Lambton Area Water Supply System (LAWSS)

Master Plan

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Master Plan Report

LAWSS Master Plan

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1 Introduction

The Lambton Area Water Supply System (LAWSS) supplies drinking water to more than 100,000 customers across three subsystems, also referred to as pressure zones. LAWSS is owned by six member municipalities:

- City of Sarnia
- St. Clair Township
- Town of Plympton-Wyoming
- Municipality of Lambton Shores
- Township of Warwick
- Village of Point Edward

LAWSS also supplies water to the Municipality of Brooke-Alvinston and can provide emergency water supply to the Town of Petrolia and the Municipality of Chatham-Kent.

LAWSS is responsible for the treatment and distribution of drinking water throughout its service area. In 2012, LAWSS entered a 20-year contract with Ontario Clean Water Agency (OCWA) to operate and maintain the facilities owned by LAWSS. The system includes the LAWSS Water Treatment Plant, West Lambton Pumping Station (WLPS) and Reservoir, East Lambton Booster Station (ELBS) and reservoir and an extensive network of water distribution mains and elevated storage facilities. Geographically, the distribution system is divided into three pressure zones:

1) **Zone 1 - Water Treatment Plant (WTP) Subsystem**: Primarily serving The City of Sarnia, Village of Point Edward, and St. Clair Township
2) **Zone 2 - Forest Subsystem:** Serving Parts of the Municipality of Lambton Shores (mainly Forest) and parts of the Town of Plympton-Wyoming
3) **Zone 3 - Watford Subsystem:** Serving the Township of Warwick and parts of the Town of Plympton-Wyoming

Figure 1-1 shows the LAWSS service area and pressure zones.

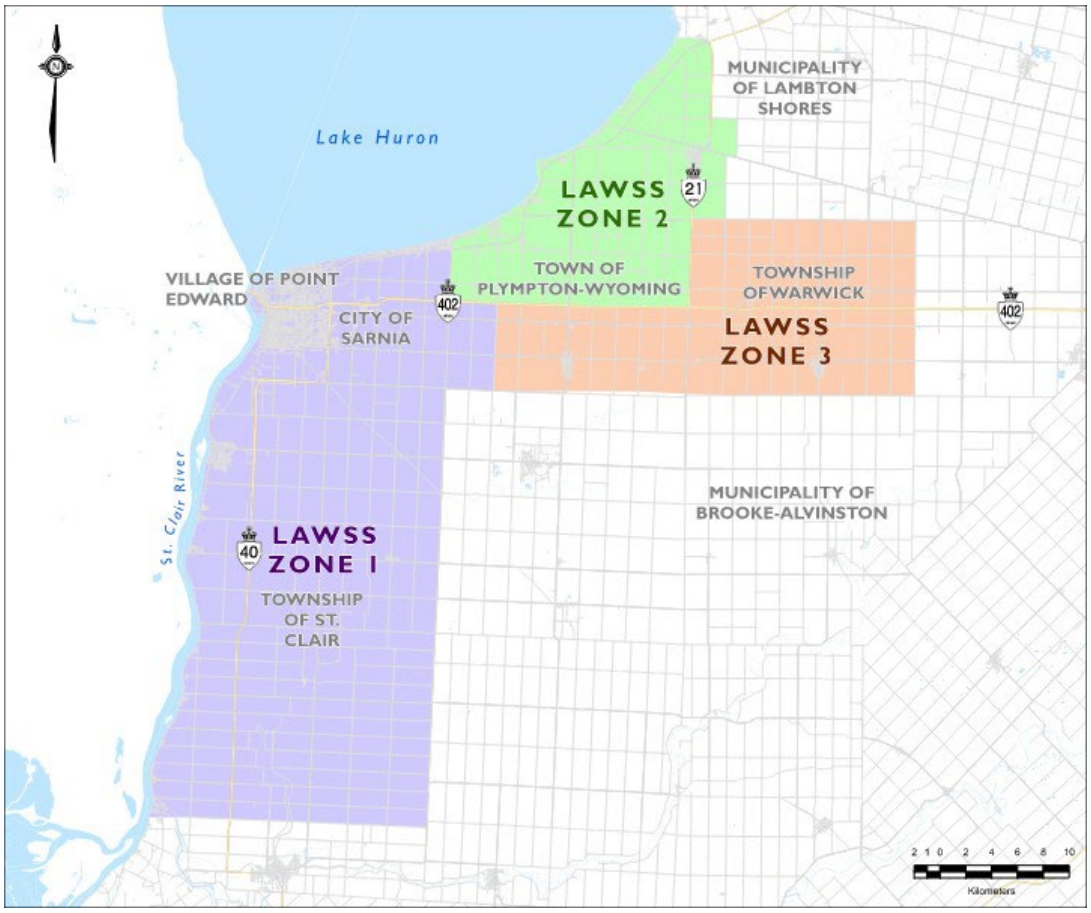

Figure 1-1: Map of the LAWSS Service Area Showing the Three Pressure Zones, or Subsystems

As many communities in Lambton County continue to grow, sustainable and reliable water servicing remains essential. In 2021, LAWSS completed a Water System Master Plan outlining a 20-year strategy for maintaining and improving drinking water infrastructure. LAWSS is now undertaking an update to the Master Plan, extending the planning horizon to 2046.

Since the completion of the 2021 Master Plan, population growth has occurred throughout much of Lambton County and this trend is expected to continue. This growth creates the possibility of new customers and increased water demands, including:

- A potential future connection servicing the Chippewas of Kettle and Stony Point First Nation (CKSPFN)
- Increased residential demands in Brooke-Alvinston

1.1 Project Overview and Master Plan Objectives

LAWSS retained CIMA+ to update the 2021 Master Plan, which was completed by AECOM. This Master Plan update is being carried out in accordance with the Municipal Class Environmental Assessment (EA) process in Ontario and follows Approach #1 for Master Plans, as defined by the Municipal Engineers Association. Under this approach, the Master Plan EA comprises high-level assessments of broad infrastructure alternatives; projects identified as falling under Schedule B or Schedule C will require separate, detailed EA studies before proceeding to design phases.

The Municipal Class EA is a regulated process used in Ontario to guide the planning of municipal infrastructure. It ensures that technical, environmental, social, cultural, and financial factors are considered, while providing opportunities for the public, government agencies, and First Nation and Métis communities to participate and provide feedback. A record of consultation activities completed during the development of this Master Plan is provided in Appendix A.

1.2 Key Challenges Facing LAWSS

LAWSS member municipalities are projecting residential growth trends that will continue throughout the 20-year Master Plan horizon. In addition to higher residential demands, LAWSS may begin to provide water service to new municipal and industrial/commercial/institutional (ICI) customers, which present the possibility of additional large, localized demands being introduced to the system. Furthermore, LAWSS has several existing servicing agreements with existing Industrial/Commercial/Institutional (ICI) customers that allow water takings under emergency conditions. Though these events are infrequent, they present an added challenge for water system planning and design as growth in Lambton County continues.

OCWA staff have identified several operational constraints throughout the system. Chief among these is a need for pump optimization at the WTP high lift pump station (HLPS). Several of the existing high lift pumps are oversized for current system demands, reducing efficiency and introducing challenges for operation and maintenance. Installation of a second filter backwash pump is also required to provide redundancy for the filtration process. While equipment upgrades in an existing facility are not required to undergo the EA process, the development of high-level upgrade alternatives was included as a dedicated component of this Master Plan update. The technical memorandum *WTP High Lift Pump Station Optimization* documents the exploration of optimization options for the HLPS and is attached in Appendix B.

Additional challenges highlighted by LAWSS and OCWA staff include operational difficulties in Zone 1, where changes in discharge pressures at the LAWSS WTP can

lead to overflowing of the Indian Road Standpipe. Operations staff have also reported experiencing difficulty filling the Watford Standpipe at the desired rate during high water demand days.

The challenges highlighted above were key considerations in the development and evaluation of Master Plan solution alternatives.

2 Background and Existing Conditions

2.1 2021 Master Plan

A review of projects included in the 2021 Master Plan was undertaken as part of this update. The objective of the review is to summarize the progress of ongoing projects as well as to confirm the continued need for planned projects under updated demand conditions. Conclusions of the review are provided in Section 5.3.

Table 2-1: Projects Proposed Under the 2021 Master Plan

Zone	Project Description	Status
Zone 1	West Lambton Pumping Station Modifications	Partially complete
Zone 1	New 150mm local distribution watermain from East Lambton BS (Forest) to Mandaumin Road (customer service changes from Zone 1 to Zone 2)	Planned for construction in 2026
Zone 3	New 350mm transmission main on London Line	Proposed for construction in 2026
Zone 3	New Booster Pumping Station New 350mm watermain on Oil Heritage Road New water chambers Acquisition of Wyoming Standpipe	Proposed for construction by 2031
Zone 3	New 200mm watermain on Stewardson Road	Proposed for construction by 2036

2.2 Related studies

A review of related studies included in, or completed since, the 2021 Master Plan is necessary to identify servicing constraints that have been addressed or may be addressed in the near future.

Table 2-2: Additional Studies Referenced for the 2025 Master Plan Update

Reference Study	Year Completed	Relevant Zone
Master Water Plan Updates Hydraulic Modelling Report *(AECOM, prepared for LAWSS)*	2022	All

Reference Study	Year Completed	Relevant Zone
Stage 1 Archaeological Assessment Lambton Area Water Supply System (LAWSS) Master Water Plan Update - Part of Multiple Lots and Concessions, Geographic Townships of Plympton and Warwick, now the Town of Plympton-Wyoming and the Township of Warwick, Lambton County, Ontario *(AECOM, prepared for LAWSS)*	2022	Zone 3
Cultural Heritage Report: Existing Conditions and Preliminary Impact Assessment *(AECOM, prepared for LAWSS)*	2022	Zone 3
St. Clair Water System Master Plan Update 2023 *(AECOM, prepared for St. Clair Township)*	2024	Zone 1
Grid Reinforcement and Transmission Main Twinning Sarnia/ St. Clair Township Area: Municipal Class Environmental Assessment Addendum Report *(AECOM, prepared for LAWSS)*	2021	Zone 1
Kettle Point Water Supply Feasibility Study – Additional Analysis *(AECOM, prepared for LAWSS)*	2024	Zone 2
Alvinston Water Supply Evaluation Study *(AECOM, prepared for LAWSS)*	2024	Zone 3

2.2.1 Stage 1 Archaeological Assessment

A Stage 1 Archaeological Assessment was undertaken as part of the 2021 Master Plan and covered potential locations and alignments for Zone 3 proposed infrastructure, which was the only component of the Master Plan preferred alternative involving construction outside existing rights-of-way. The report has been entered into the Ontario Public Register of Archaeological Reports under Project Information Form (PIF) number P438-0243-2021.

Based on a review of the historical, environmental, and archaeological context of the Zone 3 study area, it was determined that there is high potential for the recovery of First

Nations and Euro-Canadian archaeological resources. The recommendations of that report are summarized below:

- As part of any Schedule B or C MCEA undertakings, a Stage 2 Archaeological Assessment must be completed for all areas within the study area limits for Zone 3 proposed infrastructure identified as having archaeological potential.
- The Stage 2 archaeological assessment must be conducted by a licensed archaeologist and must follow the requirements set out in the *Standards and Guidelines for Consultant Archaeologists*, as defined by the Government of Ontario.
- The findings of the assessment are only applicable within the defined study limits; should future planning, studies, or proposed work include areas outside the study limits, such areas are subject to the same requirements for Stage 1 archaeological assessments (at minimum).

