sufficient to convey 2046 growth flow. It is further recommended that inflow & infiltration investigation and extraneous flow reduction be undertaken in the village of Richmond to remove excessive wet weather flows from the sewer system upstream of the facility.	
Acres PS Risk Mitigation, Capacity Upgrade, and Overflow (Phases 2, 3 and 4)	Phase 2 of the Acres PS project involves mitigating risk at the facility, while Phase 3 involves increasing the station's capacity to 4,600 l/s. Phase 4 will involve the upsizing of the facility's overflow line.	Phase 2: 2024-2029 Phase 3: 2029-2034 Phase 4: 2034-2039
Kanata West PS Capacity Upgrade	The capacity of Kanata West PS should be increased to its ultimate capacity of 1250 L/s to accommodate 2046 growth demands.	2029-2034
Manotick Main PS Capacity Upgrade (Phases 1 and 2)	The capacity of Manotick Main PS should be increased to its interim capacity of 175 L/s to accommodate 2046 growth demands. An expansion beyond the facility's interim capacity would be required to provide the necessary capacity to provide wastewater servicing to existing areas currently on septic systems and intensification.	Phase 1: 2024-2029 Phase 2: 2044-2046
Forest Valley PS Capacity Upgrade (Phases 1 and 2)	The capacity of Forest Valley PS should be increased by approximately 100 L/s to the facility's interim capacity (Phase 1) of 240 L/s, to support 2046 growth demands and existing servicing needs. An additional infrastructure project was identified at Forest Valley PS to expand capacity of the facility to 385 L/s (Phase 2), based on the pumping station's design brief; however specific requirements of this project hinges on growth flows surpassing the interim capacity of the station.	Phase 1: 2029-2034 Phase 2: 2044-2046

7.8.4 New Projects

In addition to those projects previously identified in the 2013 Wastewater Master Plan (and in several cases modified), newly identified projects have been proposed which aim to provide the necessary servicing capacity for 2046 growth demands, with a focus on optimizing the capacity of the existing system and avoiding individual solutions which rely solely on a single infrastructure component and restrict future servicing flexibility.

7.8.4.1 Collector Sewer Upgrades

Table 7-10 summarizes the upgrades that are proposed for collector sewers.

Table 7-10: Collector Sewer Upgrade Projects

Project Name	Description	Timing
Penfield Trunk Sewer Upgrade	The Penfield Trunk upgrade consists of approximately 1 km of sewer upsized from 675mm to 900mm diameter. The project is required to divert Signature Ridge PS flows from Kanata Lakes to the Main Street and the upgraded Penfield Trunk sewer and to support growth in the Kanata Town Centre intensification hub.	2029-2034
Kanata West Sewer (Diversion and Oversizing)	Two new trunk sewers will be required to service intensification in the Kanata West area, with a total length of 1.1 km (300 metres at 450mm, and 800 metres oversized at 675mm).	2029-2034
Richmond King Street Sewer Upgrade (Phase 4a)	The Richmond King Street Sewer Upgrade (Phase 4a) will require approximately 730 metres of linear upgrades (diameter ranging from 525mm to 600mm) to service development in the southeast area of Richmond.	2024-2029
Spratt Road Trunk Sewer Upgrade	The Spratt Road trunk sewer is a relatively new trunk sewer that is not currently planned for renewal. Upsizing the existing 675mm sewer to a diameter of 750mm and upsizing the existing 750mm sewer to a diameter of 900mm is proposed in the Spratt Road sewer to accommodate significant future growth flow. Based on 2046 growth projections, the existing 750mm sewer only needs to be upsized to a diameter of 825mm; however, this sewer will be oversized to 900mm to provide capacity for post-period growth. The increase in cost from the 825mm and 900mm sizing difference will be allocated to post-period capacity and is not eligible for development charge funding within the current planning horizon.	2029-2034
Conroy Trunk Sewer Upgrade (Phases 1 and 2)	A project was previously identified in the 2013 Wastewater Master Plan to twin the Conroy Road Trunk sewer, to mitigate approximately 2 kilometre of surcharging from Davidson Road to Braddish Street. This project has been removed and replaced in the 2024	2029-2034

Project Name	Description	Timing
	Wastewater Master Plan with the Conroy Trunk Sewer Upgrade Phase 1 and Phase 2 projects. Based on 2046 growth projections, the existing 750mm sewer only needs to be upsized to a diameter of 825mm; however, this sewer will be oversized to 900mm to provide capacity for post-period growth. The increase in cost from the 825mm and 900mm sizing difference will be allocated to post-period capacity and is not eligible for development charge funding within the current planning horizon.	
Walkley Sewer Upgrade	A sewer upgrade is required on Walkley (370 metres upsized to 600mm diameter) to accommodate future intensification.	2034-2039
Merivale South Sewer Upgrade and Extension	Extension of the Merivale Road sewer north to Baseline Road (600 m at 600mm) and pipe upgrade from Cleto Ave to Family Brown Lane (1000 metres at 600mm diameter) will address significant intensification development pressures along Merivale Road, as well as within the Baseline-Merivale intensification hub.	2024-2029
Pinecrest Trunk Sewer Upgrade	The Pinecrest Trunk sewer will service two high-priority upstream intensification hubs (Lincoln Fields and Pinecrest-Queensview). The trunk is operating at full capacity under existing conditions. Therefore, approximately 1.3 kilometres of upsizing to 1050mm diameter is required in the Pinecrest Trunk from Henley Street to Richmond Road.	2029-2034
Pinecrest Trunk Flow Reduction	To minimize the need for further upgrades in the Pinecrest trunk sanitary sewer, an inflow & infiltration (I&I) reduction project is recommended in the Pinecrest and Queensview neighbourhoods. Additionally, there is substantial planned intensification within the Lincoln Fields and Pinecrest-Queensway intensification hubs. I&I reduction would help to offset increased wastewater flows from these new developments. An I&I reduction project will be beneficial for the West Nepean Collector by reducing extraneous wet weather flows that are conveyed to the WNC, which has extremely limited capacity. Depending on the efficacy of this I&I reduction program, other options may be explored in the future such as a	2024-2029

Project Name	Description	Timing
	new diversion pump station to redirect flow from the Pinecrest area south to the Lynwood Collector	
Merivale North Trunk Diversion Sewer, Replacement, and Oversizing	An opportunity was identified to divert additional flow to the Merivale North Sewer and away from the Cave Creek Collector along Carling Avenue. The diversion would eliminate the need for upgrades along the Cave Creek Collector. The existing Merivale North Sewer is due for renewal. Therefore, the 700 metres of required replacement sewers will be oversized to 750mm on renewal to accommodate upstream intensification growth.	2024-2029

7.8.4.2 Pumping Station Upgrades

Table 7-11 summarizes the upgrades that are proposed for sewage pumping stations.

Table 7-11: New Pumping Station Upgrade Projects

Project Name	Description	Timing
Shea Road PS Capacity Upgrade and Forcemain	To accommodate the projected growth up to 2046, the capacity of Shea Road PS will be increased to 110 L/s.	2029-2034
Tenth Line PS Capacity Upgrade and Forcemain	The capacity of Tenth Line PS will be increased from 422 L/s to 581 L/s, to support 2046 growth demands and existing servicing needs. This project will entail the installation of larger pumps and upsizing the existing 300mm forcemain to 400mm diameter.	2034-2039
Mahogany PS Capacity Upgrade	The capacity of Mahogany PS will be increased by approximately 121 L/s to the facility's ultimate capacity of 166 L/s, to support growth in South Manotick.	2024-2029

7.8.4.3 Major Flow Diversions

As introduced in Section 7.6.3.5, alternative solutions to upsizing and/or twinning of the existing West Nepean Collector have been identified, whereby major flow diversions could be constructed at key locations within the sewer network to divert flow away from the West Nepean Collector. Through these diversions, a large amount of flow would be diverted south toward the Lynwood Collector, which has substantially greater available capacity than the West Nepean Collector and Interceptor Sewer.

The aim of these diversions is to maintain the status quo for flow conditions within the West Nepean Collector in the future. When implemented, the flow diversions would offset the additional future flow associated with intensification. The key flow diversion locations identified by the City are shown in Table 7-12 below.

Table 7-12: Key Flow Diversion Locations

Project Name	Description	Timing
Prince of Wales Diversion Sewer	The Borden Side Road Collector drains into the Mooney's Bay Collector on Prince of Wales Drive before flowing into the West Nepean Collector. A diversion has been proposed on Prince of Wales Drive to direct flows most upstream of the Borden Side Road Collector south into the Lynwood Collector. The hydraulic model showed that for the 1-in-25-year June 2014 rainfall event, the diversion would convey approximately 382 L/s away from the Mooney's Bay Collector trunk sewer, and ultimately away from the West Nepean Collector. The recommended diversion trunk spans approximately 700m with a diameter of 750mm.	2039-2044
Airport Parkway Diversion Sewer	The Upper Rideau River Collector flows into the Outfall Sewer. A diversion has been proposed to direct flows from the Upper Rideau River Collector at Airport Parkway into the South Ottawa Collector. The hydraulic model showed that for the 1-in-25-year June 2014 rainfall event, the Airport Parkway diversion would divert approximately 309 L/s away from the Rideau River Collector trunk sewer. The recommended diversion trunk spans approximately 1.4 km with a diameter of 750mm.	2024-2029
Woodroffe Diversion PS Upgrade and Forcemain	Woodroffe PS is located downstream of a diversion chamber which can convey incoming flow either toward the Woodroffe Collector or toward Woodroffe PS. Woodroffe PS pumps flow south to the Lynwood Collector, which eventually reaches the South Ottawa Collector. The proposed upgrade to the Woodroffe PS aims to increase the amount of flow conveyed south toward the Lynwood Collector, thus reducing the amount of flow from Woodroffe PS that ultimately arrives at the West Nepean Collector via the Woodroffe Collector. It is recommended that the capacity of Woodroffe PS be increased to 750 L/s, on the basis that this is the capacity required to convey the modelled peak flow for the 1-in-25-year June 2014 rainfall event. As a result, pumping this amount of flow toward the Lynwood Collector would have a	2029-2034

Project Name	Description	Timing
	notable benefit for the Woodroffe and West Nepean Collectors in terms of lowered HGL's downstream of the diversion chamber.	
Crystal Beach Diversion PS Upgrade and Forcemain Phases 1 and 2	Under current conditions, Crystal Beach PS conveys all pumped flow to Acres PS. This flow is then conveyed to the Lynwood Collector and ultimately to the South Ottawa Collector. The proposed upgrade and diversion aim to increase pumping capacity at Crystal Beach PS and construct a second forcemain from Crystal Beach PS to Acres PS. It is recommended that the capacity of Crystal Beach PS be increased to 560 L/s, on the basis that this is the capacity required to convey the modelled peak flow for the 1-in-25-year rainfall event. As a result, pumping this increased amount of flow to the Lynwood Collector via Acres PS (diverted away from the West Nepean Collector) would have a notable benefit for the West Nepean Collector in terms of lowered HGL's downstream of the diversion gate. Approximately 680 metres of new forcemain would be required with a diameter of 450mm. Acres PS is the interim outlet location for the Crystal Beach PS forcemain (Phase 1). As Acres PS approaches its capacity due to flows from the West Urban Community, there is a requirement to change the ultimate outlet for the Crystal Beach PS forcemain to the Lynwood Collector (Phase 2), bypassing Acres PS. This ultimate solution would require an extension of both forcemains (total length of approximately 2.2 kilometres) including a tunnelled portion to cross under Highway 417.	Phase 1: 2029-2034 Phase 2: 2039-2044

7.9 Infrastructure Resiliency Scenario

Further future model scenarios were used to assess the collection system and the ability of the proposed capital projects shown in Section 7.8 to handle extreme flow conditions beyond those associated with the 2046 planning scenario. Two main additional stresses were accounted for when assessing capital projects' resiliency: the climate change stress event (Hurricane Frances), and an increase in Dry Weather Flows across growth areas.

As part of the infrastructure resiliency scenario, the hydraulic model was used to test sewer system sensitivity to a 20% increase in dry weather flows in growth areas. The purpose of increasing dry weather flows across growth areas is to represent a conservative estimate of wastewater generation, and to account for possible spatial uncertainty in future serviced population estimates.

The 2046 future conditions hydraulic model was also run under an extreme wet weather event representing the effects of climate change (Hurricane Frances). This was done to assess system resiliency and support the identification of areas within the system that would be at an elevated risk of basement and/or surface flooding.

Model results for the infrastructure resiliency scenario are summarized at key collector trunk sewer locations, compared to model results from the 1-in-100-year June 2014 future conditions scenario. It should be noted that both the 1-in-100-year June 2014 future conditions scenario as well as the infrastructure resiliency scenario are inclusive of all projects required to support population growth to 2046 (both previously planned and newly identified projects). These model results are summarized in Table 7-13:

Table 7-13: Comparison of 1-in-100-Year and Infrastructure Resiliency Model Results (Collectors)

Collectors	Pipe Diameter (mm)	Peak Flow (L/s)		Surcharge State	
		1-in-100-year (Future Conditions)	Hurricane Frances and 20% Increase in DWF (Future Conditions)	1-in-100-year (Future Conditions)	Hurricane Frances and 20% Increase in DWF (Future Conditions)
Marchwood	900	525.0	636.4	No Surcharge	No Surcharge
Marchridge	900	473.2	491.8	No Surcharge	No Surcharge
Glencairn	1200	2,169.5	2,403.2	No Surcharge	No Surcharge
Penfield	675	404.9	420.7	No Surcharge	No Surcharge
Riverside Drive	1200	907.1	1,018.8	No Surcharge	No Surcharge
South Nepean	1350	1,068.9	1,189.3	No Surcharge	No Surcharge
West Rideau	1650	2,443.5	2,717.4	No Surcharge	No Surcharge
Lynwood	2700	8,853.9	9,153.4	No Surcharge	Surcharge
Greens Creek South	1350	1,290.0	1,482.1	Surcharge	Surcharge
South Ottawa	2700	9,214.1	10,123.7	Surcharge	Surcharge
South Ottawa Tunnel	3000	8,524.8	9,818.7	No Surcharge	No Surcharge
Forest Valley	900	465.5	529.8	No Surcharge	No Surcharge

Collectors	Pipe Diameter (mm)	Peak Flow (L/s)		Surcharge State	
		1-in-100-year (Future Conditions)	Hurricane Frances and 20% Increase in DWF (Future Conditions)	1-in-100-year (Future Conditions)	Hurricane Frances and 20% Increase in DWF (Future Conditions)
Orleans	900	400.8	488.4	No Surcharge	No Surcharge
Cumberland	900	506.7	542.5	No Surcharge	Surcharge
Gloucester-Cumberland	1200	722.9	834.8	No Surcharge	No Surcharge
Ottawa Sub-trunk	900	345.9	388.7	No Surcharge	No Surcharge
Graham Collector	900	633.1	503.9	No Surcharge	Surcharge
Pinecrest	900	1,216.0	1,404.8	Surcharge	Surcharge
Woodroffe	900	1,311.2	1,681.5	Surcharge	Surcharge
Cave Creek	1800	1,863.3	2,212.1	No Surcharge	No Surcharge
Mooney's Bay	1050	1,314.1	1,819.7	Surcharge	Surcharge
WNC	1950	4,417.4	4,708.7	Surcharge	Surcharge
RCI	1950	12,471.4	12,731.0	Surcharge	Surcharge
Rideau River	2100	6,821.9	8,425.8	Surcharge	Surcharge
Rideau River Interceptor	1500	2,125.4	1,911.9	Surcharge	Surcharge
Montreal Road	750	971.2	1,056.0	Surcharge	Surcharge
Cyrville	675	203.0	255.6	No Surcharge	No Surcharge
Maxim Relief	1200	295.7	336.0	No Surcharge	No Surcharge

The model results for both 1-in-100-year and infrastructure resiliency scenarios were reported at the City’s key pumping station facilities, as shown in Table 7-14:

Table 7-14: Comparison of 1-in-100-Year and Infrastructure Resiliency Model Results (Pump Stations)

Pumping Station	Future Rated Capacity	1-in-100-Year (Future Conditions)		Hurricane Frances and 20% Increase in DWF (Future Conditions)	
		Peak Flow	Remaining Capacity[1]	Peak Flow	Remaining Capacity[1]
	L/s	*L/s*	*L/s*	*L/s*	*L/s*
Acres	4,600	3,568	1032	4,103	497
Briarridge	175	90	85	99	76
Carp	95	71	24	74	21
Crystal Beach	560	620	(60)	690	(130)
Forest Valley	370	229	141	260	110
Hazeldean	1,225	944	281	1,034	191
Hemlock	150	280	(130)	280	(130)
Jackson Trails	121	56	65	62	59
Kanata West	1,250	760	490	833	417
Leitrim	361	348	13	377	(16)
Mahogany	170	138	32	155	15
Manotick	322	246	76	270	52
March	586	247	339	279	307
Munster	30	39	(9)	43	(13)
RCAF	32.5	10	22.5	12	20.5
Richmond	350	407	(57)	415	(65)
Shea Road	110	80	30	91	19
Signature Ridge	358	190	168	226	132
Stittsville	-	Decommissioned			
Tartan	210	73	137	78	132
Tenth	581	516	65	615	(34)
Woodroffe	750	887	(137)	1040	(290)

[1] Pumping stations experiencing a capacity deficit can potentially result in basement flooding and untreated sewage being discharged into the environment.

As expected, there is an approximately 20% increase in peak flows associated with the larger Hurricane Frances event as well as the increased dry weather sanitary flows. The projects identified in Section 7.8 will confirm that growth will not reduce the level of service in existing areas. Collectors identified as "surcharged" in Table 7-13 do not necessary indicate that flooding will occur, as many collectors are positioned well below ground level and often surcharge during infrequent, extreme rainfall events. Pump stations experiencing flows beyond capacity are also equipped with overflow measures designed to protect basements from potential flooding.

The recommended strategy for mitigating climate change induced increases in wet weather flows involves identifying and removing inflow and infiltration, which is discussed in Section 7.7.2. Details on modelling results for the resiliency scenario can be found in the Wastewater Master Plan.

7.9.1 Mitigation and Adaptation Opportunities

Additional adaptation strategies to manage system risks and increase system resiliency include:

- Inflow and infiltration (I&I) reduction programming is a non-infrastructure solution that reduces flows entering the wastewater system, reduces the risk of basement flooding, and reduces sewage overflows to the environment as extreme rain events become more frequent. Recommend use of flow monitors and hydraulic models to identify areas of the system that show response to rainfall exceeding the City's I&I allowance of 0.33 l/s/ha to assist with the identification of opportunities to implement I&I reduction programs.
- The projection of freeze-thaw cycling in Ottawa from the NCR climate change projections is increasing. Local sewers depths, materials, and design should be considered with changes to the frost line or cycle frequency.
- More hot days are identified in the City's climate projections. This may require consideration of Hydrogen Sulfide issues and a requirement for increased odour controls.
- In 2018 the City increased its I&I design criteria to combat the impact of large rainfall events that are expected to be more likely as a result of climate change. An update to the infrastructure Design Criteria shall be considered, as an effective way to adapt to Climate Change impacts.

Strategies to mitigate emissions are incorporated at a project-by-project basis in the following ways:

- Pump station decommissioning through gravity sewer alternatives to reduce energy consumption.
- Choose gravity solutions where possible, not only from cost management perspective but also for asset lifecycle greenhouse gas emissions.
- Explore opportunities to reduce emissions from community heating using wastewater by:
  - Enabling Wastewater Energy Transfer systems connections to the wastewater system in various capacities (i.e. municipal, private).

- Consider opportunities to support district energy nodes when upgrades to municipal infrastructure are carried out within municipal rights-of-way, including potential access to geothermal energy sources.
- Estimate greenhouse gas for each infrastructure alternative using construction greenhouse gas emissions calculator.
- Include a policy recommendation for City contracts to consider lower greenhouse gas construction methods.

PART IV – TEWIN NEW COMMUNITY

8 Infrastructure Serving Tewin

8.1 Overview

At approximately 445 ha, Tewin is the largest urban expansion area approved in the Official Plan. It is unique in that it is not contiguous to the existing urban area and many kilometers of trunk infrastructure will be needed to service the development. Given that extensive adjacent lands are free of agricultural, environmental and other land use constraints, particularly to the south and west, there is also significant potential for future expansion of the approved area. Considering the scale of investment required for this new community, it is important that infrastructure be sized with potential growth beyond 2046 in mind.

This section provides a summary of the land use and infrastructure planning process for Tewin, the recommended off-site backbone water and sanitary infrastructure needed to service the development, and implementation details, including phasing and financing.