2.2.2 Cultural Heritage Resources

A Cultural Heritage Report documenting existing baseline cultural heritage conditions in the study area for Zone 3 proposed infrastructure was completed for the 2021 Master Plan. The report also included a preliminary impact assessment on the 23 potential cultural heritage resources (CHRs) that were identified adjacent to the study area. The Cultural Heritage report, prepared by AECOM, is included in Appendix D. A summary of the report recommendations for impact mitigation is provided below:

- Construction activities were recommended to avoid impacts to identified cultural heritage resources by remaining within existing rights-of-way. Mitigation measures and additional safeguards must be undertaken where construction activities must happen outside existing rights-of-way.
- Evaluation of potential vibration impacts was recommended for 18 of the identified potential CHRs. If vibration limits are anticipated to be exceeded, mitigation measures should be implemented. Construction and post-construction monitoring may be required in some cases.
- One CHR, the Broadway Street streetscape in the community of Wyoming, was anticipated to be directly impacted through land disturbance within the right-of-way as a result of construction activities. It was recommended that the road be reconstructed to preconstruction conditions.
- Should construction activities for the proposed undertaking be required to extend beyond the existing rights-of-way or should future work/studies require an expansion of the Study Area, a Qualified Heritage Consultant should be retained to confirm impacts of the proposed work.

A Cultural Heritage Screening was completed as part of this Master Plan update to identify any new potential CHRs in the Zone 3 study area. Provincially and federally maintained databases of designated properties were searched, and the Town of Plympton-Wyoming and Township of Warwick were consulted regarding updates to municipal heritage registers. No additional CHRs were identified in the area of Zone 3 proposed infrastructure. Additional details on the cultural heritage screening are included in Appendix D.

2.3 Water System Overview

The following sections describe the existing water system in the Lambton Area, including vertical infrastructure, linear infrastructure, and current demands calculated from 2024 system data.

2.3.1 Treatment

LAWSS has one WTP, which draws water from the St Clair River to supply Pressure Zone 1. The plant employs direct filtration and chlorination for primary disinfection. Table 2-3 shows the rated treatment capacity of the WTP. A high lift pump station and reservoir is also located on the WTP site.

2.3.2 Pumping

Table 2-4 below provides details of the pumping facilities owned by LAWSS. Equipment at municipally owned pumping facilities is omitted from this inventory.

Table 2-3: LAWSS Treatment Facility Inventory

Pressure Zone	Facility	Capacity (L/s) [m^3/day]
Zone 1	LAWSS Water Treatment Plant (WTP)	2,100 [181,440]

Table 2-4: LAWSS Pump Station Inventory

Pressure Zone	Pump	Facility	Source	Pump Type	Rated Flow (L/s)	Rated Head (m)
Zone 1	HLP-1	WTP High Lift Pump Station	West Clearwell	Fixed-speed	1,260	69
Zone 1	HLP-2	WTP High Lift Pump Station	West Clearwell	Fixed-speed	636	70
Zone 1	HLP-3	WTP High Lift Pump Station	West Clearwell	Fixed-speed	314	74
Zone 1	HLP-4	WTP High Lift Pump Station	East Clearwell	Fixed-speed	1,255	70
Zone 1	HLP-6	WTP High Lift Pump Station	East Clearwell	VFD[1]	638	72
Zone 1	HLP-8	WTP High Lift Pump Station	East Clearwell	Fixed-speed	1,255	70
Zone 1	PP01	West Lambton Pumping Station	Reservoir	Fixed-speed	475	32
Zone 1	PP02	West Lambton Pumping Station	Reservoir	VFD[1]	475	32
Zone 1	PP03	West Lambton Pumping Station	Reservoir	VFD[1]	615	32/47
Zone 1	PP04	West Lambton Pumping Station	Reservoir	VFD[1]	615	47
Zone 1	PP05	West Lambton Pumping Station	Reservoir	Fixed-speed	615	47
Zone 2 (Forest)	FP-1	East Lambton Pumping Station	Reservoir	Fixed-speed	68	81.2

Pressure Zone	Pump	Facility	Source	Pump Type	Rated Flow (L/s)	Rated Head (m)
Zone 2 (Forest)	FP-2	East Lambton Pumping Station	Station Inlet	Fixed-speed	68	99.4
Zone 2 (Forest)	FP-3	East Lambton Pumping Station	Reservoir	Fixed-speed	68	81.2
Zone 3 (Watford)	WP-1	East Lambton Pumping Station	Reservoir	Fixed-speed	45	77.1
Zone 3 (Watford)	WP-2	East Lambton Pumping Station	Station Inlet	Fixed-speed	45	95.7
Zone 3 (Watford)	WP-3	East Lambton Pumping Station	Reservoir	Fixed-speed	45	77.1

Notes:

1) VFD = variable frequency drive

2.3.2.1 WTP High Lift Pump Station

High lift pumps at the LAWSS WTP are operated to maintain a discharge pressure setpoint which is currently equivalent to approximately 236 m hydraulic grade line (HGL) when the West Lambton (WL) Reservoir is filling and 232.4 m HGL when the West Lambton Pump Station (WLPS) is pumping. Currently, HLP-2 and HLP-6 are the most frequently operated pumps. When HLP-6 is operated, the variable frequency drive (VFD) is used to set the target discharge pressure. When HLP-2 is operated, a throttle control valve on the discharge pipe is used to achieve the target pressure. HLP-3 can be run in parallel with pumps 2 and 6 when needed to meet demands.

The three largest-capacity pumps (HLP-1, HLP-4, and HLP-8) are not currently in operation due to the pressure challenges created by their use. The HLPS was designed to meet the eventual design head planned for the system. Due to operational limitations of other system infrastructure, it is no longer anticipated that the system will be operated at the ultimate planned design head. While the operational constraint on pumps HLP-1, HLP-4, and HLP-8 does not compromise the ability of the HLPS to meet current demands, eventual modifications to the HLPS pump configuration would be needed to optimize facility function. Potential options for HLPS optimization are discussed in the attached technical memorandum *WTP High Lift Pump Station Optimization*.

2.3.2.2 West Lambton Pump Station

The WLPS currently discharges both southward to St Clair and northward to Sarnia, which are in the same pressure zone (Zone 1). As such, the discharge pressure is limited by the water level of the nearby Indian Road standpipe with a top water level (HGL) of 232.7 m. Additionally, due to the existing piping configuration, the West Lambton reservoir cannot fill while the pumps are operating. The reservoir fill is controlled with a pressure sustaining valve. Typically, the reservoir is filled at night, and the pump station is operated during the day. When the pump station is not running, flow by-passes the station directly from Sarnia to St Clair.

Currently, the pump station is controlled based on a discharge pressure setpoint that is equivalent to approximately 230.5 m HGL. Pump PP02 is typically operated on a VFD to maintain the pressure setting. When the fixed-speed pumps (i.e., pumps without VFDs) are operated, discharge pressure is regulated using a recycle line with a pressure relief valve within the pump station.

An upgrade at the WLPS is currently in design stages with the intention of achieving the following:

- Allow for simultaneous reservoir filling and pumping
- Creation of a new pressure zone south of the WLPS and Reservoir

- Optimize pump sizing
- Allow emergency pumping to Sarnia

While the design has not been finalized at this time, the following upgrades were assumed to be in place for the purpose of this Master Plan:

- Process piping upgrades to allow simultaneous reservoir filling and pumping
- The WLPS discharge header can be isolated such that that pump station can supply St Clair only or to St Clair and Sarnia simultaneously
- The typical discharge pressure to St Clair is increased to 236 m HGL (5.5 m higher than existing operations)
- The WLPS will typically not supply Sarnia except in the case of an emergency or an operational condition such as the WTP being offline. When this condition occurs, the discharge pressure to Sarnia would be approximately 230.5 m HGL (same as existing conditions), to avoid overfilling the Indian Road standpipe.
- When the WLPS is offline, St Clair will be supplied directly from Sarnia via a station bypass. However, the intention is that the WLPS will continuously supply St Clair under typical operations.

2.3.2.3 East Lambton Booster Station

The East Lambton (EL) reservoir fills from Zone 1 and is controlled using a pressure sustaining valve to maintain Zone 1 pressures. The East Lambton Booster Station (ELBS) consists of two separate sets of pumps and discharge headers; one for the Forest subsystem (Zone 2) and one for the Watford subsystem (Zone 3). The Forest pumps are operated based on the Forest standpipe level and the Watford pumps are operated based on the Watford standpipe level. The Watford pumps also supply the Wyoming standpipe. The supply to Wyoming is controlled via several distribution system pressure reducing valves.

The Forest pumps consist of two pumps that draw from the EL reservoir and one in-line pump that draws directly from Zone 1. It is understood that the in-line pump cannot currently be operated as it will result in adversely low pressure in Zone 1. As such, when determining the firm capacity of the Forest pumps (i.e., total station flow with the largest pump offline), the in-line pump is not considered to be a usable pump; the firm capacity is therefore equivalent to a single reservoir pump. Based on SCADA data, when one pump is in operation, the discharge flow is approximately 35 L/s. When two pumps are in operation, the discharge flow is approximately 65 L/s.

Similarly, the Watford pumps consist of two pumps that draw from the EL reservoir and one in-line pump that draws directly from Zone 1. It is understood that the in-line pump

cannot currently be operated as it will result in adversely low pressure in Zone 1. As such, when determining the firm capacity of the Watford pumps, the in-line pump is not considered to be a usable pump, and the firm capacity is equivalent to a single reservoir pump. Based on SCADA data, when one pump is in operation, the discharge flow is approximately 60 L/s. Currently, it is not typical to run one more than one pump at a time.

2.3.2.4 Summary of Pumping Capacity

Table 2-5 summarizes the total and firm capacity of LAWSS-owned pumping facilities. Total capacity is the sum of all pump capacities in the facility. Firm capacity refers to the total facility capacity less the capacity of the largest pump. Firm capacity is used for planning and capacity analyses in order to accommodate the need for individual pumps to be offline for maintenance. Observed operational firm capacity is also presented in Table 2-5 to provide an extra degree of conservatism. Observed operational firm capacity refers to facility firm capacity when 1) strictly operating to meet all servicing targets for the system, and 2) considering any potential or reported operational constraints that may affect the current system. For the ELBS, the difference in the two firm capacity metrics shown below is due to the in-line pumps not being usable, as discussed above. In the case of the WTP High Lift Pump Station, the lower observed operational firm capacity is the result of the three largest-capacity pumps not being usable as installed. The high discharge pressure of these pumps when run at full speed causes operational challenges and risks damage to infrastructure in Zone 1. OCWA staff noted that a repair to the discharge valve on HLP-8 could allow the use of this pump to increase capacity if needed; however, the observed operational firm capacity for the WTP HLPS is above the existing (2024) total system maximum day demand of 1,416.7 L/s. Potential approaches to optimize pump configuration at the High Lift Pump Station were explored in the technical memorandum *WTP High Lift Pump Station Optimization* (attached in Appendix B).

Table 2-5: LAWSS-Owned Pumping Station Capacity Overview

Pressure Zone	Facility	Total Capacity (L/s)	Design Firm Capacity (L/s)	Observed Operational Firm Capacity[1] (L/s)
Zone 1	WTP High Lift Pump Station	5,358	4,098	1,588
Zone 1	West Lambton Pumping Station	2,795	2,180	2,180

Pressure Zone	Facility	Total Capacity (L/s)	Design Firm Capacity (L/s)	Observed Operational Firm Capacity[1] (L/s)
Zone 2	East Lambton Booster Station - Forest	204	136	35
Zone 3	East Lambton Booster Station - Watford	135	90	60

Notes:

1) Observed operational firm capacity refers to facility firm capacity when 1) strictly operating to meet all servicing targets for the system, and 2) considering any potential or reported operational constraints that may affect the current system.

2.3.3 Storage

All three pressure zones utilize pumped and elevated storage. In Zone 1, the largest storage facility is the West Lambton Reservoir, at 90 ML of available capacity under normal operating conditions. Total onsite storage at the WTP site is 75 ML; however, the fraction of reservoir volume needed to meet CT disinfection requirements is not considered “available” storage for the system. Remaining available storage after accounting for CT disinfection requirements under worst-case conditions is approximately 31.2 ML (further discussion provided in Section 3.5). The HGL across most of Zone 1 is controlled by the Indian Road Standpipe, which has a top water level of 232.7 m. Water pressures entering the area surrounding the Port Lambton Standpipe are lowered by pressure reducing valves. The HGL in this area is set by the Port Lambton Standpipe, which has a top water level of 222.8 m. As it does not have a dedicated pumping facility, this area is considered part of the WTP Subsystem (Pressure Zone 1).

At the ELBS, the pump sets servicing Zone 2 and Zone 3 both draw from the East Lambton Reservoir, which has a total volume of 9 ML. The HGL in Zone 2 is set by the Forest Standpipe, which has a top water level of 253.0 m.

The HGL in Zone 3 is set by the Watford Standpipe, which has a top water level of 279.6. A pressure reducing valve separates the distribution network servicing the town of Wyoming and limits maximum pressures in the area. The Wyoming Standpipe, which is owned and operated by the Town of Wyoming, sets the HGL at 251.4 m in this area.

Table 2-6 below provides details of LAWSS-owned storage facilities, including both total and available storage volumes.

Table 2-6: LAWSS-Owned Storage Facility Inventory

Zone	Facility	Top Water Level (m)	Total Design Volume (m^3)	Immediate Available Storage[1] (m^3)
Zone 1	Indian Road Standpipe	232.7	2,300	2,300
Zone 1[2]	Port Lambton Standpipe	222.8	2,700	1,597
Zone 1	Water Treatment Plant Reservoir	184.4	75,000	31,200
Zone 1	West Lambton Reservoir	212.0	90,000	90,000
Zone 2	Forest Standpipe	253.0	4,560	2,522
Zone 2 / Zone 3	East Lambton Reservoir	204.6	9,092	9,092
Zone 3	Watford Standpipe	279.6	3,840	2,340

Notes:

1) Immediate available storage considers the volume of water that can be considered fully available for use while still maintaining other system requirements (i.e., minimum pressures of 20 psi across the pressure zone, CT disinfection, etc.).
2) The Port Lambton Standpipe provides storage only for the part of Zone 1 where pressures are controlled by Pressure Reducing Valves. Water cannot be transferred out of this area to supply other parts of Zone 1.

Table 2-7 lists pumping and storage facilities in LAWSS member municipalities which are municipally owned and operated.

Table 2-7: Municipally Owned Pumping and Storage Facilities

Facility	Owner
Warwick Pumping Station	Township of Warwick
Wyoming Standpipe	Town of Plympton-Wyoming
Brigden Pumping Station	Township of St Clair
Brigden Water Tower	Township of St Clair
Alvinston Standpipe[1]	Municipality of Brooke-Alvinston

Notes:

1) The Alvinston Standpipe and water distribution system is not included in the LAWSS hydraulic model

Figure 2-1 below shows facilities and LAWSS-owned distribution system infrastructure included in the LAWSS hydraulic model.

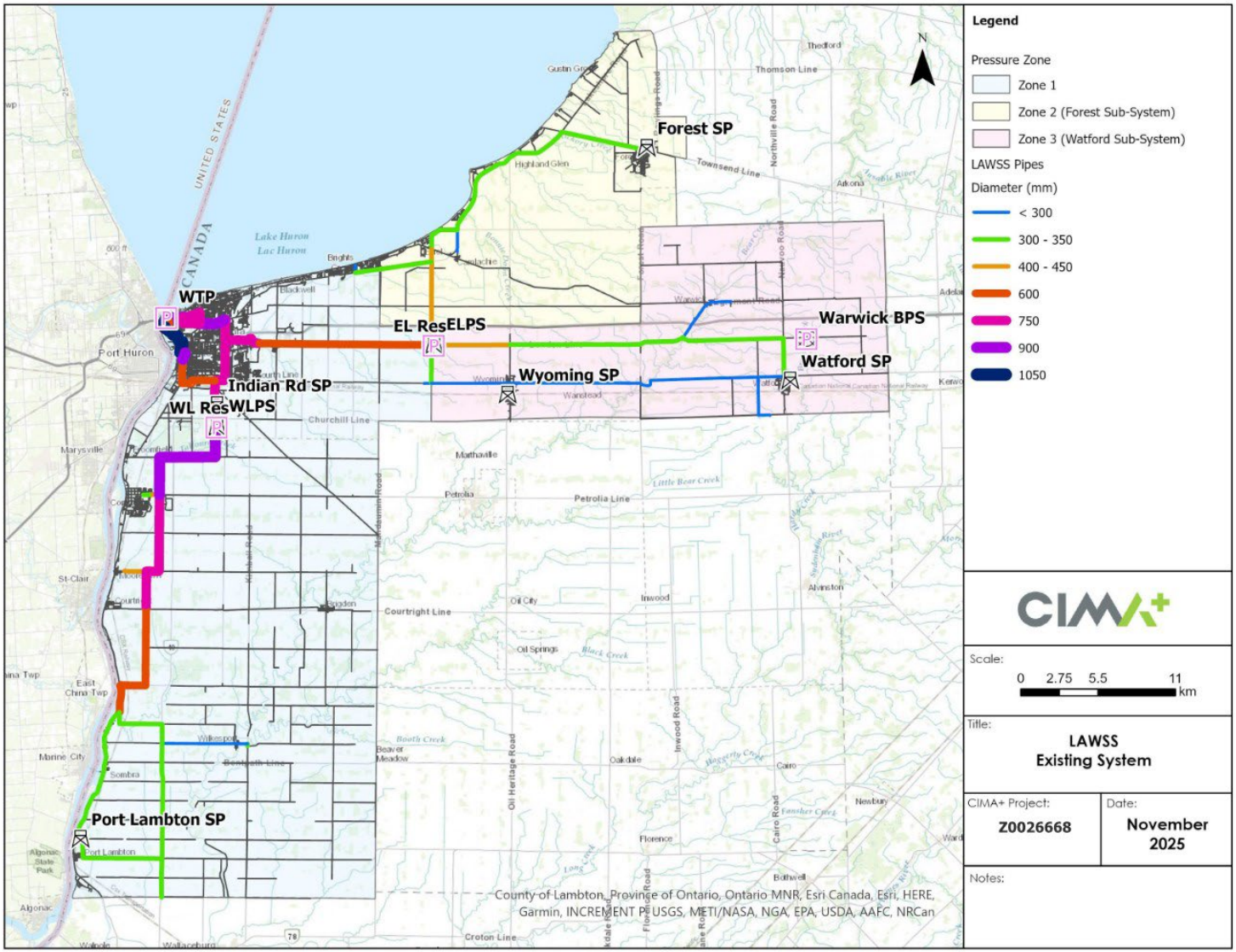

Figure 2-1: Overview of the Lambton Area Water Supply System Hydraulic Model

2.4 Hydraulic Model Updates

The LAWSS hydraulic model used for the 2021 Master Plan and subsequent studies was updated to reflect existing (2024) system conditions. Current GIS shapefiles for LAWSS-owned watermains were compared to the model pipes and the model was updated as needed with InfoWater Pro software. Local municipal-owned watermains were not updated. A municipally owned and operated booster pump station in Warwick was added to the model using facility drawings provided by LAWSS. The updated model was then used for the analysis described herein.

New extended period simulation model scenarios were developed for three time horizons:

- 2024 - Existing conditions
- 2036 - Future conditions (10-year horizon)
- 2046 - Future conditions (20-year horizon)

2.4.1 Existing demands

Existing average demands for each member municipality of LAWSS, as well as Brooke-Alvinston, were calculated for the baseline year (2024). Municipality Average Day Demand (ADD) values were determined using 2024 SCADA data collected from flowmeters throughout the system. Total system 2024 ADD values were compared to ADD values from the period 2021–2023 to confirm they were representative of a typical year. To update the LAWSS hydraulic model to existing demand conditions, all demands existing in the model were scaled to match the 2024 ADD values. Scaling within each municipality was uniform across all nodes with demands assigned, except for St Clair. A modified approach was used to more accurately represent demands of large ICI customers in St Clair, as discussed in Section 2.4.1.1 below.

After scaling to current conditions, total demands for each of the three LAWSS pressure zones were verified against flow balances calculated with 2024 flow meter data. It was found that the Zone 2 to Zone 3 demand split for Plympton-Wyoming (the only municipality in which a substantial portion of demand is divided between two different zones) was not consistent with meter data. Demands were re-allocated within Plympton-Wyoming to better reflect the flow split observed in meter data, resulting in a larger fraction of demand in the Zone 2 service area.

The 2024 total system Maximum Day Demand (MDD) was lower than MDD values calculated for the years 2021–2023. To reduce the risk of underestimating maximum day flows, the 2024 MDD was not used as a basis for modelling MDD scenarios. Instead, a modified maximum day factor was calculated by dividing the higher 2023

MDD by the 2024 ADD. This modified factor was then applied to ADD scenario demands to model respective MDD scenarios for each horizon.

2.4.1.1 Employment Water Demand

Information on water demands due to employment was not available for most municipalities. Demands on all nodes in Sarnia, Point Edward, Plympton-Wyoming, Warwick, and Lambton Shores were scaled uniformly to reflect 2024 demand conditions. In the Township of St Clair, ICI customers represent a substantial fraction of total water demand. In 2024, three existing sites accounted for roughly a quarter of the total average demand for the Township. For these three large ICI customers, existing average demands and maximum demands were both set based on 2024 water consumption data, as it was assumed that water takings would not display the seasonal trends observed in residential demands. To maintain the overall flow balance for St Clair, other demands in the Township were scaled by adjusted scaling and maximum day factors to reflect existing (2024) ADD and MDD conditions.

A provisional MDD scenario was also developed to account for the possibility of simultaneous maximum allowable takings from ICI customers, as described in Section 3.6.1. Maximum allowable takings for each customer are defined by servicing agreements with LAWSS.

2.4.1.2 Existing Demand Summary

Existing (2024) ADD and MDD values for each LAWSS demand group are shown in Table 2-8 below.

Table 2-8: Existing (2024) Scenario Demands

Municipality or Demand Group	2024 Average Day Demand (L/s)	Maximum Demand Factor	2024 Maximum Day Demand (L/s)
City of Sarnia	336.6	1.7	573.5
St. Clair Township	129.4	1.9	250.0
Village of Point Edward	11.7	1.7	20.0
Town of Plympton-Wyoming	31.8	1.7	54.2
Township of Warwick	12.7	1.7	21.6
Municipality of Lambton Shores (Forest)	12.9	1.7	21.9

Municipality or Demand Group	2024 Average Day Demand (L/s)	Maximum Demand Factor	2024 Maximum Day Demand (L/s)
Municipality of Brooke-Alvinston	3.1	1.7	5.3
Major ICI customers (St Clair)	42.0	N/A	42.0 453 (provisional[1])
Total System (without provisional demands)	580.3	N/A	988.5

Notes:

1) A provisional maximum day demand case was also evaluated with ICI customer demands set to reflect maximum allowable takings

2.4.2 Model Validation

To confirm the accuracy of the model, 2024 SCADA data for pump station flows, pressure, and tank levels were compared to model results. The updated “Existing conditions” scenario was compared to SCADA data from June 18–22, 2024. Pump station controls were adjusted to better match SCADA data.

The American Water Works Association (AWWA) provides guidelines for computer modeling of water distribution systems and states that as a general guideline, the model results should be within 4.3 psi (30 kPa) of recorded field pressure data and within 1.8 m of recorded field tank level data for Master Planning purposes (Manual of Water Supply Practices M32, AWWA (2018)).

A summary of the pressure results at each pump facility is compared to SCADA data in Table 2-9. With the exception of the ELBS discharge pressure to Forest, the range of modelled pressure results at each facility were within the acceptable level of accuracy (within 4.3 psi of SCADA data). At the ELBS discharge to Forest, the SCADA data included brief spikes of higher pressure that were not captured in the model results, however, in general the model results were within the same range as the SCADA data.