8.1.1 Land Use and Infrastructure Planning Framework

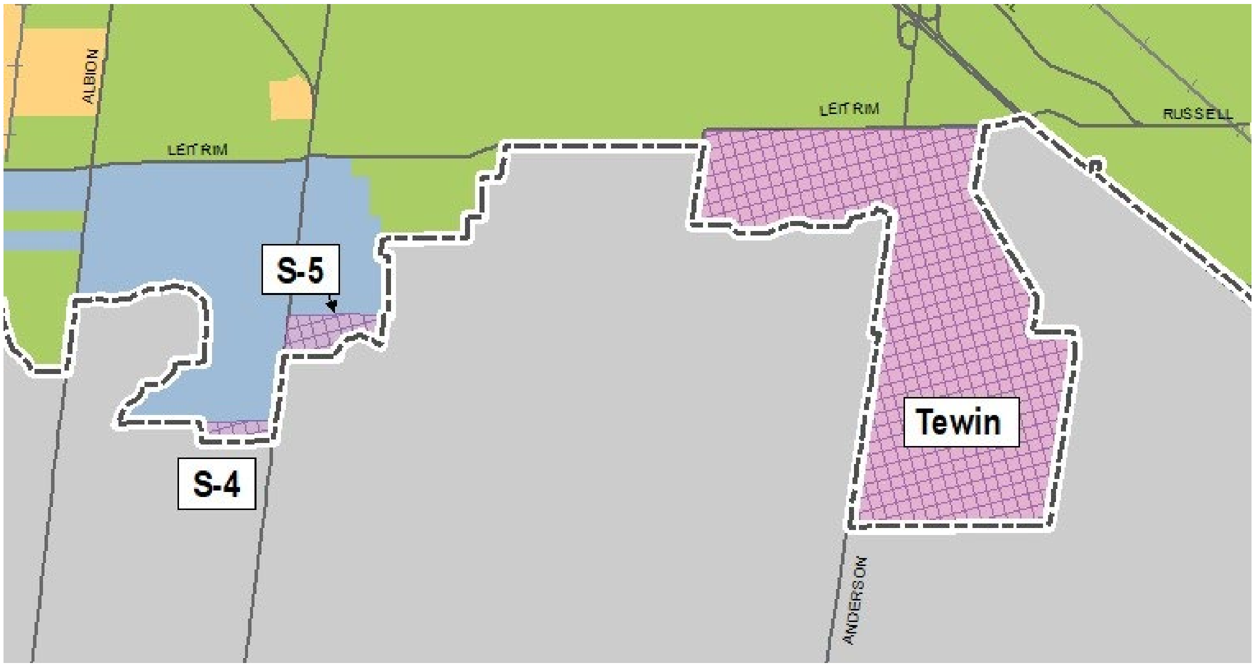
The Community Design Planning process and required studies for Tewin are outlined in Annex 10 of the Official Plan. Planning for the Tewin Community is intended to proceed following an integrated *Planning Act* application and Municipal Class Environmental Assessment (MCEA) process. As such, Community Design Planning is to occur in tandem with much of the required baseline study work and will need to be completed in an iterative manner. The integrated planning approach is intended to facilitate review and reduce duplication. All requirements of both the *Planning Act* and *Environmental Assessment Act* must still be met.

The study process will identify all the transportation and infrastructure projects that will be required to support development of the Tewin community. A Financial Plan will also be prepared as part of the Tewin master planning process to identify the costs and facilitate the commencement of the Area-Specific Development Charges background study. All the studies, including the Financial Plan, will be subject to Council approval at the time of adoption of the Community Design Plan. This section summarizes the requirements for Tewin as they relate to infrastructure planning.

8.1.2 Development Area

Figure 8-1 shows the Tewin community, and adjacent expansion lands in the South Urban Community (S-4 and S-5). The Tewin community will consist of a net developable area of approximately 445 ha. A preliminary location for Tewin is shown on Schedule C17 of the Official Plan. The exact boundary will be adjusted and finalized through the secondary planning process supported by required studies. Consistent with Section 1.1.3.9 of the Provincial Policy Statement, there shall be no net increase in the developable area resulting from the adjustments to the boundary.

Figure 8-1: Tewin New Community and South Urban Communities



8.1.3 City and Developer Responsibilities

City and developer responsibilities related to Tewin are outlined in Annex 12 of the Official Plan. As noted above and in Annex 10 of the Official Plan, a number of studies will be required to support the development, most of which will be carried out by the proponent. The Infrastructure Master Plan is one of the pre-requisite City plans that has been undertaken concurrently with the Tewin studies. Input was provided by Tewin landowners as part of the stakeholder engagement process.

The City is responsible for determining the appropriate sizing of off-site infrastructure in consideration of a potential build-out condition, through consultation with the proponent.

Class D cost estimates for off-site (and some of the on-site) infrastructure have been determined and presented herein. Class C estimates will follow through a Class Environmental Assessment (EA) and functional design process. More refined estimates will be established at the preliminary and detailed design stage. The City will lead the Class EAs for major off-site water and sewer infrastructure, which will require Council approval.

With very limited exceptions, all on-site infrastructure will be proposed by Tewin landowners through preparation of City-approved studies including a Community Design Plan, an Environmental Management Plan, and a Master Servicing Study. As for any other expansion area, the terms of reference for these studies and the study reports are all subject to City approval.

8.1.4 Master Study Requirements

Watershed Study

A comprehensive Watershed Study for the Bear Brook Watershed is required to inform land use requirements and infrastructure servicing. This is required before the planning of stormwater servicing for the Tewin community can be completed. The watershed study will assess the hydrology, hydraulics and water balance of the watershed. In addition, it will identify a comprehensive functional solution to accommodate and mitigate the cumulative impacts of drainage from Tewin, the East Urban Community, and the South Orleans Urban Expansion Area. The study will also consider possible future urban expansion west and south of Tewin.

Subwatershed Studies

A subwatershed study for the South Bear Brook subwatershed will be completed by the City and will build on the Bear Brook Watershed Study to identify existing natural heritage features, hydrologic conditions and drainage. The study will also evaluate the potential impacts of the proposed Tewin development to these local natural heritage or drainage features and identify necessary mitigative measures. Possible future expansion of the Tewin Community will also be considered. Recommendations and criteria resulting from the subwatershed study must be used to inform subsequent land use and infrastructure planning for the Tewin Community.

Approximately 160 hectares of the Tewin Community are headwaters within the Ramsay Creek subwatershed. Due to the size and location of the Tewin lands within the subwatershed, a Subwatershed Study for Ramsay Creek is not considered necessary. However, assessment of cumulative impacts and mitigation measures for Ramsay Creek is required as part of the Environmental Management Plan (EMP) for Tewin.

Environmental Management Plan and Master Servicing Study

As for other expansion areas, an Environmental Management Plan (EMP) and Master Servicing Study (MSS) are required to support the preparation of the Tewin Secondary Plan. Study specific Terms of Reference for the EMP and MSS outline the required study components and align with the Standard Terms of Reference / guidelines prepared by the City for these studies. In general, the EMP will identify how the project area contributes to the broader natural heritage context. It will provide area-specific design and mitigation to support a sustainable natural heritage system and protect natural heritage elements on the site and within proposed off-site infrastructure corridors. The MSS presents the community-wide infrastructure servicing plan.

Development Applications

As for other expansion areas, servicing plans prepared in support of development applications shall align with the overall servicing plans outlined in the EMP and MSS and must demonstrate that servicing or control criteria have been met through the proposed plan.

8.2 Off-Site Infrastructure

This section describes the infrastructure required to service the Tewin community. This will include water and wastewater that is required to be built off-site.

8.2.1 Potential Build-Out Scenarios

The sizing of the off-site infrastructure needed to support the Tewin development will require careful consideration of potential expansion beyond the planning horizon.

Any potential expansion beyond the 2046 Tewin boundary would be subject to Council approval through a review of the Official Plan. Assumptions about the direction of expansion consider adjacent existing land uses and potential suitability for urban expansion. Expansion into existing agricultural and potentially sensitive environmental areas was not considered. Generally, expansion would likely be towards the west, potentially connecting to the Leitrim area in a build-out scenario. There may also be future opportunities for limited expansion to the south-east of Tewin.

8.2.2 Relationship to Other Urban Expansion Areas

The closest urban area to Tewin is Leitrim. The Water Master Plan determined that there is insufficient capacity in the transmission system that supplies water to the overall South Urban Community (including Barrhaven, Riverside South, Leitrim) and the village of Manotick. Major upgrades would be required to the existing system in the City core, extending south past the Ottawa Airport, and into Riverside South and Leitrim. The upgrades would be along the same alignment as the Stage 2 Light Rail Transit project, and would involve recently constructed transmission mains, significant property requirements and construction risks. The Tewin project provides an opportunity to build a new transmission system through a new corridor to the east to service both Tewin and the South Urban Community (SUC).

A common water supply solution for Tewin and the SUC means that the growth costs will be shared between Tewin Area Specific Development Charge and the Outside Greenbelt Development Charge. Further information on cost sharing is provided in Section 15.

8.2.3 Development Projections and Demand Forecasts

The water demand projections for Tewin and the SUC are presented in Table 8-1. The SUC demand projections correspond to growth "Outside the Greenbelt" (OGB) in the SUC pressure zone (in addition to other downstream pressures zones) which exceeds the conveyance capacity of existing and other planned infrastructure that serve the SUC. Demand scenarios are as described in Section 6.5 of this plan. The incremental "water treatment" demands shown were determined to assess the impact of Tewin and the incremental SUC growth on the capacity requirements at the City's water purification plants. The Basic Day (BSDY) demands are relevant to major infrastructure failure scenarios, whereas the 5-year Maximum Day (MXDY) and Peak Hour (PKHR) demands are relevant to the Tewin and SUC infrastructure capacity requirements.

Table 8-1: Water Demand Projections for Tewin/SUC Water Infrastructure

Demand Scenario	2018-2046 Growth		2046-2101 Growth	2018-2101 Growth
	Tewin	SUC	Post Period Capacity	Total Potential Tewin & SUC Growth
BSDY	+6.1	+5.1	+49.2	+60.3
1-Year MXDY (Treatment)	+12.4	+8.0	+83.0	+103.5
1.30 x 1-Year MXDY (Treatment)	+16.2	+10.5	+107.9	+134.6
5-Year MXDY	+13.6	+10.2	+90.5	+114.3
5-Year PKHR	+30.6	+24.0	+175.3	+229.9

8.2.4 Recommended Approach to Sizing Infrastructure

The approach to sizing off-site drinking water and sanitary infrastructure for Tewin/SUC is similar to the approach for all expansion areas. The infrastructure needed for the projected 2046 scale of development is initially identified. Once this is done, performance of the system is evaluated based on the 2101 projections. Consideration is then given to increasing the capacity of the recommended projects to meet level of service requirements based on these longer-term projections. Consideration is not given to recommending additional infrastructure beyond what is needed for 2046. Oversizing costs are intended to be small compared to the overall cost of the 2046 infrastructure. Major cost increases for oversizing purposes are generally not justified given the uncertainty of projections beyond the Official Plan horizon. However, oversizing costs for Tewin/SUC may be more significant because the costs of twinning infrastructure connecting the City's central systems to Tewin/SUC in order to meet post-2046 demands would likely be prohibitively expensive and could make any moderate expansion of the community unaffordable.

In accordance with Annex 12 of the Official Plan, all oversizing costs will be front-ended by Tewin. However, given the magnitude of these costs, the large area (with no status in the Official Plan), and multiple landowners that could potentially benefit from the provision of Post Period Capacity, discussions about how these costs will be financed are on-going.

Potential future expansion of the Tewin community will also be considered as part of planning Tewin's storm drainage system. This will be addressed as part of Tewin's Environmental Management Plan and Master Service Study, which is beyond the scope of the IMP.

8.2.5 Water Infrastructure Requirements

This section describes the water infrastructure requirements for Tewin and South Urban Community (SUC) lands.

The first step in determining the Tewin potable water servicing strategy from the central system consisted of identifying the existing pressure zones from which Tewin could be directly serviced. Water pressure zones referenced in this section are shown on Appendix A, Schedule 6. The following two (2) options were identified:

- Servicing from pressure Zone 2C
- Servicing from pressure Zone SUC

Based on topography and a high-level assessment of hydraulics, it was determined that Tewin constitutes a natural extension of pressure Zone 2C, and therefore should be serviced from this zone. Servicing from SUC was not recommended, as the SUC area is projected to experience significant growth which will not permit existing transmission lines and pumping facilities to accommodate the additional Tewin buildout demands. Supply via Zone SUC would require a new or upgraded supply line through the NCC Greenbelt from Zone 2C along with new pumping facilities to boost pressure to SUC levels and other measures to reduce that pressure to service the lower elevations of Tewin. This would be a more costly and energy inefficient solution. However, a secondary connection from Zone SUC to Tewin is recommended for reliability in order to meet basic supply needs, in the event of a failure of the primary Tewin supply line.

When supplying Tewin from 2C, the following servicing scenarios were considered in the WMP:

- **Alternative A**: Directly servicing Tewin from the central system (without additional storage or pumping within Tewin);
- **Alternative B**: Direct servicing of Tewin in addition to supplying a storage reservoir in Tewin in order to augment supply via a new pump station during peak demand conditions; or,
- **Alternative C**: Servicing Tewin from the central system, with an elevated tank within Tewin to augment supply during peak demand conditions.

These alternatives are evaluated in detail in the WMP and Alternative B was selected as the most appropriate servicing concept. Alternatives that are consistent with this concept will be evaluated following Council approval of the IMP as part of individual project studies that address Class EA and functional design requirements.

Alternative B involves supplying Tewin from Zone 2C, filling a ground level storage reservoir on the Tewin lands, and using the stored water to augmenting the supply to Tewin under peak demand conditions through a new pump station. This option will avoid excessively large sizing of the primary supply line as well as excessive pressure losses through the supply line under peak demands. A secondary feed from SUC would also be needed for reliability in the event of failure of the primary supply line. In the initial stages of development, the storage facility will be sufficient to provide a back-up supply and so the secondary feed will not be required to be in service at this time.

An Integrated Solution for both Tewin and the South Urban Community

The capacity of the main transmission system which conveys drinking water to the South Urban Community (Riverside South, Barrhaven, Leitrim) and Manotick is insufficient to meet the 2046 development needs. A new 2C-OGB Feedermain from Zone 2C provides an opportunity to include sufficient capacity to meet 2046 peak demands in the SUC in addition to meeting all of the Tewin demands. Therefore, the Tewin servicing solution was integrated in the WMP's central system servicing strategy to augment supply to zone SUC in the latter part of the planning period. This means that the proposed Tewin booster pump station would serve as dual facility to supply both Tewin and the SUC, and the secondary feed to Tewin via SUC will ultimately be used to convey flows in the opposite direction under peak SUC demand conditions. It is anticipated that the pump station will be used to pump water into zone SUC in the short term as well, when Tewin demands are small, in order to ensure adequate turnover of water in the Tewin reservoir.

Longer-term growth projections were used to identify ultimate infrastructure sizing needs. The sizing needed for Tewin and the SUC under a 2046 scenario was identified and considered in the distribution of the total costs of each project to each benefitting area. For each project, the total costs were divided into the following components:

1. Cost for Tewin's 2046 needs only – costs borne by Tewin
2. Cost that will provide a benefit to existing development (BTE) – rate-funded costs
3. Cost for growth to 2046 for the SUC area – costs will be funded by Outside Greenbelt Development Charges or a new area-specific charge
4. Cost for upsizing infrastructure beyond 2046 requirements (Post Period Capacity, or PPC)

The costs were allocated based on each component's percentage of the total capacity demands and in accordance with Appendix H, Methods for Calculating Benefit to Existing Development (BTE). The resulting cost allocation is provided in Section 15. As noted in Section 15, the PPC costs for the proposed water infrastructure is very high. As such, it is recommended that the over-sizing of the infrastructure to meet the 2046 needs be reviewed as part of the functional design / Environmental Assessment process, considering trends in unit demands, affordability and other factors.

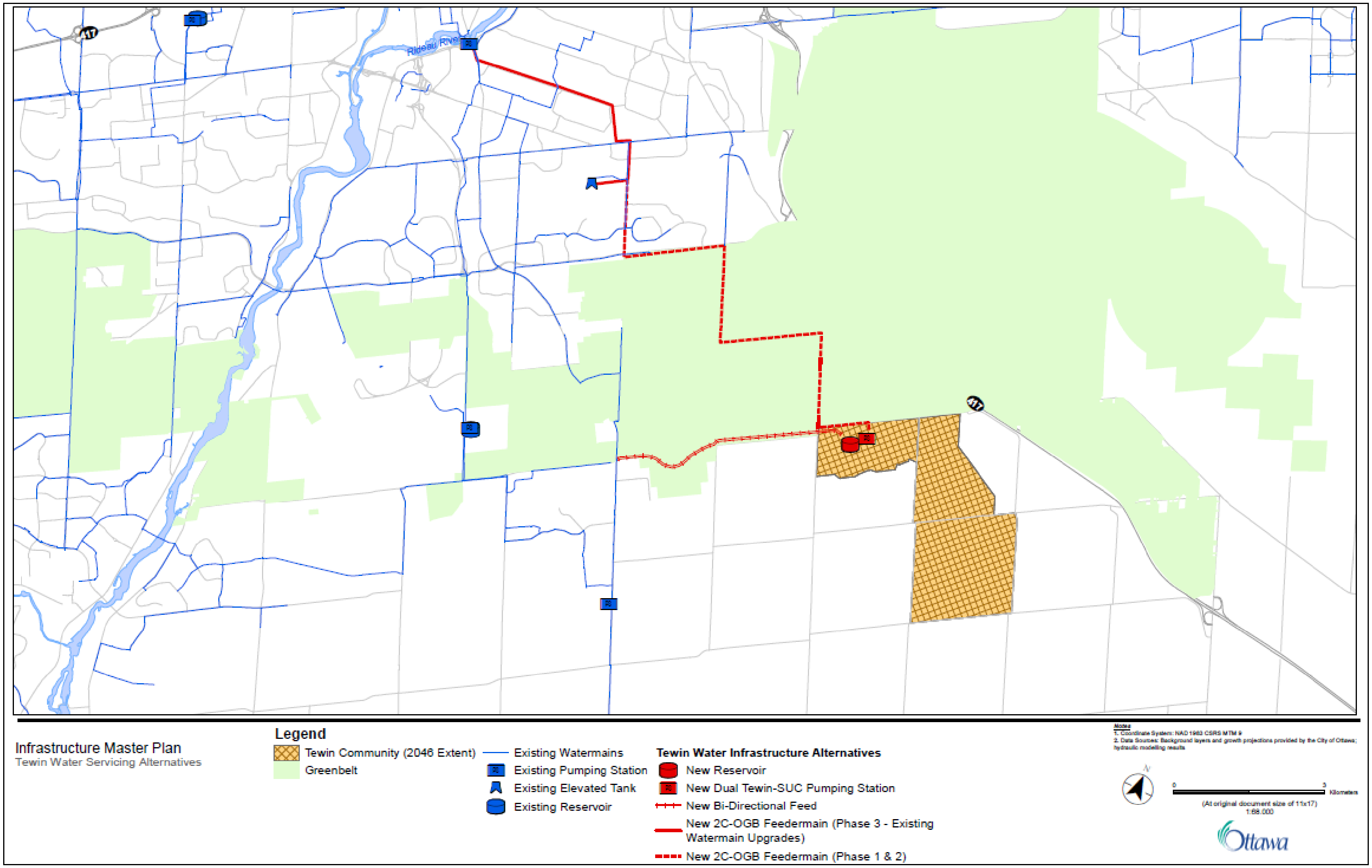
The water infrastructure to service Tewin and augment the supply to SUC to meet the 2046 demands can be implemented in multiple phases, as shown in Table 8-2. The required timing will depend on the amount of development in the overall Tewin / SUC area. When roughly 20,000 future dwelling units are added to this area, the impacts of the development will begin to reduce existing service pressures in Zone 2C. These impacts will be limited but are expected to become unacceptable by the time 33,000 units are built. Phase 2 and 3 water infrastructure will mitigate these impacts and need to be fully implemented before this upper limit of development is reached. The Bi-Directional Feed connecting Tewin and SUC will be required in the early stages of Tewin development to ensure reliability of supply under a major failure condition and to maintain adequate water quality by circulating water into the SUC area. The need for this pipe to meet incremental capacity needs in the SUC is not expected to be triggered until the 2034-2039 period.

An alternative that would meet the peak 2046 demands for the SUC but not rely on implementation of development within Tewin, could involve routing a new feedermain across the Greenbelt, to the easternmost SUC areas in Leitrim. In this case, a new reservoir and dual pump station in Leitrim could supply SUC and Tewin with two feedermains to Tewin for reliability. This alternative could be somewhat more costly, but these costs could be justified in order to provide flexibility in the phasing of development. The Tewin and SUC supply alternatives will be explored as part of a Class EA process following Council approval of the IMP. Figure 8-2 describes the layout of the IMP-costed alternative.

Table 8-2: Tewin/South Urban Community Water Servicing Phasing

<table>
<tr><th>Project Name</th><th colspan="2">Description</th><th>Timing</th></tr>
<tr><td rowspan="2">2C-OGB Water Feed Phase 1 & 2</td><td colspan="2">7,360 m of 1,220mm diameter watermain along Hawthorne Rd/ Whyte Side Rd/ Ramsayville Rd/ Leitrim Rd</td><td>Phase 1
Initial Tewin servicing
(2029-2034)</td></tr>
<tr><td colspan="2">3,580 m of 1,220mm diameter watermain along Conroy Rd/Hunt Club Rd</td><td>Phase 2
(2029-2034)</td></tr>
<tr><td>Bi-Directional Water Feed</td><td colspan="2">4,760 m of 914mm diameter watermain along Leitrim Rd</td><td>Initial Tewin servicing
(2029-2034)</td></tr>
<tr><td>2C-OGB Water Feed Phase 3</td><td colspan="2">5,020 m of 1,220mm diameter watermain along Bank St/Kilborn Ave</td><td>Phase 3
(2034-2039)</td></tr>
<tr><td>Tewin Pump Station & Reservoir Phase 1</td><td>Tewin Supply</td><td>7.5 ML of storage
32.3 MLD firm pumping capacity for Tewin</td><td>Phase 1
Initial Tewin servicing
(2029-2034)</td></tr>
<tr><td>Tewin Pump Station & Reservoir Phase 2</td><td>SUC Supply</td><td>3.2 ML of storage
30 MLD firm pumping capacity for SUC</td><td>Phase 2
(2034-2039)</td></tr>
<tr><td>Conroy Tank Feed</td><td colspan="2">740 m of 1,220mm diameter watermain</td><td>Phase 3
(2034-2039)</td></tr>
</table>

Figure 8-2: Tewin Backbone Water Servicing Alternative



8.2.6 Wastewater Infrastructure Requirements

Table 8-3 below provides estimates of 2046 future population, employment and design sanitary flows for the Tewin expansion area as approved in the City's Official Plan.

Table 8-3: Summary of Future Growth (2046) Projections and Flows

Area	New Effective Area (ha)	Future Population	Future Employment	Future Peak Dry Weather Flow (L/s)	Future Peak Wet Weather Flow (L/s)
Tewin	445.99	16,531	3,754	178.7 L/s	293.2 L/s

Development beyond the 2046 planning horizon is an important consideration given the magnitude of investment needed to service this future remote community. This is particularly important in terms of appropriately sizing the new required trunk sewers. Post-period (2101) population projections and sanitary flows (Table 8-4) were estimated based on the potential for future urban expansion in the areas surrounding Tewin. These projections are additive and do not include 2046 projection totals.

Table 8-4: Summary of Future Growth (2101) Projections and Flows

Area	New Effective Area (ha)	Future Population	Future Employment	Future Peak Dry Weather Flow (L/s)	Future Peak Wet Weather Flow (L/s)
Total	**1,694.4**	**92,667**	**10,131**	**966**	**1,524**

Total 2046 population Tewin population and employment growth will be approximately 16,531 and 3,754, respectively. Beyond the planning period (post-2046), it is anticipated that there could be an additional residential population of 92,667 and an additional 10,131 employees in the lands surrounding the 2046 Tewin community. Peak modelled flow in the Tewin collector trunk sewer is approximately 290 L/s by the year 2046, and approximately 1,700 L/s by the year 2101.

A new trunk sewer with a total length of approximately 8.5 km will be required to convey future wastewater flows from the Tewin expansion area to the South Ottawa Tunnel. Sizing for this project was originally determined to be 750mm based on 2046 population growth demands. However, there is substantial post-period growth within the Tewin community as well as in the areas surrounding Tewin. Therefore, it is recommended to oversize the new Tewin collector trunk sewer at 1500mm, which is the appropriate size to convey the design flows for the 2101 population growth.

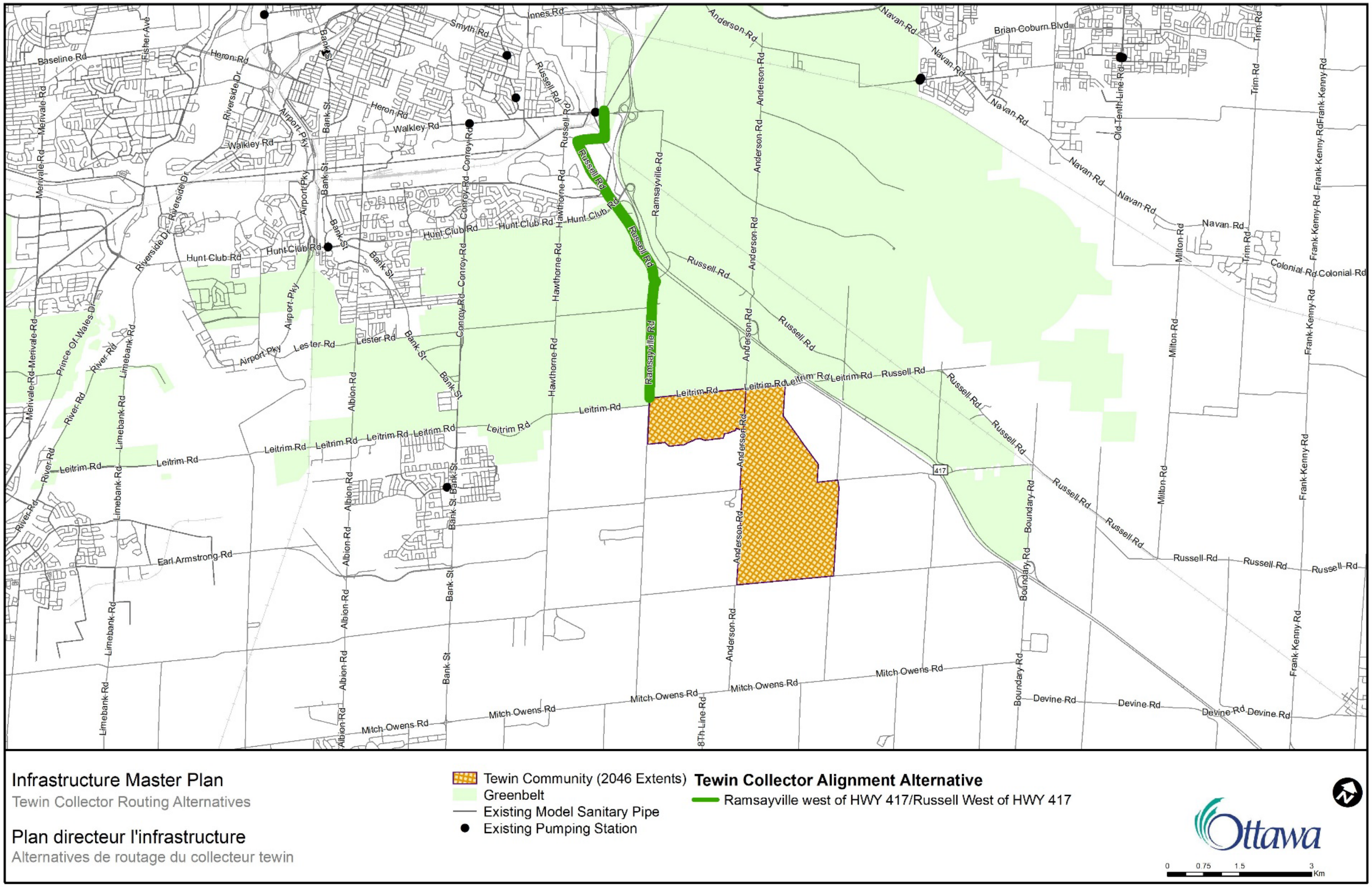
Table 8-5: Tewin Wastewater Servicing

Project Name	Description	Timing
Tewin Collector Sewer	8,500 m of 1,500mm diameter sewer along Ramsayville Rd and Russel Rd with a connection to the South Ottawa Tunnel	2029-2034

A Class Environmental Assessment (EA) will be required to determine the preferred routing for the Tewin Collector trunk sewer. The route identified for the purposes of the IMP is shown in Figure 8-3. Other potential alignments should be considered as part of the Class Environmental Assessment for the project. The Class EA should also include a review of the serviced area for the preferred solution.

Due to known existing capacity issues, the magnitude of growth within the Tewin future service area, and operational complications at Walkley Chamber, the current preferred downstream service connection is directly into the South Ottawa Tunnel downstream of the Walkley Chamber.

Figure 8-3: Tewin Trunk Collector Sewer Routing Alternative



8.2.7 Stormwater Infrastructure Planning and Design Approvals

Stormwater infrastructure planning and designs for the Tewin community are dependent on the completion of the Bear Brook Watershed Study and South Bear Brook Subwatershed Plan.

A comprehensive Watershed Study for the Bear Brook is required before the planning of stormwater servicing for the Tewin community can proceed. The need for this study has been triggered by existing and proposed communities, including the East Urban Community, South Orleans Urban Expansion Areas, and the Tewin community, all located within the headwaters of the Bear Brook watershed. Capacity and flooding issues already exist on Bear Brook, and both the City's Drainage Unit and the South Nation Conservation Authority have reported that these issues have increased since recent development in the watershed.

The watershed study will assess the hydrology, hydraulics and water balance of the watershed and identify a functional solution to accommodate and mitigate the cumulative impacts of drainage downstream of the Tewin Community, the East Urban Community, and the South Orleans Urban Expansion Area. It will also consider possible future urban expansion west and south of Tewin.

A Subwatershed Study for the South Bear Brook subwatershed will be completed by the City and will build on the Bear Brook Watershed Study to identify existing natural heritage features, hydrologic conditions and drainage features for the subwatershed. The study will also evaluate the potential impacts of the proposed Tewin Community to these local natural heritage or drainage features and identify necessary mitigative measures. Possible future expansion of the Tewin Community will also be considered. Stormwater management criteria and recommendations resulting from the subwatershed study will be used to inform subsequent land use and stormwater infrastructure planning for the Tewin Community.

Approximately 160 ha of the lands considered for the Tewin Community are headwaters within the Ramsay Creek subwatershed. Due to the size and location of the Tewin lands within the subwatershed, a Subwatershed Study for Ramsay Creek is not considered necessary. Assessment of cumulative impacts and mitigation measures for Ramsay Creek within and downstream of the Tewin Community, is required as part of the Environmental Management Plan (EMP) for Tewin.

Due to the existing capacity and flooding issues along Bear Brook, it appears unlikely that a sufficient outlet exists in Bear Brook to accommodate increased frequent event flows under the *Drainage Act*. The watershed and subwatershed studies will identify the SWM criteria, mitigation measures, works, and possible compensation requirements needed to provide the required drainage outlet within downstream reaches of Bear Brook.

Consistent with IMP policies in Section 4, the Tewin EMP must identify where legal stormwater outlets are required and the functional design of any work required to achieve sufficient outlet. The MSS must identify the process through which legal outlets are to be established for each of the outlets identified. Where drainage through Federal lands is required, this process must also consider federal approvals.

A Drainage Engineer's report will also be required under the *Drainage Act* for any works on the Bear Brook Municipal Drain or other affected municipal drains, including proposed or existing drains within Tewin lands. It will be the responsibility of Tewin landowners to initiate and complete all *Drainage Act* processes and projects required to establish legal outlet for the planned development, including drainage works within the Tewin lands.

8.3 Implementation

This section describes infrastructure implementation opportunities for the Tewin community. Phasing and Financing are discussed for water and wastewater infrastructure.

8.3.1 Phasing

This section describes infrastructure phasing opportunities associated with the Tewin Community. There may be opportunities to phase on-site and stormwater management infrastructure in accordance with development phasing plans. The Master Servicing Study for the Tewin Community will need to identify how the infrastructure is to be phased and any interim infrastructure required to support phased development.

There are no opportunities to phase in the sanitary collector sewer that will connect Tewin to the City's South Ottawa Collector. However, the detailed alignment of this sewer will need to be coordinated with the proposed initial phase of development. The sanitary flows generated in Tewin will be small in the initial phase of development and presents a risk of maintenance problems associated with sedimentation. This will be addressed by constructing the sewer with a low flow channel at the bottom of the pipe to help keep sediment in suspension.

There are multiple opportunities to phase the proposed water infrastructure based on various drivers including capacity, water quality, and impacts on upstream pressure zones. The Phase 1 primary feedermain connection, reservoir, and pump station are needed in the initial phases of Tewin development. The secondary feedermain for Tewin will be needed once the demand in this new community exceeds the emergency reservoir capacity with the primary feedermain out of service. However, earlier implementation of this project will likely be needed so that the feedermain can be used to contribute to the supply of water to the SUC in order to avoid water stagnation when demands are low in Tewin. The remaining infrastructure to supply SUC and Tewin will be phased based on the need to mitigate the impacts on operating pressures in the upstream pressure zones.

8.3.2 Financing

A Financial Memorandum of Understanding between the City and the Tewin landowners has been prepared. This Memorandum of Understanding aligns with Annex 12 of the Official Plan, which identifies Tewin-funded studies for all transportation and infrastructure related costs associated with the development. The study recommendations are to be supported by a Financial Plan with the premise that Tewin landowners assume all the capital costs that are associated with servicing the community. Cost of staff time and other resources needed to support planning and delivery would also be paid by Tewin, thereby minimizing any additional financial burden or risk to the City.

The Financial Plan will identify, among other things, an Area Specific Development Charge (ASDC), Citywide Development Charge, Front-ending Agreements, and any applicable Community Benefit Charge for the Tewin Community when it comes into force.

The planned water infrastructure for Tewin is also needed to augment service to meet 2046 demands across the entire South Urban Community. Therefore, the funding of the water infrastructure will be split between the Tewin ASDC and the "Outside Greenbelt" Development Charge in accordance with the benefits to each area. There is also a small benefit to existing (BTE) development and therefore a small percentage of the costs will be covered by the City's water rate budget. The benefit to existing areas involves an increase in water pressure in a limited area inside the NCC Greenbelt that does not fully meet current guidelines. It is important to note that without the required Tewin infrastructure there would be no City business case for upgrades to achieve the improvement in pressure.

The Tewin sanitary infrastructure provides no benefit to existing development as currently scoped, and therefore there is no rate-funded contributions. Therefore, the sanitary infrastructure will be fully funded by the Tewin ASDC, subject to a review of the project service area through the Class Environmental Assessment process.

There is significant potential for Tewin and SUC expansion post-2046. Given the magnitude of infrastructure investment required to service the Tewin Community, it is critical for to consider potential post 2046 growth and size the 2046 infrastructure accordingly. As such, a significant portion of both the water and sewer costs are allocated to "Post Period Capacity". Per Annex 12 of the Official Plan, Tewin is responsible for covering Post Period Capacity costs. However, it is uncertain to what extent Tewin could potentially benefit from this capacity as opposed to other developers in adjacent areas. Financing of post-period costs will be determined through the project planning process following IMP approval. Development Charges will be updated to allow for recovery of these costs, if and when there is an expansion of the Tewin or adjacent areas though a future Official Plan review.

The funding allocations for each project associated with the Tewin Community are summarized in Table 15-1 under Section 15. This summary excludes any Citywide Development Charges that Tewin will be required to contribute to for projects such as water and wastewater treatment plant capacity expansions.

PART V - STORMWATER MANAGEMENT STRATEGY

9 Stormwater Planning Context

9.1 Overview

This section outlines the stormwater planning context for the City. This includes a description of historical stormwater planning practices, existing stormwater systems, current objectives, standards, approvals, and opportunities.

9.2 Background

To support the IMP, a Stormwater Management Strategy (SWMS) (2023) was undertaken to establish a preferred approach to identifying stormwater management requirements for the intensification hubs and urban expansion areas.

The SWMS provides a framework that supports: environmentally sound growth; protection of property from flooding; and maintenance or improvements to watercourses and groundwater. The Stormwater Management Strategy (2023) study involved two distinct phases:

- Phase 1: development of stormwater related policy recommendations; and
- Phase 2: development of strategic directions on the management of stormwater to: protect watercourses against the impacts of development; and protect properties from flooding.

The Phase 1 Policy Review was intended to bring clarity and consistency to water resources policies and comply with legislative and regulatory requirements. Policy recommendations informed Official Plan policies, IMP policies, guidelines for preparing Master Servicing Studies. The review also generated other recommendations related to City guidelines and guidance documents.

Part V of the IMP focuses on Phase 2 of the SWMS which provides high-level guidance for stormwater management planning in the intensification hubs and urban expansion areas approved in the Official Plan. The guidance includes a stormwater management planning framework for Future Neighbourhoods, and recommendations regarding climate change, Low Impact Development, retrofits to existing stormwater systems, and floodplain mapping.

9.3 Existing Stormwater Infrastructure

The SWMS included a review of existing conditions to provide stormwater management guidance for future development. The objective was to establish an understanding of key features and constraints, as well as the potential for legacy studies to offer guidance on managing the impacts of development. This section outlines details with respect to existing urban drainage and SWM systems, watercourses and riverine systems and municipal drains.

9.3.1 Urban Drainage and Stormwater Management Systems

The City's Stormwater Asset Management Plan (2022) reports on the state of stormwater assets and establishes a basis for future asset management planning and decision making. The City's stormwater assets have been assessed generally as being in good condition and in early to mid-stage of expected service life.

As of 2022, the City's stormwater collection system includes the following:

- 2,919 km of collection pipes;
- 88 km of stormwater trunks (2,100 diameter or greater);
- 3 km of stormwater forcemains;
- 111,000 catch basins;
- 14 stormwater pump stations;
- 1,686 stormwater outfalls;
- 262 stormwater management facilities; and
- roughly 6,000 km of roadside ditches.

The City owns and operates 167 stormwater ponds and 95 other stormwater management facilities, such as oil-grit separators and underground storage facilities.

The dual drainage stormwater systems in newer development areas consist of a "minor" system and a "major" system. The minor system includes sewers and ditches to convey runoff from more frequent rainfall events. The major systems are engineered overland flow routes and include streets, drainage easements, and natural or engineered open channels. For areas built before the 1980s, a minor system is typically designed based on a 1 in 2-year return period capacity with no engineered major system. More recently developed areas were likely designed based on a 1 in 2-year or 1 in 5-year return period for the minor system and a 1 in 100-year return period for major system. When the minor system reaches capacity, inlet control devices installed in catchbasins throttle flow entering storm sewers to minimize surcharging and avoid basement flooding, resulting in excess runoff being conveyed via the major system to a stormwater outlet, typically a stormwater management pond. Backwater valves are typically installed in foundation drains as a supplemental defense against basement flooding.

The Stormwater Asset Management Plan also demonstrates that buildings outside the Greenbelt are generally less vulnerable to basement flooding in a 1 in 100-year return period event. This is because most areas outside the greenbelt have been designed with dual drainage systems – which contrasts with older neighbourhoods inside the greenbelt where potential property flooding risk is greater due to development pre-dating dual drainage system planning. The plan found that approximately 80% of buildings across the city (approximately 156,000) will not experience overland flooding in a 1 in 100-year event.

9.3.2 Watercourses and Riverine Systems

The City of Ottawa has a network of riverine systems that are regulated by the Rideau Valley Conservation Authority, Mississippi Valley Conservation Authority and South Nation Conservation Authority. (There are also many Municipal Drains – communal drainage systems generally under shared private ownership, regulated under the *Drainage Act*, and managed by the City – see section 9.3.3).

Annex 8A of the Official Plan identifies watersheds and subwatersheds within the city and associated Conservation Authority administration boundaries. Hundreds of tributaries, creeks and streams form 10 major watersheds within the City. The watercourses vary dramatically in size, drainage area and nature and are the receiving system of stormwater runoff.

Watershed and/or subwatershed plans are prepared and updated by the Conservation Authorities or the City to support Greenfield and intensification development and to provide long-term protection of the environment.

The City prepared a "Characterization of Ottawa's Watersheds: An Environmental Foundation" report in 2011. The report provides information on the existing conditions in the City's watersheds and subwatersheds. Furthermore, the report describes the functions of the watersheds considering interrelationships between key environmental components, including:

- Topography, geology and soils;
- Climate;
- Surface water;
- Groundwater;
- Land use; and
- Terrestrial and aquatic ecology.

The report summarizes available data to characterize the form and condition of each watershed. However, there is limited data on the hydrological, ecological, and human-centered functions provided by the watersheds. The City has committed to a Natural Asset Management Program for City-owned watercourses including creeks, streams and rivers to understand inventory, condition, and risks.

9.3.2.1 Watercourses and Riverine System Conditions

There are various parameters that are used to measure the existing condition of watercourse and riverine systems. These parameters include water quality, temperature, and erosion.

Water Quality

The Baseline Surface Water Quality Monitoring Program was undertaken by the City over the period of 1998 to 2014. It was initiated to understand the health of the City's rivers and shows that overall water quality improves as the size of the watercourse increases. Patterns in water quality in the rural and urban areas are somewhat inconsistent, with locations of high and low water quality found in both rural and urban areas. However, there is evidence that rural tributaries flowing through natural areas (forests or wetlands) are of higher quality than those flowing through agricultural and urban areas. In addition, water quality index values are generally better based on index values from the last five years of the program (2009 to 2014) compared with earlier results, suggesting that water quality may be improving across most watercourses within Ottawa.

The City Stream Watch Program was formed in 2003 to monitor and report the health of creeks and streams in the City. This program is a collaborative program in partnership with the City, Conservation Authorities and other municipalities and environmental organizations.

Temperature

The majority of the City's studied watercourses are categorized as "cool water" systems. Only Pinecrest Creek and Hunt Club Creek have previously been identified as "cold water" systems suitable for cold water fish communities. Tributaries of the City's creeks are typically assessed through Headwater Drainage Features Assessments in support of SWSs and EMPs.

Erosion

Erosion is a natural process affecting soil surfaces by gradually dislodging and transporting soil particles by wind and water. Within watercourses, soil particles are dislodged, transported and resettle as a result of variations in the flow of water. Erosion along a watercourse bed or bank defines and shapes the watercourse channel. Where bank erosion occurs near the base, or toe of a slope, it may contribute to increased risk of a slope failure.

A consolidated database of erosion conditions in watercourses across the City is not currently maintained. However, the City Stream Watch Program, administered by the Conservation Authorities, does track changes in monitored watercourse conditions over time.

Urbanization results in increased imperviousness contributing to higher volumes of runoff and more frequent and higher peak flows in receiving systems. These changes often contribute to increased erosion within the watercourse. As such, fluvial geomorphology studies are completed to assess the existing watercourse condition and inform development and stormwater management planning as part of SWSs, EMPs and other plans as appropriate. Additionally, slope stability and erosion hazards are assessed as part of the evaluation of Natural Hazard areas to establish safe limits for development.

9.3.3 Municipal Drains

There are approximately 1,200 km of municipal drains, mostly located outside the greenbelt, that form part of the watercourses/riverine system. In most cases, municipal drains are largely constructed across private property. Most existing municipal drains were constructed to provide agricultural and rural drainage outlets. Increasingly, as the City's urban boundary has expanded, these municipal drains are relied upon to provide legal and sufficient drainage outlets for urban development. Future development is required to provide a sufficient outlet without adverse property impacts. Detailed policies regarding legal stormwater outlets are provided in Official Plan Section 4.7.1 and IMP Section 4.3.8.