A summary of the level results at each floating storage facility is compared to SCADA data in Table 2-10 below. For the Indian Road, Forest and Watford tanks, the range of modelled level results at each facility were within the acceptable level of accuracy (i.e., within 1.8 m of SCADA data). The Port Lambton standpipe level was consistently approximately 3 m lower in the model than what was recorded in SCADA. This may be a result of hydraulic losses between the WLPS and the Port Lambton Standpipe being somewhat overestimated in the model, which can be a result of demand distribution and

pipe roughness. While this area is supplied through PRVs, the valves did not appear to be a significant source of headloss. Due to the significant distance between WLPS and the Port Lambton Standpipe (approximately 30 km), it is not possible to pinpoint the cause of the discrepancy without additional information. To improve the model accuracy, it is recommended that pressure data loggers be installed in St Clair to better understand the hydraulic profile towards the south end of the system. Although the results for the Port Lambton standpipe were not within the AWWA guidelines for model accuracy, the model was still considered to be reasonably accurate for the purpose of this Master Plan, while noting that the pressure results are somewhat conservative in the far south end of the system.

Table 2-9: Model Results Comparison to June 2024 SCADA Data - Pressure

Location	Min. - SCADA (kPa)	Min. - Model (kPa)	Difference in Min. Pressure (kPa)	Difference in Min. Pressure (psi)	Max. - SCADA (kPa)	Max. - Model (kPa)	Difference in Max. Pressure (kPa)	Difference in Max. Pressure (psi)
WTP Pressure	434.5	449.8	15.3	2.2	499.0	485.1	-13.9	-2.0
WLPS Inlet pressure	350.9	349.0	-1.9	-0.3	418.8	400.9	-18.0	-2.6
WLPS Discharge pressure	346.6	349.8	3.2	0.5	418.4	401.7	-16.8	-2.4
ELBS Inlet pressure	228.6	248.6	20.1	2.9	343.0	339.6	-3.4	-0.5
ELBS Forest Pressure	364.0	388.7	24.7	3.6	776.1	737.4	-38.7	-5.6
ELBS Watford Pressure	595.3	621.5	26.3	3.8	897.1	875.5	-21.7	-3.1

Table 2-10: Model Results Comparison to June 2024 SCADA Data - Level

Location	Min. - SCADA (m)	Max. - SCADA (m)	Min. - Model (m)	Max. - Model (m)	Difference in Min. Level (m)	Difference in Max. Level (m)
Indian Tank Level	37.3	41.1	35.7	41.0	-1.6	-0.1
Forest Standpipe level	31.1	33.0	31.2	32.9	0.2	-0.1
Watford Standpipe level	33.8	37.2	33.9	37.0	0.1	-0.2
Port Lambton Standpipe level	41.1	45.0	37.8	41.7	-3.3	-3.2

2.4.3 Implementation of Planned Upgrades

LAWSS projects that are planned for the near future were considered to be in-service under all scenarios for the Master Plan to accurately identify any system deficiencies that are not expected to be resolved by these upgrades alone. Near-future upgrades include:

- WLPS Modifications (interior)
- ELBS Fill Line Upgrades (New 200 mm local distribution watermain from East Lambton BS (Forest) to Mandaumin Road)

2.4.3.1 West Lambton Pump Station Modifications (Interior)

As described in Section 2.3.2.2, the WLPS is planned to be upgraded to allow:

- Simultaneous reservoir filling and pumping
- Increased discharge pressure to St Clair, without overfilling the Indian Road standpipe

As these upgrades are currently in design, the Master Plan analysis scenarios were set-up with this upgrade reflected in the model. The pump station was set to consistently supply St Clair at an HGL of 236 m (5.5 m higher than existing operations).

2.4.3.2 East Lambton Booster Station Fill Line Upgrades

A constraint was identified in the previous Master Plan that the ELBS reservoir cannot fill sufficiently to meet future growth needs without causing low pressure in Sarnia, specifically on London Line from Mandaumin Rd to the ELBS. The solution recommended in the previous Master Plan was to install a new 150 mm watermain along this route to supply the local customers, while the existing 600 mm watermain would become a dedicated fill line. The new 150 mm line would be supplied by the ELBS Forest pumps via a pressure reducing valve. An analysis was completed at the onset of this Master Plan to re-confirm the required timing of this upgrade. It was found that this upgrade should be completed as soon as possible to improve existing low pressures and allow growth. As such, this upgrade was considered to be in-service under all scenarios for the Master Plan update.

2.4.3.3 Twinning and Grid Reinforcement

An additional future project that has been recommended through previous studies includes feedermain twinning and grid reinforcement from Sarnia to St Clair. This project is described in detail in the report titled “Grid Reinforcement and Transmission Main Twinning Sarnia/St Clair Township Area: Municipal Class Environmental

Assessment Addendum Report" (AECOM, 2021). In general, the proposed upgrades comprise the following new feedermains (Figure 2-2):

- Phase 1:
  - Indian Road – Confederation Line to WLPS (900 mm)
  - Indian Road –WLPS to Highway 40 (900 mm)
  - Highway 40 – Indian Road to McGregor Road (900 mm)
  - McGregor Road – Highway 40 to LaSalle Line (900 mm)
  - LaSalle Line – McGregor Road to Tecumseh Road (900 mm)
- Phase 2:
  - Tecumseh Road – LaSalle Line to Courtright Line (900 mm)
  - Courtright Line – Tecumseh Road to Greenfield Road (600 mm)

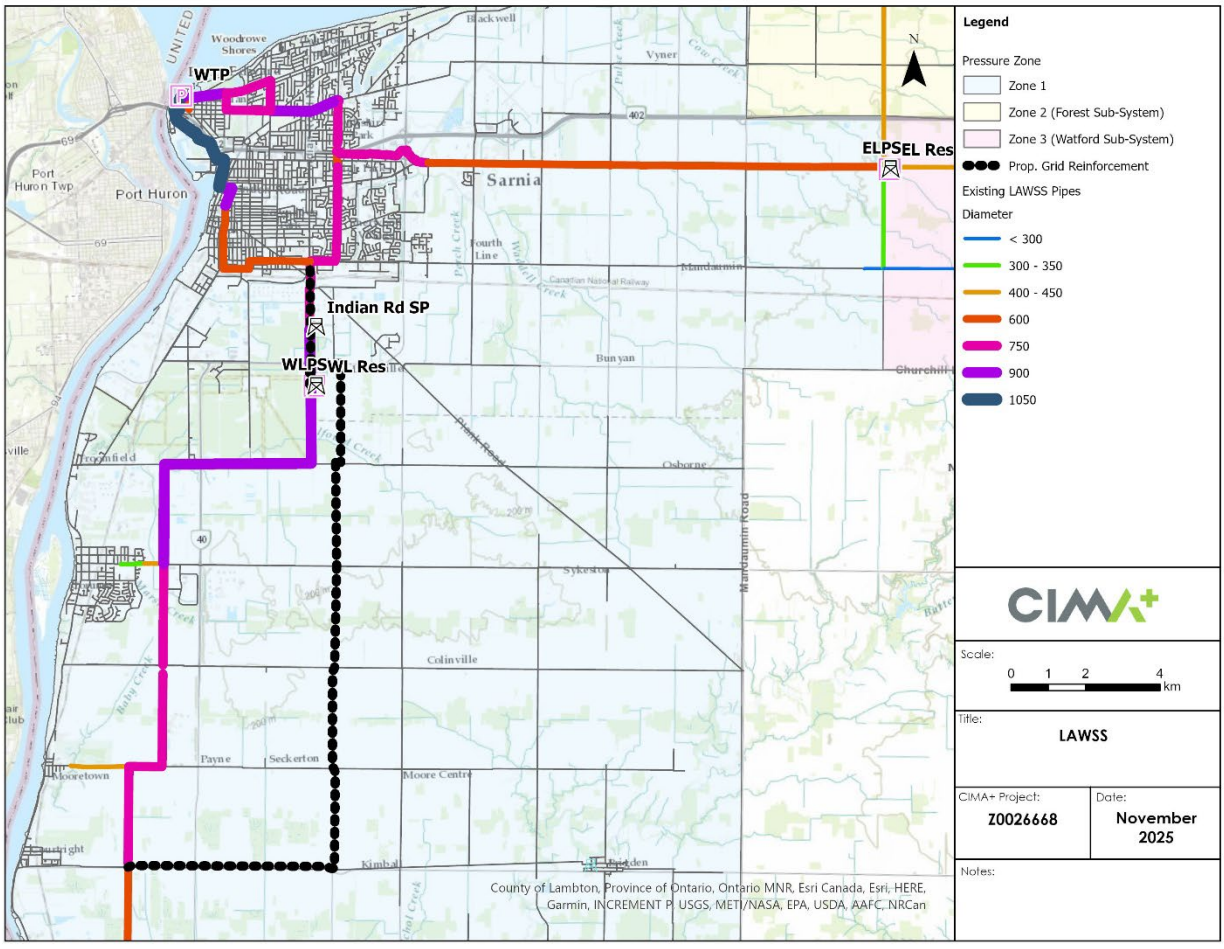

Figure 2-2: Grid Reinforcement and Transmission Main Twinning (Indicated in Black)

Recommended timing or triggers have not previously been documented for these watermain projects. As such, Master Plan scenarios were modelled both with and without these upgrades in place to determine required timing.

3 Service Requirements Analysis

3.1 Growth Projections

3.1.1 Population Projection Methodology

For the 2021 Master Plan, demand growth projections for the period 2016–2031 were approved by member municipalities, then extrapolated to estimate demands over the planning horizon (2019–2041). For the 2026 Master Plan update, the same linear trends were applied to project population growth over the new planning horizon for five of the member municipalities. The Town of Plympton-Wyoming provided alternate growth rates to be used in place of the previous trend. Population estimates for 2024 were used as the starting year for growth projections. This method was compared with the results of several other population projection strategies. Additional details of the projection methodology are provided in the technical memorandum titled “Population Growth Projections for 2026 Master Plan Update”, which is attached in Appendix C.

3.1.2 Population Projections Summary

In general, the proposed projection approaches resulted in lower population estimates than the 2021 Master Plan projections. The exception was Plympton-Wyoming, where recommended projections were based on more aggressive growth rates provided by the municipality. Population projections for the Town of Forest were used to estimate growth in the Lambton Shores service area, as most residents serviced by LAWSS reside in close proximity to Forest. Most Lambton Shores residents in other areas are serviced by a different water system.

Population projections over the planning horizon are shown in Table 3-1. Member municipalities accepted the recommended population growth projections in May 2025.

Table 3-1: Summary of Proposed Growth Projections for 2026 Master Plan Update

Year	City of Sarnia	St. Clair	Plympton-Wyoming	Warwick	Point Edward	Lambton Shores (Forest)
2023	N.A.	N.A.	9,300(1)	N.A.	N.A.	N.A.
2024	N.A.	N.A.	9,640	3,865(2)	1,991(2)	N.A.
2025	72,409(3)	15,117(3)	9,980	3,918	2,005	2,551(3)
2026	72,944	15,349	10,320	3,972	2,018	2,577
2028	N.A.	N.A.	11,000(1)	N.A.	N.A.	N.A.
2031	75,616	16,509	11,500	4,239	2,086	2,706
2036	78,289	17,668	12,333	4,506	2,154	2,835
2041	80,962	18,828	13,167	4,773	2,222	2,964
2043	N.A.	N.A.	13,500(1)	N.A.	N.A.	N.A.
2046	83,635	19,988	14,000	5,040	2,290	3,093

Notes:

1) Based on Plympton-Wyoming 2023 Drinking Water Master Plan Study and information provided by the Town of Plympton-Wyoming
2) Baseline population based on 2024 Environics Analytics data
3) Baseline population estimated from 2016, 2021 census trend continuation

3.1.3 Water Demand Growth

To estimate water demand growth from approved population growth projections, average per capita water consumption rates for each member municipality were estimated from 2024 ADD values and 2024 municipal populations (see Table 3-2). It was assumed the that per capita consumption rates would not change over the Master Plan horizon (2024–2046). Demand growth was thus projected to be linear over this period.