9.4 Existing Infrastructure Programs and Opportunities

While the SWMS provides an overview of the existing stormwater infrastructure and watercourse conditions, the strategy is largely focused on SWM requirements to support growth and is not a strategy for addressing all existing issues regarding stormwater drainage or watercourses.

Mitigation of existing flooding problems is integrated into the City's asset management and replacement programs. Integrated road-sewer-watermain renewal provides an opportunity to upgrade infrastructure to provide additional capacity and flood resiliency at a minimal incremental cost.

Under the City's asset management program, dual drainage studies are completed on a priority basis for older neighbourhoods that lack engineered overland drainage systems. These studies have been used to develop flood mitigation plans that may include modifications to catch basin inlet capacities, storm pipe upgrades, and surface flow management improvements.

Ditch drainage studies are ongoing in neighbourhoods with ditch systems that are experiencing increased intensification. These studies will confirm ditch and culvert condition, performance, and recommend remedial measures to improve drainage.

The IMP proposes new intensification-focused programs that will complement the existing asset management programs. The proposed IMP programs are discussed in detail in Section 13Intensification Capacity Management.

9.5 Stormwater System Performance Criteria

Stormwater management recommendations from watershed and subwatershed studies are typically expanded upon within Environmental Management Plans (EMPs) and Master Servicing Studies (MSS). This is done to provide direction on future stormwater management infrastructure needs for the associated planning area. The EMPs review applicable local, provincial and federal policies, guidelines, as well as the higher-level studies in order to establish SWM objectives and criteria for water quality, erosion, water budget, and protection of natural heritage features. Where an EMP is not completed or a previous study has not adequately addressed all criteria, the scope of an MSS or stormwater management plan for a Draft Plan of Subdivision, may be expanded to evaluate and establish SWM criteria.

The Sewer Design Guidelines (Ottawa, 2012) provide guidance on stormwater management policies, guidelines, criteria and objectives, including the sizing of water quality and water quantity controls for various forms of development. The Guidelines are periodically updated by

Technical Bulletins to ensure the guidelines align with current best practices. Technical Bulletin PIEDTB-2016-01, adopted in 2016, outlined climate change stress-test requirements for the design of storm drainage systems to improve the resiliency of new drainage systems to climate change. The SWMS investigated whether the 2016 climate change stress-test remains an adequate approach to designing resilient storm drainage systems based on updated climate information. Large infrequent storm events as a result of climate change could adversely impact the performance of stormwater infrastructure including End-of-Pipe SWM facilities.

The SWMS also investigated possible future impacts that could result from intensification occurring within Urban Greenfield Areas and Urban Expansion Areas. This was done within the context of two existing development areas within the Suburban Transect. The Chapel Hill South Community was chosen to represent suburban development from pre-amalgamation, and the Blackstone Community was chosen to represent a contemporary suburban development area. Potential impacts resulting from intensification and from climate change were then evaluated against various performance criteria associated with urban drainage systems. Three (3) future stressor scenarios were tested:

- Impervious coverage was increased to be representative of intensification.
- Increased rainfall as a result of climate change.
- The two (2) stressors above were combined.

The stress-test analysis completed during the SWMS was not a comprehensive review of all forms of suburban developments and all forms of stressors across the City, and therefore, the findings should be considered as general in nature.The impacts to the urban drainage system for the three stressor scenarios are notably greater for the pre-amalgamation suburban development compared to the more recent subdivision development. This is explained by the fact that older drainage systems were designed to a lower standard and do not include an engineered overland flow system to convey runoff that exceeds the capacity of the sewer system. For both development scenarios, the peak flow and runoff volume resulting from the climate change stressor was found to be greater than the impervious cover stressor.

It is recommended that the stress test results from the SWMS be considered as part of an update to the Sewer Design Guidelines through a comprehensive climate change assessment on the design of storm drainage system, specifically the planning and design of stormwater infrastructure including End-of-Pipe SWM facilities. These guidelines are scheduled to be updated in 2024.

Until recently, construction of all stormwater infrastructure in the City required an Environmental Compliance Approval issued by the Ontario Ministry of Environment Conservation and Parks (MECP) under the *Ontario Water Resources Act.* In 2022, the MECP adopted a Consolidated Linear Infrastructure Environmental Compliance Approval (CLI ECA) approach to replace the Provincial ECA framework for low-risk municipal stormwater management projects. Instead of ECAs being required for individual stormwater management projects, a single collective Consolidated Linear Infrastructure ECA will be issued for the City's stormwater management system. The Consolidated Linear Infrastructure ECA does not apply for stormwater works on industrial or commercial land. Where the Consolidated Linear Infrastructure ECA approach applies, the City is responsible for ensuring that third parties (e.g. developers) meet the minimum stormwater management criteria outlined in Appendix A and other conditions in Schedule D of the CLI ECA in designing and constructing stormwater management infrastructure. The CLI ECA Appendix A Stormwater Management Criteria includes performance criteria and discussion of constrained site conditions that may limit applicability of certain stormwater management practices. The performance criteria outlines the requirements for water balance, water quality, erosion control, water quantity, flood control and construction erosion and sediment control.

10 Stormwater Management Strategy Recommendations

10.1 Overview

The following section discusses stormwater infrastructure resiliency to climate change, and summarizes recommendations from the City's Stormwater Management Strategy (SWMS), including Low Impact Development (LID), the Stormwater Retrofit Program, and the Floodplain Mapping Program.

10.2 Stormwater Infrastructure Resiliency

Over the years, the City has undertaken many adaptative measures to improve stormwater infrastructure resiliency, including the Residential Protective Plumbing Program, Floodplain Mapping Program, Combined Sewage Storage Tunnel (CSST) and Flood Emergency Response Planning. Further, when storm sewer systems are designed, they are sized and "stress-tested" under various wet weather scenarios including historical extreme events and future climate change as discussed in Section 9.5.

A list of prioritized recommendations to adapt to increased precipitation that were provided from the Climate Change Vulnerability and Risk Assessment are as follows:

- Complete riverine hazard analysis for stormwater infrastructures in floodplains using different return periods flood events.
- A comprehensive climate change assessment and review of SDG in the planning and design of stormwater infrastructure including End-of-Pipe SWM facilities.
- Complete neighborhood urban and rural ditch studies to confirm and quantify risks.
- Complete GIS screening analysis, condition assessment, and subsequent environmental assessments for SWM facilities and City-owned bridges and culverts.
- Update the Flood Risk Profile with 2D major system analysis and/or 2D ditch analysis for storm conveyance system and right of way drainage and major systems. This can help identify priority areas for ditch renewal.
- Promote the implementation of Low Impact Development practices to assist with maintaining existing level of service during more frequent storm events.

Stormwater risk mitigation measures which are currently performed under the existing renewal program are described in Section 9.4.

10.3 Stormwater Retrofit Program

The Stormwater Retrofit Program involves the study of older built-up urban areas that are lacking stormwater management measures to address the impacts of uncontrolled stormwater runoff.

Key objectives of the program include improved water quality and erosion conditions in receiving watercourses and reduced risk of beach closures due to microbial contamination of surface water. This section provides background information on this program, a summary of existing implementation plans and progress, and recommendations for the future direction of the program.

10.3.1 SWM Retrofit Program Background

The City began a stormwater retrofit program in 2010, supporting the objectives of the Ottawa River Action Plan (2010). The intent of the program was to review those parts of the existing urban area where stormwater management is either not present or not built to contemporary standards. The goal was to study these areas (on a priority basis) and establish implementation plans for retrofit projects to improve water quality and erosion conditions in receiving watercourses. The priority retrofit study areas were identified as the Pinecrest Creek/ Westboro and Eastern Subwatersheds areas. These studies have been completed and recommendations are in the process of implementation.

10.3.2 Implementation of Existing SWM Retrofit Program

The City has completed or initiated several stormwater retrofit projects, programs and initiatives that were recommended by the completed retrofit studies, including:

- LID lot-level and conveyance projects including bioretention cells on Stewart Street, Sunnyside Avenue, Hemmingwood Way and Senio Avenue, permeable pavers at the Carlingwood Library, bioretention facilities at the Dovercourt Recreation Centre parking lot and stormwater soil cells on Bank Street and Glebe Avenue.
- End of pipe SWM retrofit measures.
- LID Screening Tool for Right-of-Way to identify suitable candidate sites for the integration of LID projects with the City's infrastructure renewal program.
- Rain Ready Ottawa pilot program that encourages homeowners to manage rainwater on their properties to reduce the impacts of rainwater runoff.
- Remediation of priority erosion sites study to review and update priorities to mitigate risks associated with erosion and bank instabilities in the Eastern Subwatersheds.
- Microbial source tracking studies to identify key sources of fecal pollution withing the Eastern Subwatersheds watercourses.

The initiatives to implement the completed retrofit studies under the existing program are recommended to continue.

While the City has made significant progress toward developing and implementing the Rain Ready Ottawa program to incentivize residential SWM retrofit, a process is still required to promote SWM retrofits on private industrial, institutional and commercial properties. It is expected that this program/process will require a different strategy than for residential retrofits. Identification of a recommended process or program is included as part of the suggested scope for the SWM Retrofit Master Plan, however this could also proceed independently.

10.3.3 Stormwater Management Retrofit Master Plan

The City will implement a SWM Retrofit Master Plan for the remaining developed areas of the City that have little or no stormwater management. These are identified as Priority 1 and 2 study areas, as shown in Appendix A, Schedule 11. While this Plan will consider impacts of intensification, this will be limited to within the SWM Retrofit Master Plan study areas. Other subwatersheds and receiving watercourses within the City are also expected to be impacted by intensification and these would require separate cumulative impact studies to inform any SWM criteria for developments, SWM infrastructure upgrades, or instream works required to support intensification.

The SWM Retrofit Master Plan for the Priority 1 and 2 areas will:

- Consider the impact of climate change;
- Consider plans for increased growth through intensification;
- Consider existing stormwater management criteria for receiving system (or alternatively establish stormwater management criteria if not already in place);
- Consider potential cumulative impacts of intensification on the receiving systems; and
- Develop recommendations for implementing stormwater retrofits.

10.3.4 Prioritization of Retrofit Study Areas

The SWMS conducted an initial assessment of the remaining developed areas and prioritized the future retrofit study areas. The purpose of conducting the prioritization work in the SWMS is to provide new guidance to continue the SWM retrofit studies as part of the IMP. The prioritization evaluation considered 14 subwatersheds located within the urban area of the City that was developed with little to no stormwater management.

Areas within combined sewer system catchments will not be a part of the SWM Retrofit Master Plan. Since the objectives of the SWM Retrofit program are aimed at improving conditions in the receiving watercourse, there is no benefit to assessing these areas. The Intensification Servicing Program, which recommends on-site SWM controls to manage runoff generated in large storms, is more relevant to these areas.

The prioritization considered the following two categories of retrofit areas:

- **Priority 1**: SWM Retrofit areas discharging to local watercourses before reaching the Ottawa or Rideau River. Stormwater management retrofits would provide a direct benefit to local watercourses and downstream beaches.
- **Priority 2:** SWM Retrofit areas draining to storm sewers which discharge directly to the Ottawa River or Rideau River. Stormwater management retrofit benefits to the receiving system would be somewhat less than for the Priority 1 areas.

Table 10-1 lists the 14 evaluated retrofit areas and their priority ratings. The SWMS documents the evaluation process for the subwatersheds within the Priority 1 and Priority 2 areas. It is recommended that this prioritization be considered when scoping the study requirements for the SWM Retrofit Master Plan.

Table 10-1: Stormwater Management Retrofit Prioritization

Retrofit Areas	Priority
Priority 1: Draining to Open Watercourse	
Graham Creek	1
Hunt Club Creek	2
Black Rapids Creek	3
Sawmill Creek	4
Nepean Creek	5
Barrhaven Creek	6
Stillwater Creek	7
Priority 2: Draining Directly or indirectly through storm sewers to the Ottawa/ Rideau River	
City Core	8
Rideau Canal	9
Rideau River	10
Britannia Bay	11
Ottawa River	12
Mooney's - Billing's Reach	13
West of Black Rapids	14

10.3.5 Recommended Strategy and Scope

The City will carry out future Stormwater Retrofit studies in accordance with the priorities outlined above. This section provides a strategy for completing these studies along with a general scope of work.

SWM Retrofit Master Plan Staging and Costing

The strategy for completing the SWM Retrofit Master Plan was prepared based upon lessons learned from completing the previous retrofit plans, evolving requirements for LID measures (current MECP LID Guidance Manual and new CLI ECA program), and other related initiatives. It is recommended to complete the plan in stages for subwatershed groupings as described below. This approach is needed given the scope and complexity of the work required and the need to provide coordination with on-going and emerging initiatives. It will allow refinement of the scope of work as each major component of work is completed. Broadly, the study should include the following stages:

Stage 1: Existing Conditions Analyses

a) Stream assessment, inventory of infrastructure within creek corridors and identification of in-stream work.
b) Hydrologic and hydraulic modelling of the Priority 1 subwatersheds (including water quality modelling).

Stage 2: Retrofit Strategy and Opportunity Screening

a) Assess and establish SWM objectives and associated criteria related to water quality, quantity, erosion control, flood control and water balance/budget.
b) Review the suitability of SWM retrofits on private residential properties in Priority 1 and Priority 2 retrofit areas and recommend areas for expansion of Rain Ready Ottawa program. Targets (uptake rate) for residential lot level measures in each retrofit area will be established in the final retrofit studies.
c) Review options for encouraging SWM retrofits on private industrial, institutional and commercial properties.
d) Complete screening of retrofit opportunities, including a range of lot level, conveyance, end-of-pipe and stream rehabilitation opportunities within public property.
e) Reconfirm if any Priority 2 areas should be considered in SWM Retrofit Master Plan.

Stage 3: Retrofit Scenarios Assessment

a) Evaluation of various SWM retrofit scenarios with different combinations and levels of retrofit measures.
b) Consideration of climate change and intensification scenarios.
c) Identify preferred retrofit plan.

Stage 4: SWM Retrofit Master Plan Report

a) Report to summarize the work from Stages 1 to 3.
b) Functional design of recommended retrofit projects (end-of-pipe and in-stream work)
c) Develop an implementation plan based on projected schedule and life cycle costing of SWM retrofits and stream rehabilitation work.
d) A Class EA report will be completed for any potential Schedule B projects (end of pipe facilities, stream rehabilitation).

Stage 5: Public Consultation of Schedule B Projects

It is recommended that the subwatershed prioritization be considered when planning the studies and analysis for each of the stages of the SWM Retrofit Master Plan. The total cost to complete the SWM Retrofit Master Plan is estimated to be $1.8 million with a completion timeline of approximately five (5) years depending on the results of each stage and impacts to level of effort for subsequent stages. For example, the number of retrofit projects would determine the effort and cost of functional design work. It is also possible that other factors (such as intensification pressures) could influence priorities and may result in a revised approach that could impact the cost and timeline to complete the overall plan.

The estimate does not include capital or other costs to implement any recommendations of the SWM Retrofit Master Plan or already completed retrofit plans. A program sheet outlining the program rationale, schedule, program funding and administration and follow-up actions is provided in Appendix G.

10.4 Low Impact Development Framework

This section presents the general Low Impact Development (LID) framework toward identifying and implementing LID to meet water budget targets (including runoff volume control).

The framework for establishing LID requirements and runoff volume control targets will vary throughout the City depending on the project and development context. Outlined below is the proposed framework for the different categories of projects and development. It is expected that these may be further refined over time and as the City progresses with implementation of SWM retrofit studies, the new MECP Consolidated Linear Infrastructure ECA and LID design guidelines.

10.4.1 Stormwater Retrofits

The MECP CLI ECA Stormwater Management Criteria defines a retrofit project as:

> *1) a modification to the management of the existing infrastructure;*
> *2) changes to major and minor systems;*
> *3) adding stormwater infrastructure in an existing development area on a municipal right-of-way, block, or easement. It does not include conversion of a rural cross-section into an urban cross-section.*

The retrofit scenario CLI ECA SWM criteria will apply for retrofit projects that are subject to MECP CLI ECA approvals.

The LID requirements and runoff volume control targets are to be provided through planned retrofit studies developed as part of the Stormwater Retrofit Program, as discussed in Section 10. Retrofit projects will be required to demonstrate how stormwater management criteria and runoff volume control targets would be met.

Retrofit interim opportunities should be assessed for areas with no completed retrofit study available, on a case-by-case basis, as part of renewal or reconstruction (capital construction) projects. Integration of ROW screening tool into business processes would facilitate the assessment process.

10.4.2 Intensification and Redevelopment

The development scenario CLI ECA SWM criteria will apply for residential intensification and redevelopment projects that are subject to MECP CLI ECA approvals.

Development proponents of intensification and redevelopment projects that are within areas with completed retrofit studies are required to apply the objectives and criteria provided in the retrofit studies. Retrofit studies, as discussed in Section 1012.2 are to provide stormwater management objectives and associated criteria within the urban built-up area. Where no retrofit study has been completed, separate assessments to determine applicable SWM criteria will be required by the developer.

Intensification development impacts on stormwater infrastructure is addressed by the Intensification Servicing Programs described in Section 13.

10.4.3 Greenfield Development

In general, direction for use of LIDs in greenfield development sites in Urban Expansion Areas shown on Schedule 11 is to be established through completion of subwatershed level studies and/or EMPs, which will determine area-specific runoff volume control targets.

The EMP will present a preferred SWM Plan which aligns with the development scenario stormwater performance criteria defined in the MECP CLI ECA including direction for LIDs to satisfy targets for water quality, erosion, flood control and water balance. Depending on local site conditions, LIDs may not be appropriate or effective.

10.5 Natural Hazards

Natural hazards generally fall into two categories: i) flood hazards, and ii) hazards associated with erosion and slope stability risks. The greater of these hazards is used to determine natural hazard regulation limits and define limits for safe development. Stormwater management planning must ensure that development does not create new or aggravate existing natural hazards. Development proponents are required to reference natural hazard regulation limits prepared by Conservation Authorities in collaboration with the City. For watercourses within development lands that are not mapped, natural hazards may need to be assessed and mapped with approval from the City and the local Conservation Authority.

10.5.1 Floodplain Mapping Program

The objective of the Floodplain Mapping Program is to identify flood hazard limits and inform planning and decision making such that riverine flooding risks to people and property are minimized. Floodplain mapping is produced and updated by local Conservation Authorities in partnership with the City for watercourses throughout the city.

Floodplain mapping updates are provided on the City's interactive map web page: [Flood Plain Mapping and Climate Change | City of Ottawa].

For Eastern Ontario, the 1 in 100-year flood event is the regulatory standard for floodplain mapping. Development is generally prohibited in the 1 in 100-year floodplain. Requirements for flood plain studies, in support of development applications will be identified in consultation with the City and the appropriate Conservation Authority.

City and Conservation Authority staff have reviewed the planned growth areas and completed a risk assessment screening to identify priority watercourses for updates to mapping or new mapping between 2023 and 2028. Priority areas include watercourses within and downstream of planned Urban Expansion Areas as well as urban watercourses where significant intensification is expected within the subwatershed.

To reduce the risks associated with climate change, OP policy defines the climate change flood vulnerable area as area between the 1 in 100-year floodplain and the 1 in 350-year floodplain. Development will not be prohibited or limited in these areas. However, development will be required to assess riverine flood risks and include mitigation measures to reduce or avoid identified flood risks where an approval under the *Planning Act* is required to permit the development.

In absence of provincial guidance regarding floodplain mapping for climate change, it is recommended that the City establish flood-risk mitigation framework and requirements for development located within climate change flood vulnerable areas.

10.5.2 Erosion and Slope Stability

In addition to flood hazards, the Official Plan requires erosion hazards to be assessed and mapped prior to land use planning. Erosion hazards are defined by the loss of land due to human or natural processes that can pose a threat to life and property. This includes meander belt as well as slope stability/slope failure due to steep slopes or toe erosion of slopes. Areas with deep valley systems or other steep slopes may have associated slope stability hazards and could be vulnerable to retrogressive landslides in areas with sensitive marine clays. Development proponents maybe required to undertake necessary studies as part of the development review and approval process to delineate the extent of these natural hazards.

11 Stormwater Management in Urban Expansion Areas

11.1 Overview

This section outlines the stormwater management planning requirements in urban expansion areas. Stormwater management programs related to intensification are discussed in Section 13.

11.2 Background

A total of approximately 2,003 gross hectares of rural land was added to the urban boundary for future residential development through the new Official Plan. An additional total of 318 gross hectares of rural land was added to the urban boundary for industrial and logistic land uses. A secondary planning process will be required to remove the Future Neighbourhood Overlay on the expansion lands before development can proceed.

The secondary planning process will involve developer-led land use, transportation, servicing, and environmental studies to inform the preferred land use concept. Through the Secondary Planning process, only an estimated 64% (about 1,281 hectares) of the 2,003 total gross hectares of urban expansion lands are anticipated to be ultimately designated for residential and industrial/logistics land uses. The balance of land will be required for parks, schools, roads and transit, Urban Natural Areas, SWM facilities and open space lands (river/creek corridors, natural hazard areas, etc.).

The findings and recommendations of Master Servicing Studies (MSS) and Environmental Management Plans (EMP) play a key role in the secondary planning process by identifying lands unsuitable for development due to natural hazards, and by identifying preferred at-source, conveyance and end-of-pipe SWM controls (including associated land requirements) to establish a storm drainage system with a satisfactory level of service for roads and urban land uses.

11.3 Watershed, Subwatershed & Community Planning Context

Development applications in Future Neighbourhoods will be supported by an approved Concept Plan or a Community Design Plan (CDP), depending on scale, context, complexities and existing available information. In Section 12 of the Official Plan, CDPs that lead to Secondary Plans and Concept plans that lead to Area Specific Policies are collectively referred to as “local plans”. A CP or CDP process is typically initiated by the landowner(s). The *Future Neighbourhoods Urban Expansion Areas Process* report outlines the overall secondary planning process in Urban Expansion Areas.

In accordance with Official Plan Policy 4.7.1, preparation of local plans for each urban expansion area will generally require approved Subwatershed Studies, Environmental Management Plans (EMP), and Master Servicing Studies (MSS) from which SWM requirements for each area will be determined. Where a Subwatershed Study has yet to be completed, the EMP can substitute provided that its scope of work is expanded to address cumulative impacts. These studies shall be prepared such that they are consistent with the City-approved terms of reference for each. In addition, water budget assessments are to be prepared to support Subwatershed Studies, EMPs and MSSs, that are factored in the CLI ECA approvals process in subsequent development applications. There may also be a need to update floodplain and natural hazard mapping to formally establish development limits, and updating *Drainage Act* by-laws, where applicable.

11.4 Stormwater Management Planning in Future Neighbourhoods

EMPs and MSSs are critical studies needed to support infrastructure planning through the secondary planning process (e.g. Community Design Plan). The EMP and MSS are coordinated plans to establish stormwater management criteria intended to effectively mitigate the impacts of post-development runoff on existing environmental features such as watercourses and wetlands, and to protect development from flooding based on approved levels of service. Terms of references for MSSs and EMPs will be prepared for each urban expansion area and approved by the City. The terms of reference will describe the scope of work required for the specific study area. A summary of master stormwater planning-level studies requirement is provided in .

11.4.1 Environmental Management Plan

An Environmental Management Plan (EMP) is a comprehensive environmental planning document intended to identify, evaluate and mitigate the potential impacts of development on the natural environment and its ecological functions at the local planning stage. The EMP defines the development constraints and limits, drainage patterns, as well as establishes mitigation measures for subsequent stages of the development. Consistent with Section 4.3.8 (1), the EMP shall identify where legal stormwater outlets are required and functional design of any work required to achieve sufficient outlet.

The individual scope of each EMP will be determined by the City in consultation with the local Conservation Authority. Standard Terms of Reference for the preparation of EMPs have been prepared by the City to guide the general scope and technical requirements of EMPs.

11.4.2 Master Servicing Study

A Master Servicing Study (MSS) is typically completed as part of a Community Design Plan process or in conjunction with a land use planning process. This would include coordination of water, wastewater and/or stormwater servicing requirements between multiple developments and/or landowners.

Guidelines for preparing terms of reference for an MSS are provided in Appendix C. The Guidelines document outlines the scope of the study work that is required in accordance with the MSS policies in Section 4.3.6 and identifies expectations of technical studies required to support the master planning of infrastructure including, for example, how the anticipated effects of climate change are factored in the planning of infrastructure. The scope of study to be undertaken in an MSS will be dependent on the planning process requirements to remove the Future Neighbourhood Overlay. Where a CDP process is required, the MSS will require greater integration and coordination with other supporting master planning studies, including the CDP, EMP and Transportation Master Plan. Where the expansion area is small, and is largely owned by one landowner, removing the Future Neighbourhood Overlay may be satisfied through preparation of a Concept Plan. In such circumstances the scope of the MSS may be reduced where integration and coordination with other master planning documents is small in scope or not required.

Consistent with Policy in Section 4.3.8 (1), the MSS must identify the process through which legal outlets are to be established for each of the outlets identified in the EMP. While there is a need to coordinate the planning of stormwater servicing with *Drainage Act* projects, the approval process for works required under the *Drainage Act* is separate from the MSS study process. It is the responsibility of the development proponent and/or landowner to initiate and complete the *Drainage Act* process.

A conceptual LID plan is also required in the MSS to demonstrate that any targets identified in the Subwatershed Study or EMP will be achieved through the proposed stormwater management plan. Further policy details are presented in Section 4.3.11.

In special circumstances where the City has confirmed that an EMP is not required, the scope of the MSS will need to address the necessary stormwater planning information, assessments and analysis that would otherwise be found in the EMP.

11.4.3 Water Budget Assessments

A water budget assessment uses the basic principles of hydrology and hydrogeology to identify the impacts of land use changes on the hydrologic cycle, and the post-development targets needed to mitigate those impacts. Water budget assessments are required to support all Subwatershed Studies, EMPs, updates to existing Master Drainage Plans and MSSs. *Planning Act* applications must demonstrate compliance to water budget requirements from higher level studies. Water budget assessments must also be integrated with stormwater management plans prepared in support of EMPs, MSSs, and draft plans of subdivision.

As stated in Section 4.3.11, provincial direction allows for area-specific runoff volume control targets to be established through subwatershed level studies. The Official Plan policies are aligned with this direction, requiring that SWSs and EMPs define the targets to be implemented in stormwater management plans for development applications. The water budget assessment is a critical step to defining runoff volume control objectives and SWM criteria.

Standard ToR provides the general scope to guide the preparation of water budget assessments.

11.5 Stormwater Management Planning – Residential Urban Expansion Areas

To support secondary planning process (e.g. Community Design Plans), Table 11-1 presents the master planning-level study requirement for each Urban Expansion Area. Detailed study requirements are to be identified through terms of references when preparing existing conditions report during the first phase of the planning process.

Based on the size and issues to address, the following urban expansion areas are required to go through the full CDP process:

- Riverside South (S-3)
- South Orleans – Wall Road Lands (E-1)
- Tewin

While most studies will apply to the limits of the study area associated with the specific urban expansion area, there are some instances where studies will be required to consider other urban expansion areas. Where two or more areas have common stormwater outlets (i.e. to a common natural watercourse or to a common municipal drain) within the same subwatershed, the cumulative impact of development will need to be considered. Coordination and collaboration will be required between the proponents of the overlapping areas.

Table 11-1: Master Planning-level Studies Requirement for UEAs

UEA		CA	Existing Subwatershed Study (SWS)	Master Planning-level Study Requirements for UEAs		
Name	ID			SWS Requirement	Drainage Act By-law Update[3]	Floodplain Mapping (1 in 100 year & 1 in 350 year)
North Stittsville	W-2	MVCA	2018 Feedmill Creek SWM Criteria Study & Upper Poole Creek Subwatershed Plan & Carp River Subwatershed Plan & subsequent studies	Updates to Feedmill Creek SWM Criteria[2] & Upper Poole Creek[2]	Hazeldean MD	Feedmill Creek - Update and extend
South Stittsville	W-4	RVCA	N/A	No	Faulkner MD	Faulkner MD - Review/Update
Barrhaven South-West of Greenbank	S-1	RVCA	Jock River Reach 1 Subwatershed Plan & Mud Creek Subwatershed Study	No	Thomas Baxter MD	Thomas Baxter MD - Review/Extend
Barrhaven South-East of Greenbank	S-2	RVCA	N/A	No	Kilroe MD & Hawley MD & John MD	Rideau River Tributaries - Review/Extend
Riverside South (Bowes ville Road)	S-3	RVCA	N/A	New Mosquito Creek Subwatershed Plan[2]	Spratt MD & Ficko MD	Mosquito Creek- Review/Update
Leitrim – West of Bank Street	S-4	SNC	1996 North Castor River Subwatershed Plan	No	N/A	No
Tewin		SNC/ RVCA	N/A	New Bear Brook Watershed Plan[1] and South Bear Brook SWS[1]	Smith Gooding MD & Johnston MD & Bear Brook MD	Ramsay Creek TBD
South Orleans – Wall Road Lands	E-1	SNC/R VCA	2014 Greater Cardinal Creek Subwatershed Plan	New Bear Brook Watershed Plan[1]; Update	McKinnons Creek MD, Lepage Charboneau	Cardinal Creek - Update to

UEA		CA	Existing Subwatershed Study (SWS)	Master Planning-level Study Requirements for UEAs		
Name	ID			SWS Requirement	Drainage Act By-law Update[3]	Floodplain Mapping (1 in 100 year & 1 in 350 year)
				Greater Cardinal Creek Subwatershed Plan[2]	MD and Chartrand MD and Bear Brook MD	include 1:350 mapping
South Orleans– Trim & Innes Road Lands	E-2	RVCA	2014 Greater Cardinal Creek Subwatershed Plan	Update Greater Cardinal Creek Subwatershed Plan[2]	Chartrand MD	Cardinal Creek - Update to include 1:350 mapping Chartrand MD - TBD
Cardinal Creek Village - Central	E-4	RVCA	2014 Greater Cardinal Creek Subwatershed Plan	Update Greater Cardinal Creek Subwatershed Plan[2]	N/A	Cardinal Creek - Update to include 1:350 mapping
Cardinal Creek Village -North	E-5	RVCA	N/A	No	N/A	No

[1] Studies led by the City and Conservation Authorities
[2] Updates to existing studies or new studies are required depending on when the secondary planning process is initiated, the City may not have the resources available to update the studies. To not delay the secondary planning process and future development, the necessary work to update the studies may be identified in the EMP Terms of Reference at the direction of the City. The EMP can be used to complete the required subwatershed-scale analysis.
[3] Municipal drains are identified to update *Drainage Act* by-laws.

11.6 Stormwater Management Planning – Industrial & Logistics Urban Expansion Areas

Two Industrial & Logistics areas were added to the urban boundary as shown in Appendix A, Schedule 1. Stormwater management planning in these areas will be completed as part of an MSS to identify a preferred SWM plan to mitigate the cumulative impact of runoff from multiple industrial sites on stormwater outlets. MSS recommendations for these areas will also require coordination with master planning in the broader North Stittsville (W-2) and South Barrhaven (S-1) urban expansion areas. The available stormwater outlets for each of these areas are engineered outlets, and the expectation is that SWM criteria can be established through the MSS, and is not likely to require completion of an EMP.

PART VI – RURAL AREA

12 Rural Infrastructure

12.1 Overview

This section summarizes the key aspects of the City's draft Rural Servicing Master Plan (2024), which will guide infrastructure planning and implementation decisions in the City's rural area pursuant to policies of the Official Plan and this Infrastructure Master Plan. Opportunities and constraints linked to groundwater conditions are discussed first, followed by information from the two Source Water Protection Plans that cover the City's rural area.

A summary of the servicing situation in villages is then presented, including both existing and planned public servicing infrastructure. Villages that operate on predominately private services are also discussed. The servicing issues pertinent to the rural area lying outside of village boundaries are also highlighted. "Centralized" systems are discussed, defined as public systems that are supported by the City's major treatment facilities (Britannia WTP, Lemieux WTP, ROPEC WWTP). "Decentralized" systems are discussed, defined as public systems that are supported by remote treatment facilities (e.g. publicly-controlled well systems).

12.2 Groundwater Conditions

Servicing in the rural area is predominantly achieved by private drinking water wells and sewage systems (i.e. septic systems). As such, preservation of the quantity and quality of groundwater resources is a key priority for the City. Over time, municipal services have been provided in certain villages for a variety of reasons, but predominantly to resolve issues with private services. Ottawa's rural area is identified as the Rural Transect on Schedule B9 of the Official Plan (2022).

There are several major aquifers that form an important source of drinking water for much of the rural area. Sedimentary limestones, dolostones and shales are the primary water supply for many private homes, although some rock formations are more reliable (e.g., Oxford Formation) as a supply than others (e.g., Bobcaygeon). Another important source of drinking water is the sandstone of the Nepean formation, which is less readily accessible (due to its greater depth) but is used on a progressively more frequent basis, particularly for the construction of municipal wells and other large water takings, as well as when a more protected drinking water source is required. Another source of good quality water can be found in eskers, such as the Kars Esker and the Vars-Winchester Esker which serves as a water supply for the Village of Vars. In general, surficial deposits with high permeability, thin overburden, or fractured bedrock, are considered particularly vulnerable to contamination from human activities that could impact groundwater resources.

Since the early 2000's, the City has been performing groundwater characterization studies in villages and privately serviced enclaves. These studies consist of sampling programs where 10-

20% of private wells within a village or enclave are sampled and tested for chemical and bacteriological parameters. The data is analyzed and relevant recommendations are provided, where applicable. This is an ongoing program, and thus far twelve of the twenty-six villages and three enclaves have been studied. Table 12-1 below provides a status update of the villages that have had groundwater studies completed, as well as those for which plans for future study and sampling are underway or planned. The Rural Servicing Master Plan includes a summary of groundwater information within each village, including the previously completed groundwater characterization studies for the villages.

Table 12-1: Status and Plans for Groundwater Studies

Status and Plan	Villages
Previous or ongoing study Plans for future study / sampling	Cumberland (2003) Greely (2003) Manotick (ongoing)
Previous study No plans for future study / sampling	Ashton (2010) Constance Bay (2006) Fitzroy Harbour (2010) Metcalfe (2003) North Gower (2006) Osgoode (2006) Richmond (2010) Sarsfield (2010) Vernon (2006)
No previous study Plans for future study / sampling	Burritts Rapids Dunrobin Fallowfield Galetta Kars Kenmore Kinburn
No previous studies No plans for future study / sampling	Marionville Navan
Not applicable (Village on municipal well water or central service)	Carlsbad Springs Carp Munster Notre-Dames-des-Champs (servicing of full village anticipated) Vars

12.3 Source Water Protection Plans

The City is comprised of two source water protection areas: the Raisin-South Nation Source Water Protection Region and the Mississippi-Rideau Source Water Protection Region. Each region has a Source Water Protection Plan that contains a series of locally developed policies aimed at protecting existing and future sources of municipal drinking water. Vulnerable areas where pollutants on the surface could enter the source of municipal drinking water, potentially causing contamination, have been mapped within each Source Water Protection Region and are identified as Wellhead Protection Areas, Intake Protection Zones, Highly Vulnerable Aquifers and Significant Groundwater Recharge Areas.

The Mississippi-Rideau Source Water Protection Region covers approximately three quarters of the area within the City of Ottawa. Three villages (Carp, Munster and Richmond) have Wellhead Protection Areas associated with municipal wells. The Raisin-South Nation Source Protection Region, which covers approximately one quarter of the City of Ottawa, includes two Wellhead Protection Areas within the Village of Vars and the Village of Greely.

12.4 Villages with Full or Partial Municipal Services

There are 26 villages in Ottawa's rural area. Villages range in size, hydrogeological conditions, existing servicing, growth potential, and planned infrastructure. In the Official Plan, villages are identified as the focus for rural growth. According to the Official Plan, 7% of the City's total projected growth to the year 2046 is allocated to rural areas, with 5% expected to occur in villages (Section 3.2.4). Servicing is a key consideration in the Official Plan's framework to guide rural growth. The majority of growth is directed to villages that have the greatest ability to become complete communities and where municipal services exist or are planned. This includes the villages of Richmond, Manotick, Greely, and Carp. Within the Rural Servicing Master Plan, these four Villages are referred to as "Growth-Focused Villages".

Table 12-2 summarizes the public servicing that is provided in villages. The following villages have existing municipal services either in whole or in part:

- **Carp**: Drinking water is provided by a municipal well system, and there is a connection to provide water servicing to the Carp Airport Development. The village is serviced by the City's central wastewater collection system via a pump station and forcemain system.
- **Greely**: The majority of the Village of Greely is currently serviced by private wells, with the exception of the Shadow Ridge subdivision, which is serviced by 2 municipal wells and 1 pumping station. The majority of the Village of Greely is currently serviced by private septic systems, with the exception of the Shadow Ridge subdivision, which is serviced by a local municipal septic system.
- **Manotick**: While the majority of new development in Manotick is on municipal services (central water supply and the central wastewater system), much of the existing village

residential development is on private groundwater wells and septic systems. As the entire village is a Public Service Area, existing development on private services is eligible for Local Improvement.

- **Richmond**: The majority of the village is serviced by private wells, with the exception of the Kings Park Subdivision and the Fox Run Subdivision. The entire village is currently serviced by the City's central wastewater collection system via a pump station and forcemain system.
- **Munster**: A City-operated communal system uses two wells to supply water to the village, and wastewater is conveyed to the City's central wastewater collection system via a sanitary forcemain to the pump station in Richmond.
- **Notre-Dames-des-Champs**: The village is currently serviced by the central municipal water supply system and private septic systems. There are also some private wells in the village.
- **Carlsbad Springs:** Water is provided by the City's central water distribution system via a unique trickle feed system. Sanitary service is provided by private septic systems.
- **Vars:** Water is provided through a municipal well system. The village has private septic systems.

Table 12-2: Summary of Existing Rural Servicing Infrastructure

	Centralized Servicing		Decentralized Servicing	
Village	Water	Wastewater	Water	Wastewater
Carp		X	X	
Manotick	partial	partial		
Richmond		most parts	partial	
Greely			partial	partial
Munster		X	X	
Notre-Dames-des-Champs	X			
Vars			X	
Carlsbad Springs [1]			*	

Note: 1. Carlsbad Springs is serviced by a low-pressure trickle feed water system.

12.4.1 Future Village Servicing Projects

A number of individual water and wastewater infrastructure projects for villages are included in this Plan. This includes projects to service the villages through the central system as identified in the Wastewater Master Plan (see Section 8 for a complete project list including timing and estimated costing). Details on the individual projects are found in the Project Sheets section in

Appendix F. There are no central system water projects planned for the villages. (Although a major watermain project serving the village of Manotick was tendered in 2023.) A summary of the central system wastewater projects is provided in Table 12-3 below.

Table 12-3: Planned Centralized System Infrastructure Projects in Villages

Type	Village	Project
Wastewater	Carp	Carp PS Capacity Upgrade and Forcemain
	Richmond	Richmond Forcemain Twinning Stage 3
	Richmond	King Street Trunk Sewer Upgrade
	Manotick	Manotick Main PS Capacity Upgrade (interim)
	Manotick	Manotick Main PS Capacity Upgrade (ultimate)
	Manotick	Mahogany PS Capacity Upgrade

Decentralized infrastructure projects for the rural area are planned for the villages of Carp, Greely, Richmond and Manotick. Due to the availability of existing and future planned municipal servicing, more than 70% of rural growth will be directed to these four villages as per the Official Plan. Table 12-4 presents the planned infrastructure studies and projects by service and village. Details on these studies and projects are provided through detailed Master Servicing Studies for each specific village.

Table 12-4: Planned Decentralized System Infrastructure Projects and Studies in Rural Villages

Type	Village	Project or Study
Water	Carp	City-led Master Servicing and Functional Design Study for long-term needs currently underway
	Greely	New production wells (identified in 2013 IMP)
	Richmond	City-led Master Servicing and Functional Design Study for long-term needs currently underway
Wastewater	Carp	City-led Master Servicing and Functional Design Study for long-term needs currently underway
	Notre-Dames-des-Champs	Developer-led Master Servicing Study to support subdivision proposal. Opportunities for Local Improvement for existing residents on septic systems to be considered

12.5 Privately Serviced Villages

Most villages within the City's rural area rely entirely on private water and wastewater services. No water or wastewater infrastructure projects are planned in these villages. In some cases, growth on private services in the villages may be constrained due to local hydrogeological conditions.

12.6 Rural Industrial and Logistics Areas

The 2022 Official Plan established a Rural Industrial and Logistics designation for appropriate lands that are strategically located near interchanges. Four such areas are identified on Schedule B9 of Volume 1 of the Official Plan:

- Carp Road Corridor
- East of the Village of Fallowfield, west of Highway 416
- Northeast of the Village of Greely
- Southeast of Highway 417/Boundary Road interchange

These areas are intended to be strategic locations for a cluster of uses that benefit from access to a highway, such as freight transfer. Future development is to be supported by individual private wells and sewage systems. The City may permit development of small water and wastewater systems in accordance with Section 9.3.1.3 of the Official Plan.

No water, wastewater or stormwater infrastructure projects are required or currently planned for any of the Rural Industrial and Logistics Areas. However, municipal servicing does exist or potentially could be provided as described below.

- Policies that could enable partial or full municipal servicing for rural areas where the is a unique economic development opportunity are outlined in Official Plan section 4.7.2. The Carp Road Corridor could be eligible for servicing based on these policies, although a unique economic development opportunity has not yet been demonstrated.
- The Boundary Road industrial area is currently serviced with municipal water from the Carlsbad Trickle Feed System. No capacity improvements to this system are planned and this may limit development on public water service in areas designated for development. The area covered by this system corresponds to the new Tewin community. As a result, part or all of the system will be replaced by a standard urban water supply system as described in Section 8 of the IMP.

12.7 Rural Lot Creation

There are three rural designations in the Official Plan besides Villages: Agriculture and Resource Area, Rural Countryside, and Rural Industrial and Logistics. Within the Agricultural Resource Area designation, the intent is to protect the land for long-term use for agricultural production, and as such development potential for non-agricultural uses is limited. Residential lot creation is highly restricted on agricultural land. The Rural Countryside designation is intended to include a variety of low intensity uses such as farming, small-scale industries, and outdoor recreation and tourism supportive uses such as golf courses, vacation properties or bed and breakfasts. There are policies pertaining to multi-residential developments, servicing of development, lot creation, and country lot estate subdivisions within the Rural Countryside. Municipal water and wastewater services are not intended to extend into the rural area outside of Villages, with some exceptions identified in Subsection 4.7.2 of the Official Plan. Development within 1 kilometer of a Village or Urban Boundary will be reviewed to confirm that the use can be adequately serviced by on-site systems and will not require the extension of public services for any reason (Official Plan, 9.2.2.3).