Table 3-2: Municipal Per Capita Water Demands

Municipality	2024 Average Day Demand (L/s)	2024 Residential Population	Per Capita Demand (L/s)
City of Sarnia	336.6	72,318	402.2
St. Clair Township	129.4(1)	15,002	745.1
Village of Point Edward	11.7	1,991	509.2
Town of Plympton-Wyoming	31.8	9,640	285.3
Township of Warwick	12.7	3,865	283.4
Municipality of Lambton Shores (Forest)	12.9	2,521	440.8

Notes:

1) Adjusted to remove major ICI customer demands

As a LAWSS customer, water takings for the municipality of Brooke-Alvinston are limited by a servicing agreement instead of being growth-driven. Growth in Brooke-Alvinston was not factored into the analysis described herein, with the exception of one proposed residential development, which was handled as a provisional case (see Section 3.6.3)

With the exception of three major ICI customers in St Clair, information on employment growth rates was not available. It was assumed that employment and residential growth would follow the same trend; therefore, employment and residential water demand growth were not separated in this analysis, beyond these three ICI customers.

Anticipated ICI demand changes for the customers were determined separately as described in Section 3.6.1.

3.1.4 Allocation of Demand Growth

The Lambton County Official Plan provides a framework for the development of local municipalities within the County. This plan includes a growth strategy based on a three-level settlement hierarchy:

1) Urban Centres – Areas where development will be focused to offer residents daily necessities.
2) Urban Settlements – Areas that will be developed to provide necessities similar to Urban Centres but to a lesser extent.
3) Secondary Settlements – Existing developed areas that are not a focus for growth.

The Official Plan provides a map of designated settlement areas for each municipality as shown in Figure 3-1. Growth within the hydraulic model was allocated based on the land area of each settlement area in this map. The area of each parcel was measured and expressed as a percentage of the total designated growth area within the municipality. Projected growth for each municipality was then distributed evenly across each parcel. Resulting percentages of total growth for each settlement type are provided in Table 3-3.

Table 3-3: Percentage of Total System Growth per Settlement Type

Settlement Type	% of Total Growth
Urban Centre	64%
Urban Settlement	22%
Secondary Settlement	13%

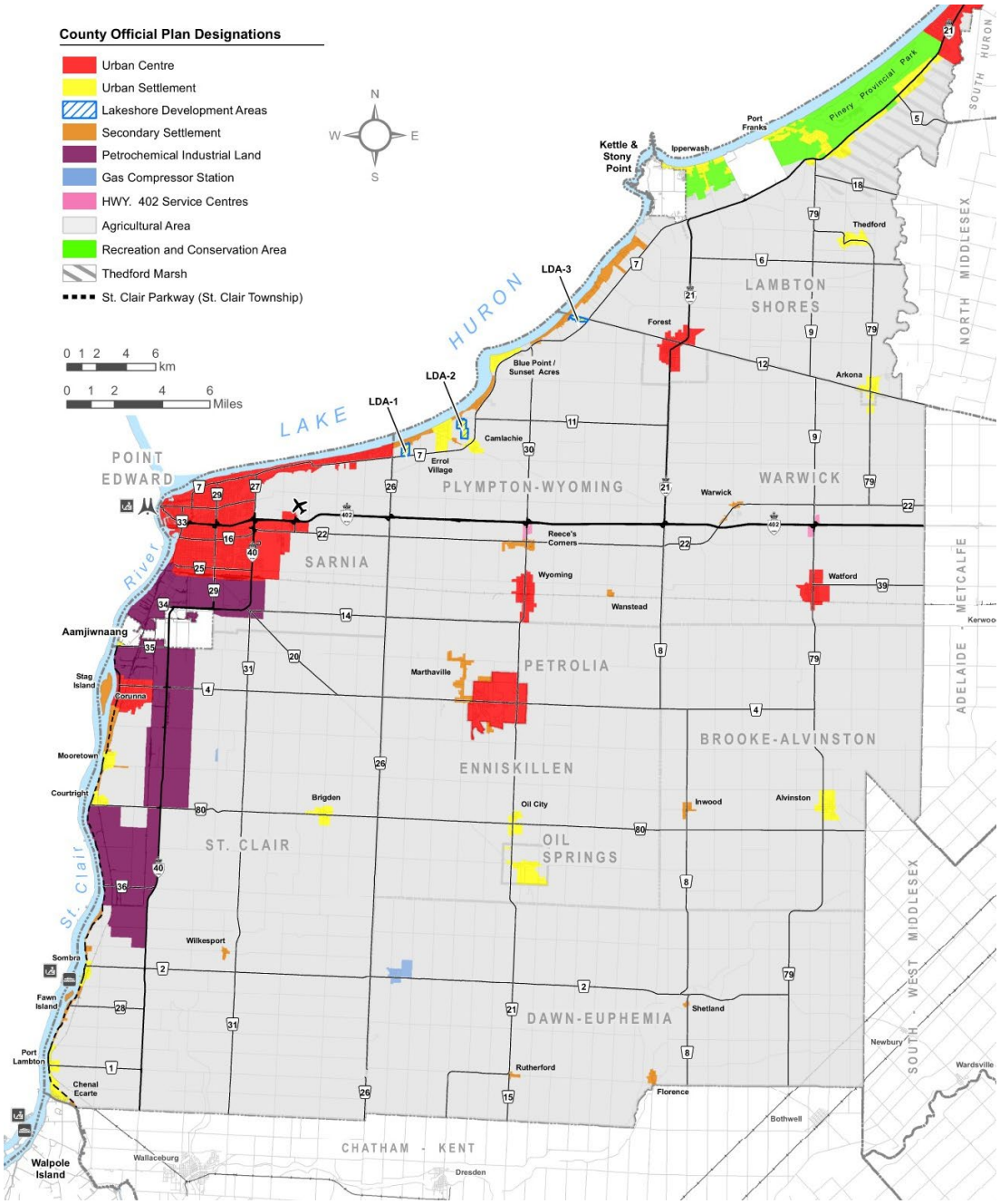

Figure 3-1: Official Plan Settlement Designations (Source: Lambton County Official Plan)

3.1.5 Summary of Population-Growth Driven Demand

Table 3-4 below summarizes existing and future demands, organized by municipality. This summary considers population-driven demand growth only, which forms the base analysis of this Master Plan. Additional provisional demands are described in Section 3.6 with a full demand summary being provided in Section 3.7.

Table 3-4: Summary of Existing and Future System Demands Considered for the Base Analysis Case

Municipality or Demand Group	2024 ADD (L/s)	2024 MDD (L/s)	2036 ADD (L/s)	2036 MDD (L/s)	2046 ADD (L/s)	2046 MDD (L/s)
City of Sarnia	336.6	573.5	364.4	620.8	389.3	663.2
St. Clair Township	129.4	250.0	152.4	294.4	172.4	333.1
Village of Point Edward	11.7	20.0	12.7	21.6	13.5	23.0
Town of Plympton-Wyoming	31.8	54.2	40.7	69.4	46.2	78.8
Township of Warwick	12.7	21.6	14.8	25.2	16.5	28.2
Municipality of Lambton Shores (Forest)	12.9	21.9	14.5	24.6	15.8	26.9
Municipality of Brooke-Alvinston	3.1	5.3	3.1	5.3	3.1	5.3
Major ICI customers (St Clair)	42.0	42.0	42.0	42.0	42.0	42.0
Total System	580.3	988.5	644.6	1,103.4	698.9	1,200.4

3.2 Water Service Criteria

Establishing appropriate design criteria and levels of service (LOS) is an important step in the development of alternative solutions and planning for cost-effective infrastructure investment. The water servicing criteria established and used for the 2025 LAWSS Master Plan update were based on the Ontario Ministry of the Environment, Conservation and Parks (MECP) 2019 Design Guidelines for Drinking Water Systems and are shown in Table 3-5 below.

Table 3-5: Water Servicing Criteria

Criteria	Level of Service Targets	Source
System Pressure	40 – 100 psi allowable 50 – 70 psi preferred where applicable 20 psi minimum pressure during fire flow events	MECP
Headloss	Maximum 2 m/km under typical operating conditions	Other Ontario Municipalities[1]
Fire Flow	Zone 1: 378 L/s (exist. and 2046) Zone 2: 174 L/s (exist.) – 208 L/s (2046) Zone 3: 176 L/s (exist.) – 203 L/s (2046)	MECP
Pump Capacity	Firm capacity must exceed the MDD for each pressure zone. If limited or no floating storage is available, firm capacity must exceed the greater of MDD plus fire flow and peak hour demand (PHD).	MECP
Storage	Guidelines for Total Storage, A+B+C A = Fire Storage B = Equalization Storage (25% of maximum day demand) C = Emergency Storage (25% of A+B)	MECP

Notes:

1) Head loss Level of Service target was selected based on criteria used by other municipalities in Ontario.

3.3 Pumping Capacity Analysis

A desktop pumping capacity analysis was completed for the base analysis case to ensure the relevant level of service targets were met for all zones (see Table 3-5 above). Due to the limited floating storage available in pressure zone 1, pumping capacity is recommended to supply the greater of either Zone 1 peak hour demand (PHD) or the sum of the Zone 1 MDD and fire flow. Calculated PHD demands governed in Pressure Zone 1 for the existing and future scenarios. The MDD for Pressure Zones 2 and 3 were also subtracted from the Zone 1 firm pumping capacity to account for the transfer of water to those zones via the ELBS and Reservoir. As Pressure Zones 2 and 3 have elevated storage to supply peak demands, it was not necessary to account for their PHDs in the Zone 1 capacity analysis.

To determine the governing criteria for Pressure Zones 2 and 3, required fire storage was compared to available elevated storage. Pressure Zones 2 and 3 have greater elevated storage volumes than Zone 1, and the size of the serviced populations are much smaller. Storage analysis (described in Section 2.4 below) found that the available elevated storage in Pressure Zones 2 and 3 exceeded fire storage requirements; it was therefore determined that firm pumping capacity would only be required to supply the respective zone MDD to meet the level of service target.

When required pumping capacity values were compared to the overall design firm capacity for the zone, it was found that the existing pump station capacities would be sufficient to meet the 2046 demand conditions for the base analysis case (see Section 3.6.4 for an analysis including provisional demands). However, as discussed in Section 2.3.2.3, the firm capacity of the ELBS is reduced with in-line pumps out of operation; the observed operational firm capacity was found to fall below the capacity required to meet existing and future demands for Zone 2 and future demands for Zone 3. Immediate upgrades to the ELBS are recommended to restore the facility's firm capacity. Table 3-6 below shows the results of the pumping capacity analysis.

Table 3-6: Pumping Capacity Desktop Analysis for Existing (2024) and Future (2046) Conditions

Zone	Pumping Facilities	Design Firm Pumping Capacity (L/s)	Observed Operational Firm Pumping Capacity (L/s)	Required Capacity[1] (L/s)	% Surplus (+) or Deficit (-)
Zone 1	WTP WLPS	4,098 2,180[2] 6,278 (Total)	1,588 2,180[2] 3,768 (Total)	1,380.7 (exist.) 1,688.2 (future)	+78% (exist.) +73% (future)
Zone 2	ELBS – Forest Pumps	136	35[3]	51.6 (exist.) 72.4 (future)	+62% (exist.) +47% (future)
Zone 3	ELBS – Watford Pumps	90	60[3]	50.0 (exist.) 65.2 (2046)	+44% (exist.) +28% (future)

Notes:

1) Zone 1 required capacity is based on Zone 1 peak hour demand plus the Zone 2 and 3 maximum day demands
2) The firm capacity of WLPS is anticipated to change following upgrades underway at the time of this report
3) Based on current operations when one pump is operating

3.4 Storage Requirements Analysis

A desktop storage capacity analysis was completed for the base analysis case to ensure the relevant level of service target was met for all zones (see Table 3-5). Existing and future storage requirements for each LAWSS pressure zone were calculated in accordance with the Ministry of the Environment, Conservation and Parks (MECP) Design Guidelines for Drinking Water systems. The total storage required is equal to the sum of the total fire storage, equalization storage, and emergency storage.

In Zone 3, the Wyoming Standpipe provides storage that is available to the Town of Wyoming but not to the full subsystem due to the presence of a pressure reducing valve. A storage requirements analysis was completed for the Township of Warwick as well as Zone 3 as a whole to ensure sufficient storage would be provided to Warwick without the Wyoming Standpipe.

As Brooke-Alvinston has a servicing agreement which sets a cap on water takings from LAWSS, its population was not factored into the calculation of fire storage requirements. Maximum day demands for Brooke-Alvinston were included in the overall zone 3 MDD values used for required pumping capacity and equalization storage calculations. Table 3-7 below shows the results of the storage capacity analysis for the base analysis case (provisional demands not included).

Table 3-7: Storage Requirements Desktop Analysis for Existing (2024) and Future (2046) Conditions

Zone or Demand Area	Suggested Fire Flow (L/s)	Selected Fire Flow Duration (h)	Total Fire Storage (m^3)	Equalization Storage (m^3)	Emergency Storage (m^3)	Total Required Storage (m^3)
Zone 1 (Existing)	378.0	6	8,165	19,158	6,831	**34,153**
Zone 1 (Future)	378.0	6	8,165	22,955	7,780	**38,900**
Zone 2 (Existing)	174.4	3	1,884	1,115	750	**3,748**
Zone 2 (Future)	208.1	3	2,247	1,564	953	**4,764**
Zone 3 (Existing)	175.8	3	1,899	1,079	744	**3,722**
Zone 3 (Future)	203.1	3	2,194	1,409	901	**4,504**
Warwick only (Existing)	121.8	2.5	1,096	466	391	**1,953**
Warwick only (Future)	139.0	2.5	1,251	804	514	**2,568**

Storage requirements were compared to the total existing storage volume available in each zone. Table 3-8 below provides the total volume and available volume for LAWSS storage facilities, as well as the basis upon which available volumes were determined. It should be noted that the zones listed in the table refer to the LAWSS pressure zone in which the facility is located. Available storage indicates volumes of water available at the site; available storage on-site may not be equal to the volume available to a specific zone, as other zonal demands would need to be accounted for. Storage available to each zone is determined later in this section.

Table 3-8: LAWSS Storage Facility Available Volume

Zone[1]	Storage Facility	Total Volume (m^3)	Available Storage Volume (m^3)	Basis of Available Volume Calculation
Zone 1	LAWSS WTP Reservoir	75,600	31,200	Volume required for sufficient disinfectant contact time in “worst case scenario”
Zone 1	WLPS Reservoir	90,000	90,000	N/A
Zone 1	Indian Road ET	2,300	2,300	Volume above elevation that can provide pressures of ≥20psi
Zone 1	Port Lambton Standpipe	2,700	1,597	Volume above elevation that can provide pressures of ≥20psi
Zone 2	Forest Standpipe	4,500	2,522	Volume above elevation that can provide pressures of ≥20psi
Zone 2	ELBS Reservoir	9,000	9,000 (general) 1,469 (fire)	N/A Facility firm pumping capacity
Zone 3	ELBS Reservoir	9,000	9,000 (general) 972 (fire)	N/A Facility firm pumping capacity
	Watford Standpipe	3,840	2,340	Volume above elevation that can provide pressures of ≥20psi
	Wyoming Standpipe	1,590	928	Volume above elevation that can provide pressures of ≥20psi (available to Wyoming only)

Notes:

1) Listed zones indicate the location of the facility. Available storages listed may be shared across multiple zones.

The following considerations were used to determine available volume:

- The full volumes of reservoirs and elevated tanks where no primary disinfection is employed was considered available to the overall system.
- Where a facility supplies water to multiple zones via inter-zone transfers, the volume fraction available to individual zones was determined by subtracting the demand of the other zone(s) over the suggested fire flow duration under maximum day conditions.
- The LAWSS WTP employs chlorine disinfection. A minimum reservoir volume of roughly 33 ML must be maintained to meet primary disinfectant contact times (see Section 3.5 for additional detail on the calculation of WTP reservoir CT). The remaining volume was considered immediate available storage for the overall system.
- The available fraction of storage in standpipes is that above the water level that would maintain a minimum pressure of 20 psi at all points in the pressure zone.
- The fraction of ELBS reservoir storage available to Zones 2 and 3 during fire flow events is limited by ELBS pumping capacity. However; over the recommended fire duration, the available elevated storage plus available pumped volume exceeded the required storage needed to meet fire demand and MDD for the respective zones. This was found to be the case for both Zones 2 and 3, assuming ELBS firm capacity is restored.

Table 3-9 shows the storage requirements for the base analysis case and available storage surplus for existing (2024) and future (2046) conditions. For all three zones, it was found that sufficient storage would be available to the 2046 horizon, assuming the ELBS design firm capacity is restored. See Section 3.6.4 for an analysis including provisional demands.

Table 3-9: Comparison of Available Storage and Storage Requirements

Zone or Demand Area	Required Storage – Existing (m^3)	Required Storage – Future (m^3)	Immediate Available Storage (m^3)	Surplus (+) or Deficit (-)
Zone 1	34,153	38,900	116,332 (exist.) 113,216 (future)1	+71% (exist.) +66% (future)
Zone 2	3,748	4,764	10,982	+66%(exist.) +57% (future)

Zone or Demand Area	Required Storage – Existing (m^3)	Required Storage – Future (m^3)	Immediate Available Storage (m^3)	Surplus (+) or Deficit (-)
Zone 2 – Fire[2]	1,884	2,247	3,991	+53%(exist.) +44% (future)
Zone 3	3,722	4,504	11,711	+68%(exist.) +62% (future)
Zone 3 – Fire[2]	1,899	2,194	3,268	+55%(exist.) +48% (future)
Warwick only	1,953	2,568	6,380	+69%(exist.) +60% (future)
Warwick only - Fire	1,096	1,251	3,312	+67%(exist.) +62% (future)

Note:

1) Zone 1 available storage is affected by zone 2 and 3 demands.
2) Available storage for pressure zones 2 and 3 depend on the volume of water that can be pumped over the suggested fire flow duration.

3.5 WTP Reservoir CT Requirements

CT disinfection requirements at the LAWSS WTP were evaluated to determine the fraction of the reservoir volume that can be considered available storage. CIMA+ was provided “peak” flows leaving the WTP reservoir per day. These flows include treated water to distribution, backwash to the WTP, and service water to the WTP. A theoretical required volume and corresponding level to meet CT requirements was calculated using the worst-case scenario provided;

- Highest peak flow observed in the last ~10 years +10% additional high lift and backwash flow - 2760 L/s (or 238,464 m^3/day)
- Lowest water temperature recorded of 0.5ºC (Stn #7)
- Free chlorine residual at critical low of 1 mg/L (Stn #7)
- Highest Recorded Treated Water pH of 8, (Stn #5) (pH of 8.5 also referenced as it is included as a requirement in the Revised OCWA WTP O&M manual)

A reservoir level of 3.75 m in both cells under this scenario results in a theoretical contact time of 129.4 minutes. This exceeds the required minimum contact times of 101 minutes at a treated water pH of 8 and 122 mins at a more conservative pH of 8.5.

These values are based off a 1-log inactivation of Giardia cysts by free chlorine at 0.5ºC or lower and a free chlorine concentration of 1 mg/L. This analysis indicates that there is an approximate available storage volume of 15.6 ML in each reservoir (31.2 ML total) that can be utilized before CT is a concern.

All calculations were completed following Section A.43.40 in the Revised OCWA WTP Operations Maintenance Manual.

3.6 Provisional Demand Cases

Three provisional cases were considered where additional demands were applied to several demand scenarios. The demands associated with the provisional cases are either unconfirmed future demands or are infrequent in nature, as discussed in the following subsections.

3.6.1 St Clair Major ICI Customers

Maximum allowable water takings for major ICI customers in St Clair are provided in the St. Clair Water System Master Plan Update 2023. As per servicing agreements with these existing customers, LAWSS is required to supply water up to a maximum duration in emergency events when customers' onsite supplies are not available. The maximum allowable takings for existing customers were included in MDD scenarios as a provisional case.

Average daily water demands for ICI customers were assumed to remain unchanged throughout the Master Plan horizon. The same average day demands used in the existing ADD scenario (calculated from monthly 2024 data provided by the Township of St Clair) were also applied in future ADD scenarios. Therefore, the provisional case only impacted MDD scenarios.

Major ICI customer demands are summarized in Table 3-10.

Table 3-10: Existing and Estimated Future Demands for Major Industrial, Commercial, and Institutional (ICI) Customers in St Clair Township

ICI Customer	ADD – Existing (L/s) (1)	ADD – Future (2036, 2046) (L/s) (1)	Max. Allowable Demand – Existing (2) (L/s)	Max. Allowable Demand (2) – Future (2036, 2046) (L/s)
Nova Corunna	4.5	4.5	256	256
Nova Moore	26.5	26.5	94	94
Eastern Power	11.1	11.1	103	103

ICI Customer	ADD – Existing (L/s) [1]	ADD – Future (2036, 2046) (L/s) [1]	Max. Allowable Demand – Existing [2] (L/s)	Max. Allowable Demand [2] – Future (2036, 2046) (L/s)
Future Plant #1	N/A	N/A	N/A	45
Future Plant #2	N/A	N/A	N/A	70
Total ICI Demand	**42.0**	**42.0**	**453**	**568**

Notes:

1) Current average daily usage based on 2024 monthly consumption data
2) As stated in the St. Clair Water System Master Plan Update 2023 (Maximum allowable taking limits defined in service agreements with LAWSS)

3.6.2 Chippewas of Kettle and Stony Point First Nation

As of 2025, LAWSS is in contact with the community of Chippewas of Kettle and Stony Point First Nation (CKSPFN) regarding a possible servicing agreement, in which the community would connect to Pressure Zone 2 (Forest subsystem) as an additional LAWSS customer.

Neegan Burnside Ltd. completed a study for the CKSPFN connection, which determined required storage and pumping needs for the community to a 2041 horizon. The community has existing storage infrastructure, which was factored into the needs analysis. A subsequent feasibility study completed by AECOM in 2024 determined that LAWSS would be able to accommodate a connection at that time.

The 2025 Master Plan update evaluated the hydraulic impacts of CKSPFN connecting to LAWSS under existing and future (2036, 2046) conditions. Storage and MDD values for the evaluated horizons were determined through linear interpolation and extrapolation of data provided in the feasibility study (see Table 3-11).

Table 3-11: Pumping and Storage Requirements for Chippewas of Kettle and Stony Point First Nation (CKSPFN)

Year	Maximum Day Demand (L/s)	Total Storage Requirements (m^3)	Source
2019	12.9	559.0	(AECOM, 2024)

Year	Maximum Day Demand (L/s)	Total Storage Requirements (m^3)	Source
2024	17.2	674.5	Calculated through linear interpolation
2032	24.0	859.2	(AECOM, 2024)
2036	25.2	891.2	Calculated through linear interpolation
2042	27.0	939.1	(AECOM, 2024)
2046	28.2	971.1	Calculated through linear extrapolation

3.6.3 Schouten Development (Brooke-Alvinston)

A proposed development in Brooke-Alvinston has applied to receive water service from LAWSS. The 250-home subdivision south of Watford would be included under a revised servicing agreement, which would set a cap on water takings for the community of Brooke-Alvinston overall. Average day demands for the development were estimated using per capita water demand rates calculated for Warwick. Maximum day demands were calculated using the Maximum Demand Factor applied in other municipalities. It was determined that the existing servicing agreement to Brooke-Alvinston would need to be revised to accommodate the new development demands.