With the aim of limiting the fragmentation of rural lands and ensuring the preservation of public health, lot creation for residential uses is prohibited within the Rural Countryside designation unless a series of conditions are met. This includes minimum sizes for the severed and retained lots, and the availability of adequate servicing that will not adversely affect groundwater or the safe operation of wastewater systems on adjacent lots (Official Plan, 9.2.3.3). The Official Plan requires that new lots not be created from a lot within a registered plan of subdivision unless the severed and retained lots have a minimum size of 0.8 hectares, both the retained and severed lots can be adequately serviced, and the water and wastewater systems of adjacent developments are not adversely affected (Official Plan, 9.2.3.5).

Country lot estate subdivisions are prohibited in the Rural Countryside designation (Official Plan, 9.2.3.4), except for those that were received and deemed complete by December 31, 2009, or those that meet the conditions of a growth management policy aimed at focusing growth in Villages. The growth management policy in Section 3.4 Policy 8 of the Official Plan enables transfers of country lot subdivisions subject to conditions, including that draft or final approval or registration was received prior to December 31, 2009, and that the new location abuts a Village boundary. The policy lays out a process for formal deregistration of subject lands at the Land Registry Office and the removal of the country lot subdivision's zoning permissions at the previous location. If on private servicing, new residential lots created in this manner must be a minimum of 0.4 hectares (1 acre) in area. If full municipal services with sufficient capacity are available and the systems of nearby development will not be affected, then public services may be provided and lot sizes could be reduced. In all cases, the development shall be serviced by adequate water quality and quantity, and shall not adversely affect the water and wastewater systems of nearby development.

12.8 Enclaves on Partial/Private Services Within the Designated Urban Area

Annex 9 of the Official Plan identifies areas within the Urban Area that are on partial or full private services for water and wastewater. These areas consist of older developments, typically located where municipal servicing was not readily available when the local community was established, and may remain a challenge to provide under existing conditions. Some of these areas may connect to municipal services in time, through resident-funded *Local Improvements*, but some may remain on private services. The following are the major privately serviced enclaves, as shown in Appendix A, Schedule 4:

- Pineglen
- Riverside Drive
- Grenfell Glen
- Cedardale
- Ashdale
- South Merivale
- Heart's Desire
- Honey Gables
- Gloucester Glen
- Cedardale

PART VII – INTENSIFICATION CAPACITY MANAGEMENT

13 Intensification Capacity Management

13.1 Overview

The Official Plan anticipates intensification rates increasing from 40% of total development to 60% by 2046. An additional 140,000 persons are expected to be added to intensification areas. High density residential intensification growth is expected to be concentrated in specific geographic areas (intensification hubs), along key transit corridors, and in areas zoned for high density residential uses. Lower density residential intensification, by contrast, is expected to occur throughout the existing serviced area, particularly in older neighbourhoods.

The information in this section represents a summary of the various studies that were conducted to understand the impact of intensification growth on infrastructure systems, particularly at the local level, and to identify recommendations on how to support intensification. These studies are listed in Appendix B.

These studies led to a recommendation to implement two new programs to address the impacts of intensification, as described in Section 13.4:

- On-Site Stormwater Management
- Infrastructure Capacity Management

13.2 Infrastructure that Supports Intensification

As part of the IMP process, the City reviewed backbone infrastructure capacity and the impact of growth within the existing Public Service Area. While the impacts of intensification on backbone infrastructure can be predicted with satisfactory accuracy, the timing and location of redevelopment at a local level is very challenging to forecast. As a result, it is difficult to accurately assess the impact of intensification on local municipal infrastructure. Furthermore, many smaller residential developments are not subject to Site Plan Control and are therefore not subject to existing capacity assessments.

Backbone systems: *infrastructure capable of conveying high flows and serving large areas (large diameter pipes, pumping stations, water storage facilities).*

Local systems: *infrastructure serving individual streets and small neighbourhood areas (small diameter pipes, low-capacity pumping stations).*

Intensification-focused programs and policies are required to address the servicing of these properties with existing infrastructure systems while maintaining existing levels of service.

These programs will also help the City respond to new provincial housing targets (in excess of Official Plan projections) and new permissions under *Bill 23, More Homes Built Faster Act,* allowing up the 3 dwelling units per lot. Supporting intensification policies related to infrastructure are provided in Section 4.3 of this plan.

Capacity is generally available in existing sanitary and water infrastructure systems to accommodate some intensification. Leveraging available existing system capacity where possible has reduced the cost of intensification development projects. However, all systems have a finite capacity. These capacities vary across the City and each local area can accommodate a different amount and type of intensification before upgrades are needed. Upgrades to backbone water and wastewater systems to accommodate intensification to 2046 are identified in the Water and Wastewater Master Plans. However, these plans do not address potential limitations in the local pipe networks that connect to the backbone systems.

With increased intensification in the future, the City can no longer broadly rely on residual capacity to avoid local system capacity upgrades. Impacts are already being observed in ditch-drained areas where infill intensification projects not subject to Site Plan Control is generating more runoff. This trend is expected to continue with the passing of *Bill 23*. Climate change will place further limits residual capacity in existing systems.

The key intensification challenges can be summarized as follows:

1. Maintaining existing levels of service for **urban drainage** as intensification proceeds.
2. Managing **infrastructure capacity** of the drinking water, sanitary sewer, and combined sewer systems as intensification proceeds.
3. Managing the impacts of **climate change** related flooding impacts as intensification proceeds.

13.3 Practices and Conditions that Support Intensification

The following section provides an overview of current and historical City practices, conditions, opportunities and challenges. This background is necessary to inform improvements infrastructure-related processes and planning. A more in-depth analysis of this background information and how it will be used to support intensification and housing growth with can be found in supporting studies for intensification, as listed in Appendix B.

13.3.1 Historical Practices

Residual Capacity Usage

Historically, rates of intensification have generally not triggered the need for capacity upgrades because:

- Infrastructure design has been based on very conservative estimates of per capita water consumption;

- Per capita water consumption has declined over the last several decades;
- Redevelopment of properties has created opportunities to disconnect foundation and roof drains from older sanitary systems that allowed for these connections when originally designed;
- Minimum pipe sizing in local systems to support maintenance often exceeds the required sizing for capacity; and
- On-Site SWM has been a requirement for larger projects subject to *Planning Act* approval processes.

As a result of the increased intensification rates proposed in the Official Plan, the City can no longer consistently rely on these factors to avoid local system capacity upgrades. Capacity-related issues specific to stormwater and drinking water systems are described below.

For stormwater systems, incremental increases in impervious surfaces create more runoff and greater risk of flooding during small and large events. All stormwater pipe networks effectively already operate "at capacity" because they are sized for small events only (2 to 5 year return period), and excess runoff must be managed as overland flow on City streets, drainage easements and in watercourses. As described in Section 9.3.1, there are no engineered overland flow routes in many older development areas, and surface flooding commonly occurs in large events. The City continues to identify, plan, and implement projects to mitigate impacts related to historical development based on outdated standards.

The sizing of local drinking water systems is driven by fire flow requirements. Therefore, intensification will not impact the ability of existing systems to deliver water at sufficient pressure under normal operating conditions. However, fire risks associated with intensification must be managed through appropriate fire response models, strategic watermain upgrades, and conditions related to development approvals.

Upgrading Infrastructure through Development Charge Projects

Development Charges (DCs) provide a means of funding major infrastructure projects collectively by the development community. Projects must satisfy specific criteria, as described in Local Servicing Guidelines, per the City's Development Charges By-law. Generally speaking, the guidelines describe eligibility for major wastewater and water infrastructure projects that support growth, for more than one developer. DCs have not been used to fund small (local) watermains and sewers based on the City's Local Servicing Guidelines.

Upgrading Infrastructure Through the Renewal Program

End-of-life renewal of existing infrastructure provides cost-effective opportunities to improve the capacity of city-owned infrastructure to support intensification.

Upgrading infrastructure in advance of end-of-life renewal is a far more costly and challenging way of increasing capacity to support intensification. Funding does not currently exist in the renewal program to replace and upgrade infrastructure if done before the end of its functional life.

Opportunities to improve the overland drainage system are limited, whether at lifecycle renewal or earlier. This is primarily because topography, building elevations, road grading, and ROW widths are very difficult to change without affecting the neighbouring private properties.

Infrastructure Upgrades for Intensification that are Directly Funded by Developers

Where there is insufficient local capacity to support a new *Planning Act* application it is the responsibility of the developer to fund infrastructure capacity upgrades. This may cause delays to the project. Subsequent development projects may be able to take advantage of the additional capacity provided without contributing to the cost or may find that the upgrade was insufficient to meet their needs.

13.3.2 Planning Challenges

Accuracy of Local Development Projections

Individual development projects are challenging to forecast ahead of time at the IMP level. The 2046 population projections are sufficient for backbone infrastructure planning because any differences between the projections and actual future development at a local scale tend to even out at large scales.

Local scale differences between projected and actual development can have a significant impact on local infrastructure upgrade requirements. Individual development projects and the cumulative impact of these projects at a local area can trigger the need for capacity upgrades to the local infrastructure system.

Therefore, local area planning and engineering studies are needed to support local infill and intensification development projects and to identify what infrastructure upgrades are needed. Planning and implementation of these upgrades must be timely to meet the needs of development.

Existing Approval Processes

Applications subject to *Planning Act* processes, including Site Plan Control, Zoning By-Law Amendment, Plan of Subdivision and Plan of Condominium, provide the opportunity to verify that sufficient capacity is available in the existing local water and sanitary system for an individual development application. However, there is no existing process or legal mechanism currently in place to verify capacity for small projects that are not subject to *Planning Act* approvals. This challenge has increased as a result of the recent enactment of *Bill 23*. Under this legislation, developments of 10 dwelling units or less are now exempt from Site Plan Control.

13.3.3 Drainage Challenges

Challenge with Cumulative Effects of Incremental Increased Imperviousness

All drainage systems have a finite capacity. Incremental increases in impervious surfaces create more runoff and greater risk of flooding from small and large storm events.

Residents tend to increase hard surfaces on their properties over time through home improvement projects. Surface drainage can also be altered when changes are made to property grading, driveways, ditches, and structures. These changes usually happen gradually over long periods of time.

Residential intensification increases the cumulative impacts through:

- Increases in hard surfaces on individual lots through additions and full re-development;
- Increased building footprints;
- Severances of existing lots allowing for more units to be built;
- Reducing space available for overland drainage on and between properties; and
- Reducing space for pervious surfaces and trees which reduce runoff by absorption and evapotranspiration of rainfall.

Significant cumulative effects can result from the net increase in impervious area at the neighbourhood scale as individual lots intensify. These effects include an increased occurrence, frequency and/or severity of flooding on the lot, on adjacent properties, and on the road. These effects may also be exacerbated by climate change, which is tending to increase rainfall volume and the frequency of both small and large storms.

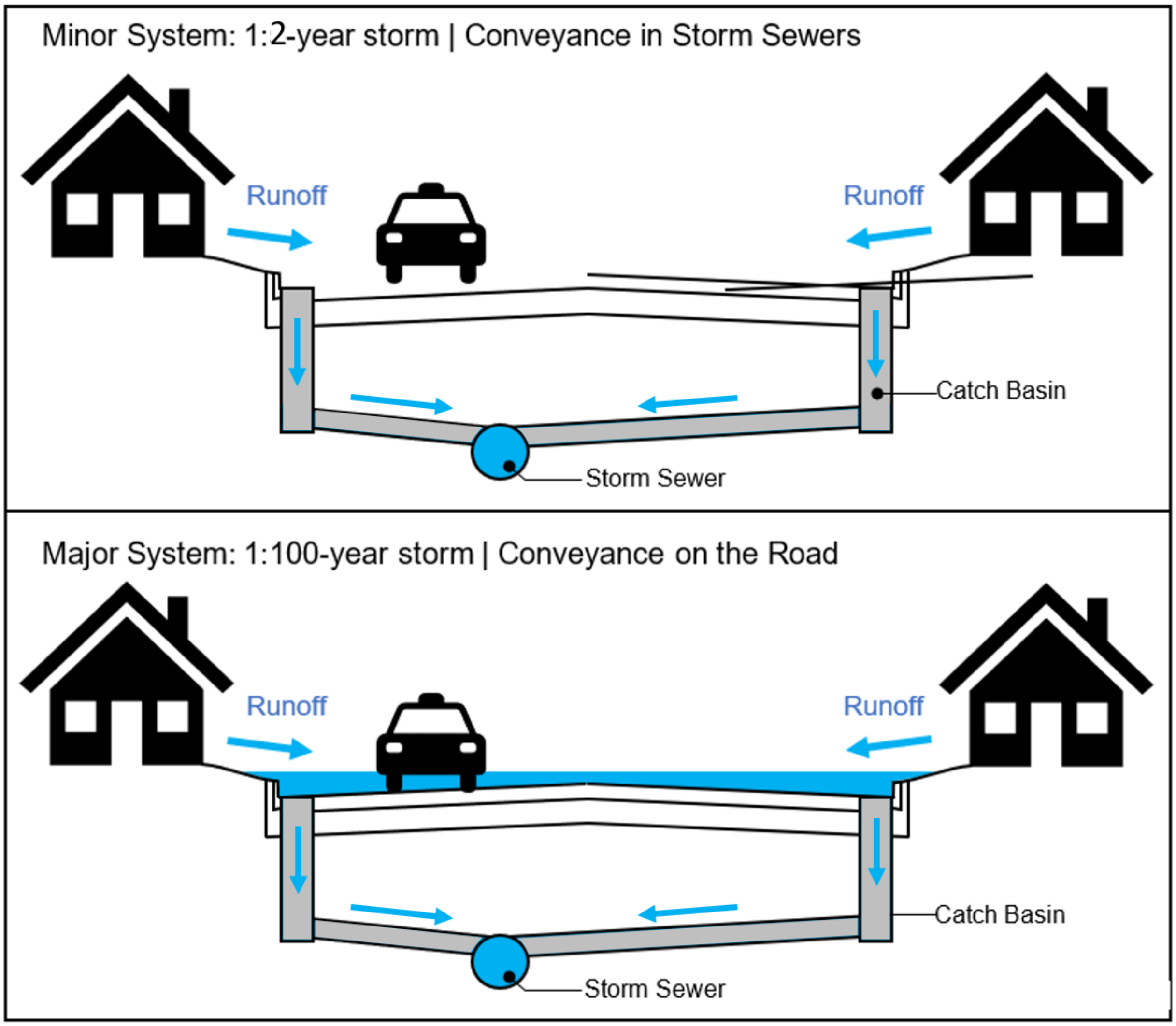
Background – Premise of Dual Drainage: Two connected systems of drainage

As described previously, storm sewer systems and ditches are designed for small, frequent storm events only. Sewers and ditches are known as the “minor” system. In larger storm events that exceed the capacity of the minor system, the excess runoff will drain overland through the “major” system – typically the road network, other corridors, or accumulate in low points in the road until it can drain into a sewer. A conceptual illustration of the major and minor systems is shown in Figure 13-1.

The ground surface and elevation of lots and roads in new neighbourhoods are designed so that excess runoff from larger, less frequent storm events can eventually reach a watercourse via the major system which, like the minor system, also has a finite capacity. Any hard surfaces that were not considered in the original design will contribute to increased overland flood risk. However, controlling inflows to limit them to the capacity of the storm sewer and adding backflow prevention valves where there is a risk of sewer surcharge, and effectively eliminate the risk of sewer back-up into basements.

Older neighbourhoods did not consider excess runoff in their design and some homes in these neighbourhoods have already experienced overland flooding. It is very difficult to fix overland flow problems because of the presence of homes, driveways, and roads that cannot be moved, and very limited opportunities to adjust grading at a neighbourhood scale.

Figure 13-1: Typical Dual Drainage Storm System in the City Right-of-Way



Challenges due to Private Property Constraints

Incremental changes to grading, lot coverage and landscaping on private property tend to occur gradually over time. The City has limited ability to monitor and control these changes.

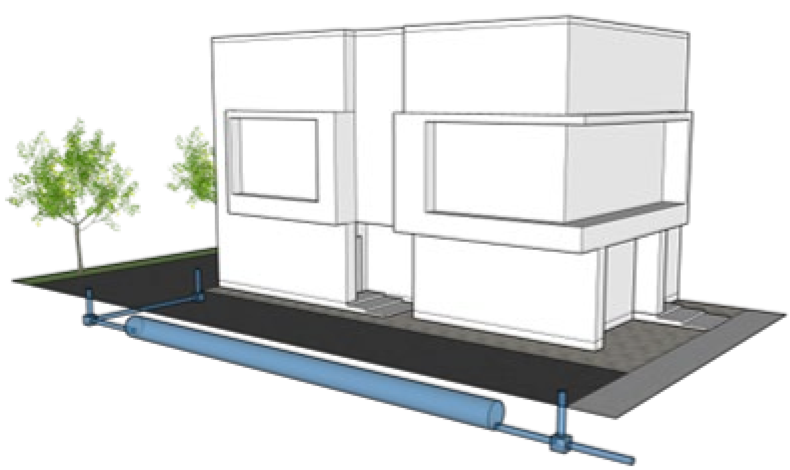
Rear yard drainage is often designed during original subdivision development as an integrated system that drains multiple private properties. Restoration or improvement of drainage capacity in these systems cannot usually be accomplished by the City because it does not own the properties, easements may not exist, and/or there is insufficient access for construction equipment.

Current Practice: On-site Stormwater Management (On-site SWM) under Site Plan Control

On-Site Stormwater Management (On-Site SWM) is already a requirement for development projects that are subject to *Planning Act* approval processes, such as Site Plan Control. On-site SWM is not, however, a current requirement for development that only require a building permit. On-site SWM allows development to proceed while making effective use of the existing drainage system capacity. The intent is to mitigate the impact of new hard surfaces added to a property through redevelopment. This mitigation occurs before the runoff leaves the site. It involves the capture and storage of stormwater on the property. Stormwater is slowly released from storage into the City's drainage systems to match the peak rates of runoff that occurred prior to redevelopment.

On-Site SWM can also improve rear yard drainage systems on private property by collecting and controlling the runoff on each property that undergoes development. Figure 13-2 provides a visual example of pipe storage to manage stormwater onsite.

Figure 13-2: Conceptual On-site Stormwater Management System for a Small Residential Site



13.4 Proposed New Programs

As described in the sections which follow, a new **Intensification Servicing Program** is needed, including two (2) distinct components to manage infrastructure in support of increased intensification. The following sections will discuss alternatives and provide further rationale for these programs, describe key technical challenges, identify business process change requirements, discuss implementation challenges, and recommend next steps for the following proposed programs:

1. On-Site Stormwater Management: A program to manage urban drainage as intensification proceeds.

2. Infrastructure Capacity Management: A program to manage infrastructure capacity of the local pipe systems as intensification proceeds.

Program sheets that describe each of these new programs is provided in Appendix G. Information provided in these sheets includes program rationale, schedule, program funding and administration, and follow-up actions.

13.4.1 On-Site Stormwater Management Program

The following presents a high-level summary of the evaluation of alternatives, challenges related to stormwater management, the impacts on urban drainage systems, and the current practices that may be applied to mitigate those impacts. The analysis of the strengths and weaknesses of current practices informs the program development recommendations that follow.

13.4.1.1 Options to Mitigate Intensification Impacts on Urban Drainage

To addressing the cumulative impact of increased runoff as a result of intensification, the following options were considered:

1) **"Do Nothing"**
   - Developments that are subject to *Planning Act* processes would continue to require On-Site SWM where the development involves a net increase in hard surfaces.
   - Developments that are not subject to *Planning Act* processes (including sites exempted by recent provincial legislation) would continue to be exempt from On-Site SWM.

   The result of the "do nothing" option would be a reduction in drainage system performance and increase in flooding risks as intensification progresses. Pilot area studies have been completed to assess these potential impacts.
2) **Municipal Drainage System Upgrades**
   - On-site SWM requirements would be the same as discussed in Option 1.
   - Studies would be prioritized to identify drainage system upgrades involving upsizing of existing sewer systems and adjustments to overland flow systems where feasible.

   Municipal drainage system upgrades are very expensive and require long lead times to implement. In the interim, if intensification continues to proceed in areas that have not be upgraded, flood risks will increase. Furthermore, larger storm sewers cannot address rear-yard flooding or major overland flow. As described previously, opportunities to improve the overland drainage system are limited.
3) **On-Site Stormwater Management**
   - Developments that are subject to *Planning Act* processes would continue to require On-Site SWM.

- Small residential developments of 4-10 residential units would require On-Site SWM as required until recently as a result of Bill 23 and previous City changes to planning approval requirements.
- Developments that were not previously subject to Site Plan Control (developments of 1-3 units) would also be evaluated for an On-Site SWM requirement.

The result would be that the net impacts of intensification would be effectively mitigated by the development itself and new development would not exacerbate existing drainage issues.

The following Table 13-1 summarizes the evaluation of these options to mitigate the impacts of intensification on urban drainage.

Table 13-1: Evaluation of Options to Mitigate Impacts of Intensification on Urban Drainage

Criteria	1. Do Nothing	2. Municipal Upgrades	3. On-Site SWM
Impacts to Level of Service	Flood risk increases as intensification proceeds.	Flood risk increases until future upgrades partially mitigate the increased risks.	Flood risk generally maintained as intensification proceeds; rear yard flood risk likely decreases.
Effectiveness	Ineffective at controlling runoff from any development not subject to Planning Act processes.	Does not address rear-yard flooding. Sewer sizing based on best guesses of the extent and timing of new hard surfaces.	Effective. Sizing based on the specific details of the development proposal. Solution will mitigate rear-yard flooding.
Cost	Increased flooding costs borne by residents.	Extremely high cost borne by development industry and residents.	Additional cost to developments not previously subject to *Planning Act* processes. Costs are shared by all residential units created in the intensification project.
Construction Impacts	None.	Extensive across the city.	Limited to the development itself.
Construction Delay	Not applicable. Status quo.	Century time scale: implementation period in the order of 100 years.	Implemented "just in time" to mitigate impacts for each proposed development. No delay to development required.