3.6.4 Provisional Surplus Pumping and Storage Capacity Analysis

Pumping capacity and storage analyses were repeated with provisional cases considered. Results are provided in Table 3-12, showing surpluses of pumping and storage capacity were maintained.

Table 3-12: Pumping and Storage Analysis with Provisional Demands Applied

	Existing Total Available Capacity	Existing Required Capacity	Surplus (+) or Deficit (-)	2046 Total Available Capacity	Future Required Capacity	Surplus (+) or Deficit (-)
Zone 1 Pumping Capacity	6,278 L/s	1,791.6 L/s	+71%	6,278 L/s [1]	2,214.2 L/s	+65%
Zone 1 Storage Capacity	116,332 m^3	45,249 m^3	+61%	110,461 m^3	53,101 m^3	+52%
Zone 2 Pumping Capacity	136 L/s	68.8 L/s	+49%	136 L/s	100.6 L/s	+26%
Zone 2 Storage Capacity	10,982 m^3	4,423 m^3	+60%	10,982 m^3	5,735 m^3	+48%
Zone 3 Pumping Capacity[2]	90 L/s	50.0 L/s	+44%	90 L/s	69.0	+23%
Zone 3 Storage Capacity[2]	11,711 m^3	3,722 m^3	+68%	11,711 m^3	4,604 m^3	+61%

Notes:

1) The firm capacity of WLPS in Zone 1 is anticipated to change following upgrades underway at the time of this report
2) Schouten Development demands only applied in future scenario

3.7 Demand Summary

Table 3-13 below summarizes existing demands and future demand projections used in each scenario modelled for the Master Plan update, organized by municipality or demand group. Provisional cases are included as shown.

Table 3-13: Summary of Existing and Future System Demands, Including Provisional Demand Cases

Municipality or Demand Group	2024 ADD (L/s)	2024 MDD (L/s)	2036 ADD (L/s)	2036 MDD (L/s)	2046 ADD (L/s)	2046 MDD (L/s)
City of Sarnia	336.6	573.5	364.4	620.8	389.3	663.2
St. Clair Township	129.4	250.0	152.4	294.4	172.4	333.1
Village of Point Edward	11.7	20.0	12.7	21.6	13.5	23.0
Town of Plympton-Wyoming	31.8	54.2	40.7	69.4	46.2	78.8
Township of Warwick	12.7	21.6	14.8	25.2	16.5	28.2
Municipality of Lambton Shores (Forest)	12.9	21.9	14.5	24.6	15.8	26.9
Municipality of Brooke-Alvinston (with provisional future growth)	3.1	5.3	5.3	9.0	5.3	9.0
Chippewas of Kettle and Stony Point First Nation (Provisional)	N/A	17.2	N/A	25.2	N/A	28.2

Municipality or Demand Group	2024 ADD (L/s)	2024 MDD (L/s)	2036 ADD (L/s)	2036 MDD (L/s)	2046 ADD (L/s)	2046 MDD (L/s)
Major ICI customers (St Clair)	42.0	42.0 453.0 (Provisional)	42.0	42.0 568.0 (Provisional)	42.0	42.0 568.0 (Provisional)
Total System (base case)	580.3	988.5	644.6	1,103.4	698.9	1,200.4
Total System (with provisional demands)	580.3	1,416.7	646.8	1,543.3	701.1	1,758.2

4 System Constraints and Opportunities

The following sections outline existing and future servicing challenges and potential future constraints identified through hydraulic analysis under existing (2024), 2036, and 2046 scenarios.

4.1 Zone 1

Based on the maximum day demand scenario analysis of the water system under existing and 2046 conditions, the conclusions listed below were made for Pressure Zone 1. Unless otherwise indicated, modelling was completed with the following projects implemented, as described in Section 2.4.3: 1) grid reinforcement and transmission main twinning projects in St Clair Township, 2) upgrades at the West Lambton Reservoir and Pump Station, and 3) ELBS fill line upgrades.

Due to the potential for significant variance in demands as a result of the maximum allowable taking agreements with the St Clair major ICI customers, Zone 1 was assessed under two demand conditions for each planning horizon:

1) MDD with none of the large ICI users taking their servicing agreement amounts. Demands for these users were based on the 2024 typical average usage.
2) (Provisional) MDD with all large ICI users simultaneously taking their maximum agreement amount (453 L/s under existing conditions and 568 L/s under future conditions)

Existing Conditions – No St Clair Large User Taking

- Desktop analysis found sufficient storage and pumping capacity was available (see Section 3.6).
- Pressures were within the acceptable operating range (40 – 100 psi) both with and without the twinning and grid reinforcement projects in service.

Existing Conditions – With St Clair Large User Taking (453 L/s)

- Desktop analysis found sufficient storage and pumping capacity was available (see Section 3.6.4).
- Pressures in St Clair fell below 40 psi when the twinning and grid reinforcement projects were not in service. With the twinning and grid reinforcement projects in service, pressures in St Clair were within the acceptable operating range (40 – 100 psi).
- Without the proposed 900mm twin on Indian Road from Campbell St to the WLPS (part of the grid reinforcement and twinning project), the system struggled to fill the West Lambton Reservoir without overflowing the Indian Road

Standpipe. It was found that the West Lambton Reservoir would drain within approximately 72 hours. This issue was found to be resolved with the proposed Indian Road 900mm watermain built to the West Lambton Reservoir.

Future Conditions (2046) – No St Clair Large User Taking

- Desktop analysis found sufficient storage and pumping capacity was available (see Section 3.6).
- Pressures in St Clair were found to fall slightly below 40 psi if the twinning and grid reinforcement projects were not in service. With these projects in service, pressures were within the acceptable range.

Future Conditions (2046) – With St Clair Large User Taking (568 L/s)

- Desktop analysis found sufficient storage and pumping capacity was available (see Section 3.6.4).
- Minimum pressures over much of St Clair were well below acceptable levels (<40 psi) when the grid reinforcement and twinning projects were not in service. With the grid reinforcement and twinning projects built, there were small areas with minimum pressures slightly below 40 psi when all five large customers were taking their maximum agreement amount at the same time. It was found that if any one of the five customers were not active, the pressures were maintained above 40 psi.
- The system struggles to fill the West Lambton Reservoir without overflowing the Indian Road Standpipe, and thus the reservoir empties in approximately 72 hours, even with the proposed Indian Road 900mm watermain built.

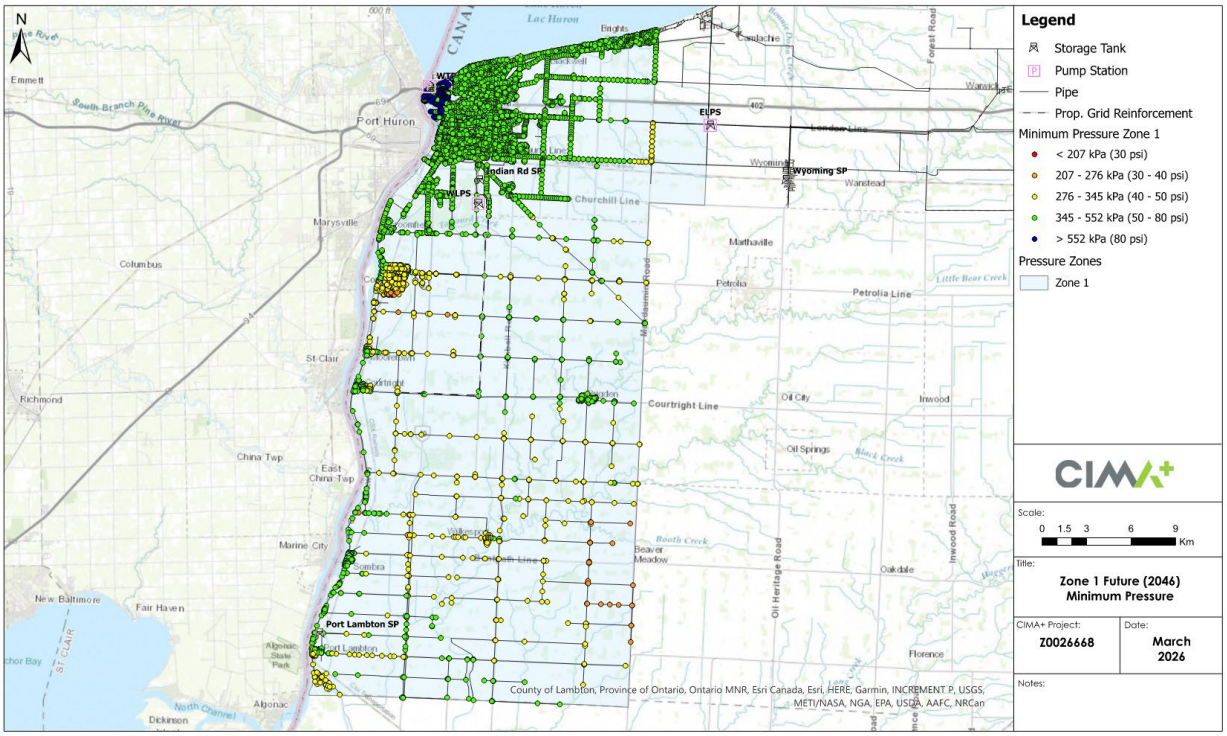

Figure 4-1: Minimum Pressures in Pressure Zone 1 Under Future (2046) Maximum Day Demand Conditions

4.2 Zone 2

Existing Conditions

- Desktop analysis found sufficient storage and pumping capacity was available, both with and without provisional demands applied (with ELBS at design firm capacity; see Sections 3.6 and 3.6.4).
- Isolated but non-extensive areas of high head loss (>2 m/km) were observed.
- Pressures were adequate (>40 psi) but lower than ideal.
- With CKSPFN connected to LAWSS, pump upgrades at the ELBS were needed immediately to restore sufficient firm capacity.

Future Conditions (2046)

- Desktop analysis found sufficient storage and pumping capacity was available, both with and without provisional demands applied (with ELBS at design firm capacity; see Sections 3.6 and 3.6.4).
- With CKSPFN connected, minimum pressures were below acceptable levels near Forest and near the connection point at the north end of the pressure zone. Extensive areas of high head loss were observed along the LAWSS feedermain, as well as along local mains in the north part of the zone.