Criteria	1. Do Nothing	2. Municipal Upgrades	3. On-Site SWM
Program Implementation	No new intensification programs created. However, this option further burdens the City's efforts in flood mitigation.	Significant challenges including staff and funding resources to carry out local studies; identify, prioritize, plan, and implement projects.	Requires an approval process for developments not subject to *Planning Act* processes. New guidance and tools required to minimize approval timelines and confirm consistent implementation.
Legal issues	City, developers, and new property owners potentially liable for flooding impacts.	Legal mechanism needed to collect fair cost contribution from development industry.	Requires a new regulatory enforcement mechanism for developments not subject to *Planning Act* processes.

Recommended Option to Mitigate Impacts of intensification on Urban Drainage

On-Site Stormwater Management (On-Site SWM) is the recommended solution to mitigate the impacts of intensification on urban drainage systems. This solution has many benefits in terms of supporting intensification and maintaining the level of service in existing neighbourhoods:

- Housing supply can continue to increase through intensification without increasing flood risk.
- On-Site SWM is sized for hard surfaces not housing units. Cost per dwelling unit decreases as number of units increase per property and therefore the approach encourages projects that increase population density.
- On-Site SWM does not require accurate estimation of future build-out conditions. On-Site SWM would be sized correctly for each development as it occurs when precise information about the project is known.
- On-Site SWM does not require stormwater system capacity assessment for each individual development application.
- On-Site SWM occurs only when and where needed: mitigate development delays for planning, design, and implementation of extensive storm sewer upgrades.
- Development is not restricted by current urban drainage system capacity because it will not increase flood risk or decrease drainage performance.
- Developers have flexibility to meet On-Site SWM requirements using various methods.
- On-Site SWM improves rear yard drainage one lot at a time. Rear-yard catchbasins can reduce flooding in rear yards by directing the runoff to the storm sewer instead.
- On-Site SWM avoids extensive construction impacts to public roads.

13.4.1.2 Program Development Recommendations

Program Objective

The objective of the On-Site SWM program is to meet the intensification goals of the Official Plan while not increasing flood risk to existing properties.

Program Description

This program is an extension of On-Site SWM requirements currently imposed on properties that are subject to *Planning Act* processes, including Site Plan Control, Plan of Subdivision or Plan of Condominium. Under the proposed program, the stormwater management requirement will also apply to low-rise residential intensification projects that only require a building permit, when the project involves a net increase in imperviousness. The program is intended to improve on-site and rear yard drainage as well as control flows from the property to the municipal drainage system. Options for on-site control include:

- Surface, underground, or rooftop storage;
- Low Impact Development (LID) measures; or
- A combination thereof.

The requirements will apply within the urban serviced area and rural village boundaries for building permit applications not subject to *Planning Act* processes. Depending on the increase in imperviousness, SWM requirements may also apply to additions to existing residential buildings or accessory structures with a footprint exceeding 55 m^2 or closer than 1.2m to the property line.

Program Implementation

The City is now in the process of developing resources such as design tools, standards, guidelines, specifications, pre-approved products, and sample drawings to provide consistent and effective On-Site SWM systems.

Key challenges for the successful implementation of this program involve the development of a new regulatory enforcement mechanism and a new streamlined review process for developments not subject to Planning Act approval processes. The process will be designed to avoid delays in the building permit approval process. Securing easements to protect existing overland flow paths through private property through the development approvals process will improve the City's ability to manage overland flow but is anticipated to be challenging in some situations.

The City is currently reviewing various regulatory tools. Refundable securities are recommended to facilitate compliance.

The approval process is expected to involve integration with the current building permit grading review to leverage synergies between grading and SWM.

Program Resource Requirements

The City is currently assessing staffing resources and development fees needed to support the program. The program is anticipated to be launched in 2025 subject to approval of this IMP. Details will be provided in the Committee Report to Council. A robust annual monitoring program will be implemented to confirm resources match work volume to provide timely service delivery. Periodic improvements and refinements are expected as the program matures.

Complementary Actions

In addition to this program, the City will continue to employ a range of other actions to improve levels of service and reduce flood risk under current and future climate conditions. These include:

- Sewer upgrades and strategic re-grading at the time of end-of-life renewal;
- Backwater valve and sump pump program to protect basements from sewer surcharge;
- Improvements to existing ditch systems in urban areas; and
- Rain Ready Ottawa initiatives.

Further discussion about the key findings, program directions, implementation and cost challenges related to the On-site Stormwater Management program is found in supporting studies about Intensification, listed in Appendix B.

13.4.2 Infrastructure Capacity Management Program

The second component of the recommended Intensification Servicing Program is a new Infrastructure Capacity Management Program (ICMP). A high-level summary of the constraints and opportunities of current infrastructure systems and current infrastructure capacity management practices is provided in the sections which follow. This analysis of the strengths and weaknesses of the current state informs the ICMP recommendations that follow. A more in-depth analysis of current practices and challenges to support intensification and housing growth with sufficient drinking water, wastewater, and stormwater infrastructure is discussed in the supporting studies for intensification, listed in Appendix B.

13.4.2.1 Infrastructure Constraints and Opportunities

Storm Drainage Infrastructure (Pipes and Ditches)

As described previously, storm sewers and ditches are generally only designed for small storm events (minor event). Runoff from large events (major event) must be conveyed overland to a suitable drainage outlet. In very large events in many older areas, overland drainage can exceed the capacity of the roadway and spill onto private property. This can lead to property and basement flooding.

Building elevations are a key factor affecting resilience to flooding:

- Buildings that are close to the road elevation are more likely to flood when runoff accumulates and overtops the curb.
- Deep basements are closer to the groundwater table and are at greater risk of flooding as rainfall infiltrates into the ground.
- Basements without functioning backwater valves that are close to the sewer elevation are more likely to flood if the sewer surcharges in an extreme event.
- Depressed driveways that slope towards the building can funnel runoff from the road towards building creating a risk of flooding.

Furthermore, existing topographic constraints (building elevations, driveway elevations, road elevations, road widths, road slope) presents major challenges to improving overland drainage and reducing the risk of property and basement flooding.

Water Infrastructure

Local water distribution systems are sized based on firefighting needs. As intensification takes place, factors such as building size, separation between buildings, building materials proposed in the new development, and building uses generally yield an increase in potential water demands for firefighting.

The increase in normal water demands that occurs as a result of intensification is not significant compared to available capacities in existing watermains to fight fires. In certain situations, the increase in flow through local watermains that results from intensification can be beneficial, as it reduces or eliminates flushing requirements to maintain water quality standards.

Wastewater Infrastructure

In many older areas of the city, foundations and roof drains were connected to the sanitary sewer at the time of construction. The contribution of flow from these sources typically exceed the sanitary sewage flows in long rainfall events. Many roof drains have since been disconnected to reduce peak demand on sanitary capacity during wet weather conditions. Foundation drains are much more difficult to disconnect. The best opportunity to disconnect foundation drains in many cases is during redevelopment of an existing property.

Wet weather conditions can also result in sewer surcharge due to leaks in the pipe network. Water can enter through cracks when the groundwater is high and when rainwater infiltrates below the ground.

In extreme events, water can enter the sanitary system through holes in older maintenance hole covers.

13.4.2.2 Current Capacity Management Practices

Current Practice

A range of practices are currently employed to manage infrastructure capacity. The City has a program to study existing local systems that have existing performance issues to identify where upgrades will be cost-effective. This program is generally driven by complaints about surface or basement flooding, or unsatisfactory water pressure. The City also has a program to identify and prioritize end-of-life renewal of existing infrastructure to ensure that it is maintained in a state of good repair. Renewal of infrastructure provides opportunities to improve infrastructure performance through changes in design, rather than "like for like" replacement. It also provides opportunities to upsize existing infrastructure to accommodate planned intensification.

Limitations of Current Practice

Generally, City staff are available to verify that sufficient system capacity exists for development applications, however this is not generally done for building permit applications not subject to *Planning Act* approval processes.

There is currently no program that proactively studies local areas to identify the cumulative impacts of intensification and implement upgrades needed to support intensification.

Recommended Program to Mitigate Impacts of intensification on Infrastructure Capacity

A new Infrastructure Capacity Management Program is necessary to:

- Support intensification;
- Identify the most appropriate intensification-driven upgrades to local systems that will meet long-term needs;
- Ensure adequate capacity is available for individual development projects; and
- Manage risks to level of service due to intensification and climate change.

In the absence of such a program:

- More development projects will be stalled due to lack of local infrastructure capacity and/or be faced with major off-site costs;
- There will not be a fair allocation of costs to those who benefit from projects that increase local capacity;
- Performance of existing local systems may deteriorate, potentially resulting in reductions in level of service; and
- Projects will not be optimized to meet long-term needs.

13.4.2.3 Program Development Recommendations

Program Objective

The main objective of the Infrastructure Capacity Management Program is to plan for adequate servicing capacity to meet the intensification goals of the Official Plan, as well as confirm that an appropriate level of service is maintained in existing development areas.

Program Description

This program will bring together existing processes currently used to support development. This includes the City's renewal program, Development Review support, and project funding identification and management. It will involve the following key components:

1. Local Intensification Planning and Servicing Studies

   Similar to greenfield development, servicing studies are needed within the existing built area where intensification is anticipated. Servicing studies must be supported by detailed planning studies. This would include working collaboratively with developer stakeholders and local communities. This should be done in conjunction with Secondary Planning processes where applicable and are normally City led. Financial Plans for these studies will be needed as described below.

2. Project Scoping and Delivery

   Projects identified by servicing studies must be scoped through a functional design process to identify the detail needed to support more detailed design and construction. In addition to creating capacity for intensification, these projects may also be leveraged to improve level of service to existing residents (such as reducing flooding issues, reducing surcharging, and improving availability or pressure of water) and the costs would be fairly allocated to existing ratepayers where appropriate, based on the "Benefit to Existing" calculations as described in Appendix H. Scoping would normally be completed by the City whereas design and construction could be carried out by the City or a developer through an agreement.

3. Project Funding and Financing

   Funding sources and financing plans for projects identified through individual studies under the program will need to be established based on a fair allocation of costs as described above. Section 15.6 provides further information on funding for the Intensification Capacity Management Program and associated infrastructure projects.

4. Study and Project Prioritization

   Studies and capital projects will need to be prioritized based on several factors including development pre-consultation activity, industry consultation, areas of known capacity limitations, risks to level of service posed by intensification, and funding availability.

5. Development Capacity Assessments

   As per the policies in Section 4.3.7, the City will complete capacity assessments of existing water and sanitary systems to confirm availability of capacity for development applications. A new regulatory process is required for projects no longer subject to *Planning Act* processes.

6. Flow Monitoring, Modelling, and Capacity Tracking

   To inform servicing studies, optimize servicing solutions, and avoid unnecessary projects, the City will enhance its understanding of capacity utilization throughout its sewage collection systems. This would include strategic flow monitoring, calibration of local area models, and tracking of the allocation of capacity to individual development projects.

7. Flow Removal

   Significant wet weather flow contributions can sometimes be removed to improve sanitary sewer capacity and minimize construction costs. Flow monitoring and modelling and extraneous flow source investigations such as smoke and dye testing will be used to determine the opportunities for, and the cost-effectiveness of, flow removal projects. Foundation drains will also be disconnected through redevelopment of individual residential properties.

8. Flood Protection for Redeveloped Properties

   Surface drainage models will inform minimum construction elevations and the need for easements to maintain existing drainage across the property. Flood risks can also be reduced at the time of development through the installation of backwater valves and elimination of depressed driveways.

9. Fire Risk Mitigation

   Risk associated with increases in potential water demands for firefighting will be addressed through the following strategies:

   - Strategic intensification-driven upgrades of existing watermains, extension of watermains, and additional hydrants;
   - Updates to firefighting response models based on area-specific risk information; and
   - On-Site fire risk reduction measures identified as part of the development review process.

10. Water Loss Reduction and Water Demand Management

    Increased efforts to reduce drinking water losses in the water distribution and manage water demand will help meet intensification needs while minimizing infrastructure upgrades. See Section 6.7 in the Water Master Plan for more details on water loss prevention initiatives.

Further discussion about the key findings, program directions, and implementation and cost challenges related to an Infrastructure Capacity Management program can be found in supporting studies, listed in Appendix B.

Program Implementation

Key implementation challenges include the establishment of:

- An appropriately staffed program as intensification development continues; and
- Funding mechanisms for capital projects identified under the program.

Other challenges for the successful implementation of this program include information management and coordination between existing City program including community planning, infrastructure planning, development approvals, the City's renewal program, and design & construction.

Verification that sufficient capacity is available for individual development projects involving 10 dwelling units and less will require the development of new streamlined processes that are not tied to *Planning Act* approval processes. Similar to the approach taken by the City of Hamilton, these may include a combination of provisions in the Zoning By-law and a new process to verify capacity prior to issuance of a building permit.

Program Resource Requirements

It is recommended that two permanent and one temporary staff positions be created to set up the new program and manage infrastructure capacity to support on-going intensification. It is likely that the program will ultimately require additional resources to meet program demands. The program is anticipated to be launched in 2024 subject to approval of this IMP (and/or the 2024 City budget). A robust annual monitoring program will be required to assess on-going levels of effort and work volume to ensure that the program is adequately staffed and is able to provide timely service delivery. It is also recommended that staff report to Council within two years of IMP approval with a review of program and resource requirements.

Complementary Actions

In addition to the proposed Infrastructure Capacity Management Program, the City will continue to employ a range of other actions to improve levels of service in neighbourhoods and reduce flood risk under current and future climate conditions. These actions include:

- Backwater valve and sump pump program to protect basements from sewer surcharge;
- Increasing pipe capacity at lifecycle renewal; and
- Sealing perforated maintenance hole covers.

13.4.3 Project Funding and Financing

Projects that are identified and scoped through the Infrastructure Capacity Management program will be needed to support intensification. Funding and financing may vary depending on the scale of the project, the benefit that the project provides to existing and future development, and the desired project timing. Larger projects with longer lead times (such as those identified in the Wastewater Master Plan) may be funded mainly through Development Charges, subject to eligibility criteria. Upgrades to local systems will generally not meet the criteria to be eligible for project-based Development Charges funding. This topic is further discussed in Section 15.6.

PART VIII – PLAN IMPLEMENTATION

14 Capital Project Implementation

14.1 Overview

This section provides information on the steps required for implementation of capital projects identified in the IMP, as well as related considerations. Project implementation will generally be the City's responsibility. However, implementation may be the responsibility of a landowner group in cases where the project is directly associated with a Master Servicing Study for an urban expansion area or village. Individual developers may also choose to front-end a project if it is needed to support development before the City has budgeted to design and build the project.

14.2 General Process

Project implementation will generally involve the following:

- Functional Design and Class Environmental Assessment;
- Preparation of Class C capital estimate and confirmation of required year of commissioning;
- Approval of spending authority through City capital budget process;
- Preparation of Project Charter;
- Preliminary and detail design;
- Tendering and construction; and
- Commissioning and final acceptance for City operation and maintenance.

Details regarding key steps in the above process are described below. Funding and financing issues are discussed in Section 15 Infrastructure Affordability and Financing. Further explanation of the Municipal Class Environmental Assessment process is found in Section 16 Approvals, Monitoring, and Amendments.

14.2.1 Functional Design and Class Environmental Assessment

Each project identified in the IMP is conceptual. A functional design process is required to properly scope the project for design and construction. That process will involve consideration of high-level alternatives (if any) such as alternative corridors for linear (pipe) projects and alternative property locations for facility projects in the general area required. Project sizing will be confirmed, and further detail established to allow the project to be scoped for design and construction. Class 'C' cost estimates will be prepared as part of the functional design.

For projects involving upgrades to existing facilities, any renewal or upgrades unrelated to capacity are identified as part of functional design. Only the costs that are related to capacity increases will be allocated to growth. The remaining costs will be covered by the City's rate budget through a separate capital account.

Class Environmental Assessment requirements, if any, will be addressed as part of the functional design process. For Schedule 'B' projects, this will involve a formal evaluation of alternatives, public consultation, and selection of a preferred alternative. These alternatives will be consistent with the project concept and qualifications identified in the IMP.

The functional design (and any Class Environmental Assessment requirements) for linear projects that connect directly to a specific expansion area may be completed by a landowners' group as part of a Master Servicing Study for the area. This would be done as part of a Community Design Planning process. A formal evaluation of alternative alignments for these projects would generally be required through that process. As further clarification to Official Plan policy 4.7.1 (14), consideration may be given to alignment of linear infrastructure outside of a settlement area if it can be demonstrated that the alignment is preferred based on the results of the evaluation, subject to Council approval of the Master Servicing Study. The Master Servicing Study Financial Plan will need to identify how any incremental costs for the project, over and above the alignment identified in the IMP, will be funded and financed, with supporting rationale provided.

14.2.2 Detail Design and Construction

Once the functional design process is complete, a project charter is prepared which defines the full scope of work required, including possible coordination with other City projects within the same corridor or area. Project funding sources for all components of the project are identified and sufficient spending authority confirmed.

Typically, a Request for Proposal is prepared and competition held to identify a consulting team that will complete the design. Class B (preliminary design) and Class A (detail design) cost estimates will be prepared as part of the design process. Once adequate funding is confirmed based on the Class A estimate, the project is tendered for construction, with contract administration services generally provided by the consultant. Projects may be front-funded or front-ended by a developer. In this case, the developer covers the full cost of the project with subsequent repayment based on the City's front-ending policies. Depending on the project, either the City or the developer will be responsible for the design and construction, in accordance with City policies.

Any project that impacts federal land will require both a federal Impact Assessment process and a federal land use, design, and transaction approval.

15 Infrastructure Affordability and Financing

15.1 Overview

This section presents a consolidated summary of the estimated costs for the proposed infrastructure projects. It also summarizes who pays for different portions of the project costs and available financing mechanisms to the City. Affordability is defined and parameters for analyzing the City’s affordability of the IMP are identified. Discussion is provided for the Tewin development funding options. Also discussed are funding alternatives for projects that would be identified through the proposed Infrastructure Capacity Management Program.

Funding issues related to additional staff resources needed to support the overall Intensification Servicing Programs, are outside the scope of this section. These issues will be addressed in the staff report that seeks IMP approval.

15.2 Proposed Infrastructure Project Costs and Funding Sources

A summary of the overall costs of the capital program identified in the IMP is provided in Table 15-1. The total cost of the program is estimated at **$1.508B** with a BTE of about 17%. This does not include the growth projects associated with the water purification or treatment plants. The total costs of the plant projects to support growth is **$494M** with a BTE of 8%; details are provided in Table 15-2. Values shown are in millions of dollars (2024).

Table 15-1: Overall Capital Program Costs ($Million)

Projects (excl. central treatment plants)	2024-2029	2029-2034	2034-2039	2039-2044	2044-2046	Full Planning Period			
						Capital Cost	Growth (%)	BTE (%)	PPC (%)
Water Master Plan[1]	$95	$221	$0	$9	$0	$325	95	5	-
Wastewater Master Plan[1]	$139	$235	$172	$39	$7	$592	62	38	0
Tewin/SUC – Water[2]	-	$271	$114	-	-	$385	65	3	32
Tewin – Wastewater	-	$205	-	-	-	$205	77	-	23
Total	**$234**	**$932**	**$286**	**$48**	**$7**	**$1,508**	**72%**	**17%**	**11%**

[1] Excludes all project costs funded by Tewin.

[2] Includes share of project costs that benefit other growth areas outside NCC Greenbelt.

As all of the projects are driven by growth needs, the majority of costs are allocated to growth and are shown under the Growth heading. Portions of each project that provide a benefit to existing development are shown under the benefit to existing development (BTE) column. Various methods can be used to estimate the BTE provided by a project relative to the benefit provided to growth. The methods of calculation are being updated through the 2024 IMP process and are provided in Appendix H. As some projects have been oversized to accommodate growth beyond 2046, the additional capacity provided because of oversizing is referred to as “Post Period Capacity” and is shown under the ‘PPC’ column.

Development Charges (DCs) generally fund the portion of costs that support the projected growth for the 2046 Official Plan horizon. DCs are generally paid to the City by developers at the time that a building permit is issued, in accordance with the Development Charges Act. The City’s rate-supported budget for water and wastewater fund the portion of each project that provides a BTE. Users of water and wastewater pay for these services on their water/sewer bill. The PPC portion may be funded by future Development Charges through a new update to the City’s Official Plan that considers a new planning horizon that extends beyond 2046, and a subsequent DC Background study update. To support project implementation, PPC may be financed by the City or the benefiting developers.

The Overall Capital Program Costs (Table 15-1 above) identifies that approximately 17% of the total program will be funded from the City’s rate-supported budgets. The remaining costs are attributed to growth and will be funded by development, mainly through Development Charges**.** The project cost and timing information will inform the City’s growth affordability analysis to be presented within the IMP staff report to committee and council. In turn, the growth affordability analysis will inform the next update to the rate-supported Long Range Financial Plan. Future capital budgets will respect affordability limits and priority phasing of the projects identified in the Infrastructure Master Plan. Affordability and capital financing considerations are discussed in more detail in Section 15.3.

The master plans for the water purification and wastewater treatment plants are being prepared as separate planning initiatives. Table 15-2 summarizes the growth-driven projects required for the water purification and wastewater treatment plants based on currently available information. Until the capital implementation and financial plan are finalized for these master plans, the costs presented below for growth funding are based solely on the incremental need arising from development (BTE=0%), with the exception of the ROPEC Outfall expansion, and the Lemieux Island winter capacity upgrade. Gross project costs, including any condition-based renewal costs will be determined at the functional design stage. Renewal funding associated with the plants will be approved as part of the City’s annual Rate Supported Capital Budget. At the time of writing, the share of growth funding to be covered by Development Charge was unavailable for the ROPEC projects. For the Lemieux Island project, 100% of the growth funding as indicated in Table 15-2 is to be covered by Development Charges (no Post Period Capacity).

Table 15-2: Water Purification and Wastewater Treatment Plant Growth Projects ($Million)

Project	Total Capital Cost Estimate	BTE Share (%)	Capital Cost Estimate		Estimated Year Capacity Required [a]
			Rate (BTE)	Growth	
Lemieux Winter Capacity Upgrade – Basins 1-3	$35.3	25%	$8.8	$26.5	2029-2034
Subtotal - WPP	**$35.3**	25%	**$8.8**	**$26.5**	-
ROPEC Raw Wastewater Pumping – SOT Pumping Expansion	$43.7	-	-	$43.7	2024-2029
ROPEC Raw Wastewater Pumping – OCCPS Upgrade	$45.6	-	-	$45.6	2024-2029
ROPEC Screening and Degritting Facility Expansion	$2.1	-	-	$2.1	2034-2039
ROPEC Secondary Treatment Expansion	$7.6	-	-	$7.6	2024-2029
ROPEC Disinfection Expansion	$23.7	-	-	$23.7	2024-2029
ROPEC Outfall Expansion	$46.4	70%	$32.5	$13.9	2024-2029
ROPEC Anaerobic Digestion Expansion	$119.8	-	-	$119.8	2024-2029
ROPEC Biosolids Dewatering and Storage Expansion	$169.9	-	-	$169.9	2034-2039
Subtotal - WWTP	**$458.8**	7%	**$32.5**	**$426.3**	
Total – all plants	**$494.1**	8%	**$41.3**	**$452.8**	

Notes:

[a] Based on average day flow projections developed

Table 15-3 and Table 15-4 provide the list of proposed infrastructure projects for the Water Master Plan and the Wastewater Master Plan including timing, costs, and funding sources. The estimated year of implementation for each project is based on several factors including interpolation of projected demands, the scale of benefits provided, and risks to existing levels of service. Projects are otherwise distributed over time to address affordability considerations.

Table 15-3: Water Master Plan - Capital Program

Project Name	Area	Identified in 2013 IMP	Timing	Total Project Cost	DC (%)	BTE (%)	PPC (%)
Kanata West Feedermain Phase 2	Suburban west	Yes	2029-2034	$ 4,400,000	90	10	-
Kanata West Feedermain Phase 3	Suburban west	Yes	2029-2034	$ 6,000,000	90	10	-
Kanata West Feedermain Phase 4	Suburban west	Yes	2029-2034	$ 13,800,000	90	10	-
March Rd Upgrades	Suburban west	Yes	2024-2029	$ 5,000,000	90	10	-
Orleans Storage Upgrade	Suburban east	Yes	2029-2034	$ 154,400,000	100	-	-
New Watermain for Urban Expansion Area E-4 & E-5	Suburban east	No	2039-2044	$ 6,300,000	100	-	-
Ottawa South Storage Upgrade	Suburban southeast	Yes	2024-2029	$ 45,300,000	90	10	-
New Riverside South Elevated Tank	Suburban southwest	Yes	2024-2029	$ 33,800,000	90	10	-
Limebank Feedermain Phase 2	Suburban southwest	Yes	2024-2029	$ 11,100,000	90	10	-
Limebank Feedermain Phase 3	Suburban southwest	Yes	2029-2034	$ 8,100,000	90	10	-
Greenbank Watermain	Suburban southwest	Yes	2029-2034	$ 14,100,000	90	10	-
New Watermain for Urban Expansion Area S-1	Suburban southwest	No	2029-2034	$ 5,100,000	100	-	-

Project Name	Area	Identified in 2013 IMP	Timing	Total Project Cost	DC (%)	BTE (%)	PPC (%)
New Watermains for Urban Expansion Area S-3	Suburban southwest	No	2029-2034	$ 15,200,000	100	-	-
Brittany Dr Suction Upgrade	Urban and downtown	Yes	2039-2044	$ 2,800,000	50	50	-

Table 15-4: Wastewater Master Plan - Capital Program

Project Name	Area	Identified in 2013 IMP	Timing	Total Project Cost	DC (%)	BTE (%)	PPC (%)
Richmond King Street Sewer Upgrade (Phase 4a)	Rural	No	2024-2029	$ 6,600,000	75	25	-
Carp PS Capacity Upgrade and Forcemain	Rural	Yes	2029-2034	$ 30,100,000	75	25	-
Richmond Forcemain Twinning (Phase 4)	Rural	Yes	2024-2029	$ 38,600,000	75	25	-
Manotick Main PS Capacity Upgrade (Phase 1)	Rural	Yes	2024-2029	$ 2,500,000	64	36	-
Manotick Main PS Capacity Upgrade (Phase 2)	Rural	Yes	2044-2046	$ 4,300,000	5	95	-
Mahogany PS Capacity Upgrade	Rural	No	2024-2029	$ 3,300,000	90	10	-
Penfield Trunk Sewer Upgrade	Suburban West	No	2029-2034	$ 7,800,000	95	5	-
Kanata West Diversion Sewer	Suburban West	No	2029-2034	$ 3,000,000	95	5	-
Kanata West Sewer Oversizing	Suburban West	No	2029-2034	$ 1,800,000	100	-	-
Kanata West PS Capacity Upgrade	Suburban West	Yes	2029-2034	$ 3,300,000	100	-	-
March PS Capacity Upgrade	Suburban West	Yes	2039-2044	$ 2,800,000	70	30	-
Signature Ridge Forcemain	Suburban West	Yes	2029-2034	$ 5,900,000	75	25	-
Stittsville PS Decommissioning and Gravity Sewer	Suburban West	Yes	2024-2029	$ 6,500,000	30	70	-
Shea Road PS Capacity Upgrade and Forcemain	Suburban West	No	2029-2034	$ 7,800,000	100	-	-

Project Name	Area	Identified in 2013 IMP	Timing	Total Project Cost	DC (%)	BTE (%)	PPC (%)
Acres PS Risk Mitigation (Phase 2)	Suburban West	Yes	2024-2029	$ 25,500,000	48	52	-
Acres PS Capacity Upgrade (Phase 3)	Suburban West	Yes	2029-2034	$ 34,100,000	39	61	-
Acres PS Overflow (Phase 4)	Suburban West	Yes	2034-2039	$ 26,300,000	80	20	-
Spratt Road Trunk Sewer Upgrade	Suburban South West	No	2029-2034	$ 13,800,000	90	5	5
Conroy Trunk Sewer Upgrade (Phase 1)	Suburban South East	Yes	2029-2034	$ 12,300,000	90	5	5
Conroy Trunk Sewer Upgrade (Phase 2)	Suburban South East	No	2029-2034	$ 8,800,000	90	5	5
Walkley Sewer Upgrade	Suburban South East	No	2034-2039	$ 2,700,000	95	5	-
Forest Valley PS Capacity Upgrade (Phase 1)	Suburban East	Yes	2029-2034	$ 2,600,000	4	96	-
Forest Valley PS Capacity Upgrade (Phase 2)	Suburban East	Yes	2044-2046	$ 3,000,000	100	-	-
Tenth Line PS Capacity and Forcemain Upgrade	Suburban East	No	2034-2039	$ 2,300,000	100	-	-
Merivale South Sewer Upgrade and Extension	Urban and downtown	No	2024-2029	$ 10,100,000	95	5	-
Pinecrest Trunk Sewer Upgrade	Urban and downtown	No	2029-2034	$ 11,000,000	95	5	-

Project Name	Area	Identified in 2013 IMP	Timing	Total Project Cost		DC (%)	BTE (%)	PPC (%)
Pinecrest Trunk Flow Reduction	Urban and downtown	No	2024-2029	$	5,300,000	95	5	-
Merivale North Diversion Sewer	Urban and downtown	No	2024-2029	$	1,400,000	95	5	-
Merivale North Sewer Replacement and Oversizing	Urban and downtown	No	2024-2029	$	4,600,000	5	95	-
O'Connor Flood Control Works	Urban and downtown	No	2034-2039	$	119,000,000	5	95	-
Rideau River Collector Twinning	Urban and downtown	Yes	2034-2039	$	21,400,000	100	-	-
Prince of Wales Diversion Sewer	Urban and downtown	No	2039-2044	$	5,300,000	80	20	-
Crystal Beach Diversion PS Upgrade and Forcemain (Phase 1)	Urban and downtown	No	2029-2034	$	32,600,000	80	20	-
Crystal Beach Diversion PS Upgrade and Forcemain (Phase 2)	Urban and downtown	No	2039-2044	$	31,100,000	80	20	-
Woodroffe Diversion PS Upgrade and Forcemain	Urban and downtown	No	2029-2034	$	59,900,000	80	20	-
Airport Parkway Diversion Sewer	Urban and downtown	No	2024-2029	$	34,700,000	80	20	-

Table 15-5 shows the proposed phasing and cost splits for each of the proposed water projects required to service the South Urban Community and Tewin community. The DC funding will be a combination of an Area Specific Development Charge (ADSC) for Tewin, and an Outside-the-Greenbelt (OGB) Development Charge. The Post Period Capacity costs for this infrastructure is very high and it is therefore recommended that the extent of over-sizing be reviewed as part of the functional design / Class EA process following Council approval of the IMP.

Table 15-5: Proposed Tewin Project Phasing and Cost Splits ($Million)

Projects	Total Capital Cost	Tewin ASDC	OGB DC	PPC	BTE
2C-OGB Water Feed Phases 1 & 2	$174.3	$57.5	$43.6	$73.2	-
Bi-Directional Water Feed	$52.9	$28.0	$15.9	$9.0	-
Tewin Pump Station & Reservoir Phase 1	$44.1	$44.1	-	-	-
Tewin Pump Station & Reservoir Phase 2	$18.9	-	$18.9	-	-
2C-OGB Water Feed Phase 3	$82.7	$21.5	$16.5	$34.7	$9.9
Conroy Tank Feed	$12.6	$3.3	$2.5	$5.3	$1.5
Water Subtotal	**$385.5**	**$154.4**	**$97.4**	**$122.2**	**$11.4**
Tewin Collector Sewer	$205.0	$158.9	-	$46.1	-
Wastewater Subtotal	**$205.0**	**$158.9**	**-**	**$46.1**	**-**
Total	**$590.5**	**$313.3**	**$97.4**	**$168.3**	**$11.4**

15.3 Affordability and Financing

In the context of growth planning, affordability is determined on the basis of whether there is adequate funding to deliver the service and provide the related infrastructure from forecasted revenue sources. The following assumptions are used to assess affordability:

- Rate revenue to increase per the last approved Long Range Financial Plan.
- No new revenue sources will be made available.
- The 5-year historical average of Development Charge collections will be used to establish what may be achievable in the future, taking into consideration potential or existing regulatory exemptions and impacts on revenue (e.g. Bill 23).
- Debt servicing will not exceed the city and provincial limits.
- Project cost estimates include appropriate provisions for contingencies and will inflate over time as per the City's Construction Price Index.
- Priority will be given to funding renewal projects to maintain assets in a good state of repair.

A challenge to financing growth is the timing difference between growth costs and the collection of DCs. Growth that relies on the implementation of an IMP project cannot occur until the project is complete. However, DCs associated with that growth cannot be collected until individual building permits are issued for the benefiting area. The City can draw on existing DC reserve balances and/or issue DC-funded debt to finance project costs upfront. Despite these financing alternatives, non-financial strategies may also need to be considered to remain within the City's affordability limits and estimated project timing may change.

The City's current Fiscal Framework identifies limits for issuing rate-supported debt and it is expected that an upcoming update to the Fiscal Framework will identify targets for Development Charge funded debt. DC-funded debt is used most often to finance the Post Period Capacity portion of the capital projects and when DC reserve balances are not sufficient to finance the capital project upfront. Per Annex 12 of the Official Plan, Tewin will be responsible for covering oversizing costs associated with its off-site infrastructure.

Although the analysis assumes that no new revenue sources will be made available to fund IMP projects, Federal and Provincial stimulus funding programs are periodically available to address specific issues and interests, such as a poorly performing economy, building resiliency to climate change, or addressing other environmental issues. The City is well-prepared to respond to these programs and continues to maximize opportunities to leverage these funding sources to advance infrastructure projects that are in the interest of the general public.

15.4 Developer Front Ending Agreements

The benefiting developers may wish to proceed with implementation in advance of the City's project schedule to allow development to proceed based on their own desired timelines. In such cases, the developer and the City will enter into a front-ending agreement through which the full cost of the project is financed up front by the developer. Developers will be repaid in accordance with the City's Front Ending Policy.

15.5 Special Area Development Charges

Development Charges are applied on a Citywide and an area-specific basis. The City has four main benefiting areas: Citywide, Inside the Greenbelt, Outside the Greenbelt, Rural and several Special Area Charges. Special Area Charges have been established to cover the costs of infrastructure needed to support growth in specific areas of the City, including in the villages of Richmond and Manotick. These charges have also been established to cover the cost of stormwater-related infrastructure in specific drainage areas where greenfield growth is taking place. Additionally, landowner groups have financed stormwater infrastructure through private owner agreements rather than through special area charges.

It is expected Tewin will be subject to a Special Area Charge that covers the growth-related cost of infrastructure for the community, including over-sizing costs. As noted in Section 6, the water infrastructure that is needed to supply the Tewin Community is also needed to augment supply to the South Urban Community. As such the Development Charges component of funding for this infrastructure will be allocated in part by the Tewin Special Area Charge and in part by the OGB Development Charge.

15.6 Intensification Capacity Management Program Funding

Intensification Capacity Management projects will be needed to support development in existing areas. Larger projects with longer lead times (such as trunk sewer projects identified in the Wastewater Master Plan) can be funded by Development Charges. However, upgrades to local systems will generally not meet the eligibility criteria for project-based Development Charges funding, based on the City's Local Servicing Guidelines. Project-specific upgrades to local systems have not been included in the IMP project list as they are currently unknown and would only be identified through the recommended Infrastructure Capacity Management Program.

Various options for funding growth-driven upgrades to local systems are being considered, including:

- A *Municipal Act* charge;
- A program-based Development Charge; and
- Direct funding by benefiting developer or property owners' group

A *Municipal Act* charge or program-based *Development Charges Act* charge could be applied to cover the growth-related costs. This approach would accelerate implementation times compared to a project-specific Development Charge. A *Municipal Act* charge, if implemented, would have to very clearly avoid overlap with any charge that is collected under the *Development Charges Act*. A potential charge would be based on estimated project costs, divided by a measurement of the net increase of development in existing development areas.

In the near term, the City will begin collecting sufficient information to support a per-unit charge. Once implemented, the revenue collected would be used to fund upgrades to local systems. If the program-based DC alternative is chosen, an update to the DC Background Study will be required. Regardless of the alternative chosen, the per-unit charge will be reassessed and updated periodically. Direct funding by proponent would remain an option when project timing is critical.

In the short term, it is anticipated that intensification-driven upgrades will most commonly arise in existing development areas subject to Secondary Planning processes. Detailed servicing studies will be required to identify any upgrades needed to support intensification within these areas. Financial plans will be needed to support implementation of the servicing plan recommendations. These should include cost-sharing calculations for the growth component and the benefit to existing properties. These calculations would be based on established BTE methods as discussed in Appendix H.

16 Approvals, Monitoring, and Amendments

16.1 Overview

The following section describes the approval process and monitoring indicators which will be utilized to measure the success of the various policies, projects and programs recommended in the IMP, as well as the procedure for Plan amendments.

16.2 Municipal Class Environmental Assessment

The IMP has been completed in accordance with the provisions for "Master Plans" completing Phases 1 and 2 as outlined in the Municipal Class Environmental Assessment (EA) process (2023) by the Municipal Engineers Association following "Approach 1". The Municipal Class EA process is an approved process under the *Environmental Assessment Act RSO 1990* (EA Act) that follows a planning process leading to environmentally sound decision-making. An EA involves identifying and planning for environmental issues and effects prior to implementing a project or set of projects. The development of the IMP Master Plan included consultation with the public and stakeholders, consensus building, consideration of reasonable alternative solutions and a high-level assessment of the effects on the environment at the network level. The Notice of Commencement for the Master Plan was first issued on November 1, 2019.

Project-specific Class Environmental Assessment studies will be completed after approval of the IMP for all Schedule B projects to fully satisfy the Schedule B requirements. These assessments will include more detailed evaluations of alternative project alignments, and specific facility locations that a consistent with the IMP project concepts and qualifications.

16.3 Monitoring the Plan's Effectiveness

The success of long-range plans such as the IMP depends on ongoing monitoring of system performance. Any constraints, such as capacity limitations or project funding shortfalls, must be identified and resolved early on. Adjustments to priorities and corrective actions may be needed to confirm that the servicing needs of existing and developing communities are met. Specific monitoring efforts will vary from one component of the plan to the next.

16.3.1 IMP Policies

The City will maintain a log of policy gaps and shortcomings to inform the next update to the IMP. In between updates, to monitor the policies it is recommended that the interdepartmental IMP Steering Committee established for this IMP continue to meet. The Committee can then vet any of the monitoring results and provide additional input into the 'Annual Land Development Report' regarding the success of the IMP policies and status of the actions.

16.3.2 Water and Wastewater Master Plans

Potential indicators of the effectiveness of the Water Master Plan and Wastewater Master Plan include:

- variations between the planned and actual project costs (once adjusted for inflation);
- variations between the planned and actual timing of projects;
- performance of the backbone system over time as growth occurs and projects are commissioned; and
- any delays to development approvals resulting from a lack of backbone system capacity.

The success of the Master Plans hinges on assumptions about growth and the associated demands on the water and sewer systems, and the ability of the City to deliver capital projects in a timely manner. Also important is the degree to which the affordability of the plan aligns with development needs. In reality, the pace of growth and where it occurs over time will vary from these assumptions and will not always align with financial constraints. As such, it is expected that many projects will need to be advanced through Front Ending Agreements between the City and developers.

Updates to the IMP will be carried out, normally at the time of Official Plan reviews, to make adjustments that align with updated growth assumptions, project costs, and other new information that is important to the effectiveness of the plan.

16.3.3 Stormwater Management Strategy

As the Stormwater Management Strategy was focussed on surface drainage, key indicators of the effectiveness of the Stormwater Management Strategy will be related to conditions in the City's water courses that are affected by development, including water quality and in-stream erosion. The performance of both new and existing stormwater systems, as well as the frequency of inland and riverine flooding will also be important indicators. The risk of flooding can never be eliminated, but drainage system performance should align with the objectives set out in the City's Sewer Design Guidelines.

The City will continue to monitor conditions in urban water courses and identify any trends and issues that need to be addressed through amendments to the Stormwater Management Strategy.

16.3.4 Programs Facilitating Intensification

Potential key performance indicators to measure the effectiveness of the proposed intensification programs include comparison to metrics that are currently measured. For stormwater surface flooding, this could include monitoring changes to the frequency of flooding based on complaints. For water systems, the ability of Ottawa Fire Services to effectively respond to fires, based on fire fighting capacity, could be measured in existing development areas that are subject to intensification. The City's ability to identify and respond to emerging capacity constraints in local infrastructure systems in a timely manner will also be a key indicator of success.

It is inevitable that some individual proponents of major projects such as high-density residential towers will be required to directly fund the majority of costs for municipal infrastructure upgrades to provide the capacity needed for these projects. Once the programs have matured, the objective is that the need for such upgrades will be identified and project planning will be well underway before applications for development that require the upgrades are submitted. This will require strong working relationships between the City and the development industry in order to anticipate intensification at the local level.

Finally, the effectiveness of the program will be demonstrated by the consistent inclusion of on-site SWM in small residential development projects that are exempt from the Site Plan Control process, and the lack of complaints by owners of these systems or their neighbours.

The City will evaluate the performance of these new programs and report back to Council periodically with any recommendations to improve them.

16.4 Procedure for Plan Amendments

The IMP is normally updated at the time of each comprehensive review of the Official Plan, or roughly once every 5 years. I should be noted that the time since the last update was roughly ten years, due to outstanding appeals related to the 2013 Official Plan review. Historically, there have been no amendments to the plan between updates.

If the need for an amendment is identified, formal stakeholder consultation and a report to Council would be required. A Master Plan Class EA process would only be considered if an amendment to the capital project plan presented in the IMP were required. However, additional information that becomes available during detailed studies will be incorporated into the evaluation of alternatives during Class EA process for individual projects. These processes will verify the IMP-identified alternatives.

17 Closure

The Infrastructure Master Plan (2024) was created in support of the Official Plan (2022), with the best available information that was available at time of writing.

PART IX – IMP PUBLIC CONSULTATION

18 Public Consultation and Engagement

The IMP benefitted from public consultation and stakeholder engagement throughout the study process. The study was conducted in accordance with the Municipal Class EA process (Municipal Engineers Association, 2023), an approved class under the Environmental Assessment Act process for Master Plans following "Approach 1".

Appendix I provides a summary of the key consultation and engagement activities.

The IMP was presented to Committee and Council in Q2 2024, after which the Notice of Master Plan was issued with a 30-day public review period. The IMP was finalized in consideration of all feedback received.