- Maximum pressures in the area of Bonnie Doon South were high (~125 psi)

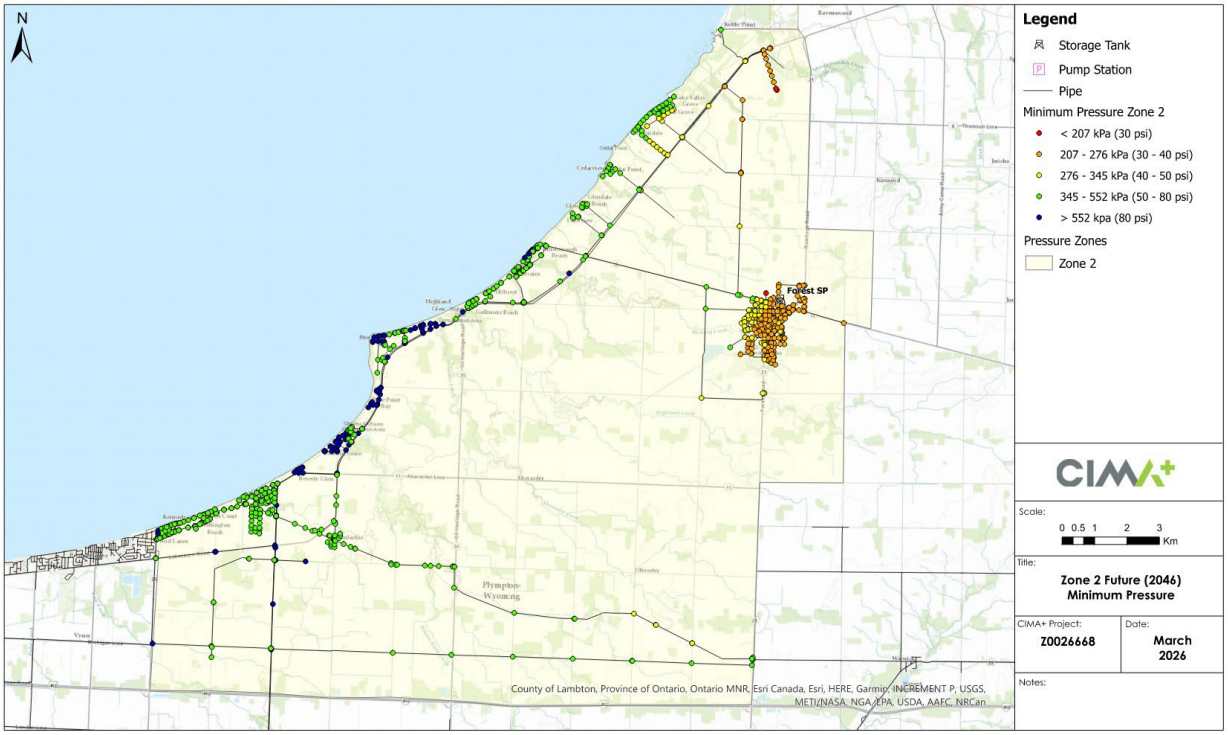

Figure 4-2: Minimum Pressures in Pressure Zone 2 Under Future (2046) Maximum Day Demand Conditions

4.3 Zone 3

Existing Conditions

- Desktop analysis found sufficient storage and pumping capacity was available both with and without provisional demands applied (with ELBS at design firm capacity; see Section 3.6 and 3.6.4).
- Minimum pressures below acceptable levels were observed in the Wisbeach area, both with and without the addition of the provisional Schouten development demands.
- Low pressures in Wisbeach appeared to be a result of limited local (municipally owned) watermain capacity servicing this area and thus were not considered to be within the scope of this Master Plan.

Future Conditions

- Desktop analysis found sufficient storage and pumping capacity was available both with and without provisional demands applied (with ELBS at design firm capacity; see Sections 3.6 and 3.6.4).

- Minimum pressures below acceptable levels were observed in the Watford and Wisbeach areas, both with and without the addition of the provisional Schouten development demands.
- Low pressures in Wisbeach appeared to be a result of limited local watermain capacity servicing this area and thus were not considered to be within the scope of this Master Plan.
- Low pressure in the Watford area was a result of headloss between the ELBS and Watford. As demand increases in this area, the London Line watermain becomes constrained.

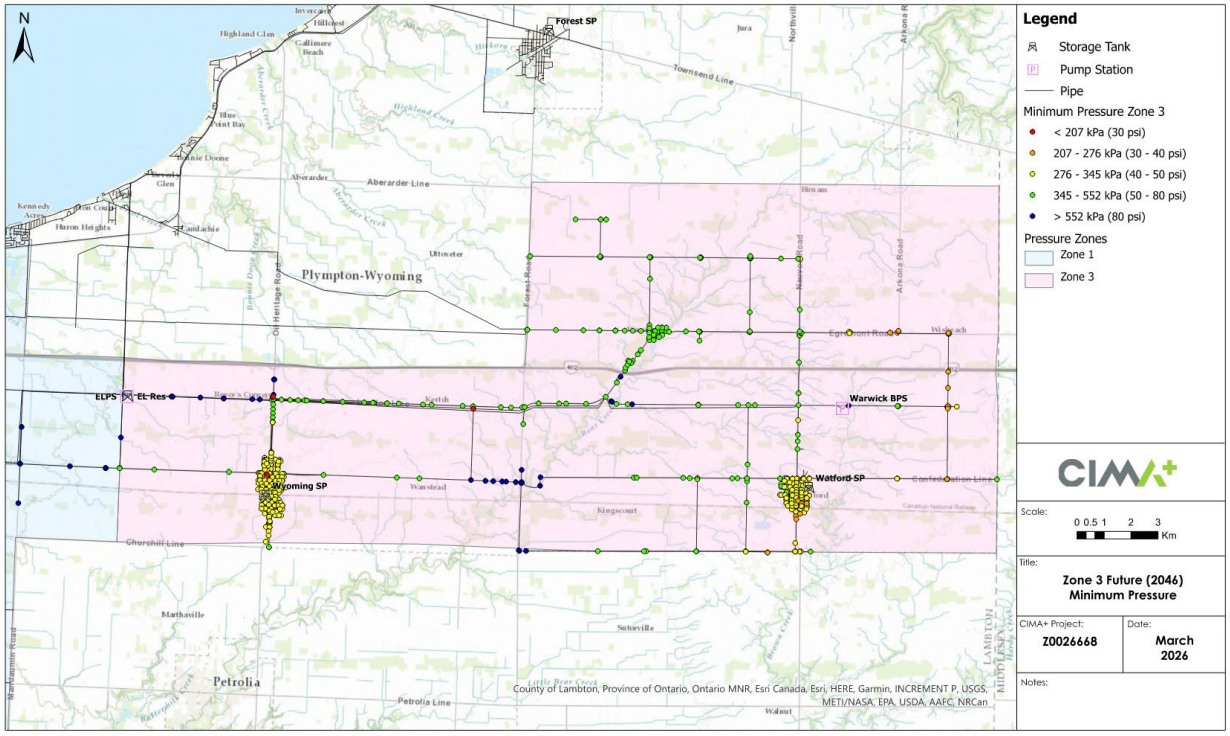

Figure 4-3: Minimum Pressures in Pressure Zone 3 Under Future (2046) Maximum Day Demand Conditions

5 Alternative Solutions Development and Evaluation

5.1 Evaluation Criteria

Following the identification of system opportunities and constraints, servicing solution alternatives were identified. Servicing alternatives were evaluated against a list of criteria developed by the project team with input from LAWSS staff, which included environmental, social-economic, and technical considerations.

During the evaluation process, each category was given equal weight in the comparison. The preferred solution for each pressure zone was identified as the alternative with the highest overall score, indicating it provided the required technical performance and supported system resilience over the planning horizon, while also offering the lowest overall impacts.

Details of the evaluation categories and criteria indicators are summarized in Table 5-1 below. Additional details of the cultural heritage screening and cost estimates completed to inform the evaluation are provided in Appendix D and Appendix E, respectively.

Table 5-1: Alternative Evaluation Criteria

Category	Criteria
Land Use	• Conformance with approved local, county, and provincial plans and policies (in the context of alignment with the 2021 Master Plan and existing land uses) • Potential effects on existing and approved / planned land uses and cultural heritage resources
Technical	• Potential constructability with the system – requirement for system upgrades • Potential constructability and minimum utility conflicts • Ability to meet long-term water servicing requirements including flow, pressure, and fire flow for the servicing area
Natural Environment	• Potential to impact sensitive ecosystems/habitats • Potential to impact surface water and groundwater • System or facility vulnerability to: • Climate change effects (e.g., algal blooms, changing water chemistry, flooding if applicable)

Category	Criteria
	• Adverse events (e.g., contamination) • Relative greenhouse gas contributions of facilities
Socio-Economic	• Potential effects (Noise, vibration, dust, access to property) related to disruption to residences, agricultural, businesses, and travelling members of the public during construction and operation • Degree of property acquisition / easement requirements
Cost	• Cost of construction (including property acquisition) • Cost of operations / maintenance

5.2 Solution Alternatives

Solutions to address the water servicing constraints and challenges discussed in Section 4 were developed for each of the three pressure zones. All Zone 2 alternatives are only required for the provisional case in which CKSPFN connects to LAWSS. For each zone, a preliminary “long list” of alternatives was developed and screened for overall hydraulic and operational viability. Alternatives found to be viable were short-listed for further evaluation against the criteria in Table 5-1.

A “Do Nothing” alternative was considered for each zone, in which no upgrades are undertaken in over the 20-year Master Plan horizon. It was determined that a Do Nothing approach would fail to address system constraints identified in future modelling scenarios (i.e., the level of service provided would not meet the MECP servicing criteria in Table 3-5). The “Do Nothing” alternative was not carried forward for further evaluation.

5.2.1 Zone 1

Eight alternative solutions were considered for Zone 1 to address pressure, flow, and storage needs within the subsystem.

5.2.1.1 Screening of Long-Listed Alternatives

In addition to the “Do Nothing” alternative, Alternative 1 (increase discharge pressure at WTP) was also screened out as modelling indicated it presents a risk of overflowing the Indian Road Standpipe.

5.2.1.2 Short-List Alternatives

The Zone 1 alternatives short-listed for further evaluation are described below. All alternatives assume prior implementation of WLPS upgrades and Grid Reinforcement and Transmission Main Twinning projects.

Alternative 1A

Alternative 1A involves making operational adjustments by slightly increasing the discharge pressure at the LAWSS WTP and lowering the pressure sustaining valve setting at the WLPS reservoir inlet. This would allow a higher filling flow rate to the West Lambton Reservoir, without draining the Indian Rd standpipe, and improve the system's ability to replenish storage during peak demand periods.

Alternative 2

Alternative 2 focuses on increasing transmission capacity by upsizing the watermains between the WTP and WLPS. Larger watermains along this route would help reduce head losses and improve capacity. The recommended alignment for these new watermains is shown in Figure 5-1 as a solid black line. The alternative has technical considerations such as complications with shutdowns and construction in the urban area zone and near the St Clair River.

Alternative 3

Alternatives 3A, 3B, and 3C consider replacing the existing Indian Road elevated tank with a larger tank to provide increased elevated storage. Additional elevated storage would improve operational flexibility, especially during times when higher reservoir filling rates are required. The various alternatives differ in the proposed location of the new tank (shown in Figure 5-2):

- The current Indian Road site (3A),
- A new suitable location within Zone 1 (3B), or
- The East Lambton Booster Station site in Plympton-Wyoming (3C)

Alternative 4

Alternative 4 involves constructing a new direct feedermain from the WTP to WLPS. This would require approximately 12 kilometres of new 900 mm diameter pipe, as shown in Figure 5-3.

Table 5-2 to Table 5-9 below provide a summary of the Zone 1 alternatives evaluated. Figure 5-1, Figure 5-2 and Figure 5-3 show the proposed upgrades for alternatives 2, 3 and 4. The approximate locations of new facilities are shown with yellow icons.

Table 5-2: Solution Alternatives – Zone 1

Alternative	Action	Description	Result of Pre-Screening
0	Do Nothing	No upgrades or new infrastructure. Existing operations continue.	Eliminated – Will not allow the system meet servicing requirements in scenario.
1	Increase discharge pressure at the WTP	• Slight increase in discharge pressure (+3psi) from WTP	Eliminated – Presents risk of overflowing the Indian Road Standpipe
1A	Increase pressure at WTP, increase fill rate at WLPS Reservoir	• Slight increase in discharge pressure (+3psi) from WTP • Lower inlet pressure to West Lambton reservoir (allow higher fill rate)	Short-listed
2	Increase pipe capacity between WTP and WLPS Figure 5-1	Upsize 4.5km of existing watermain to 900mm	Short-listed
3A	Replace Indian Road SP with larger tank, same location	Demolish Indian Road tank, new 7ML Elevated Tank at same location	Short-listed
3B	Replace Indian Road SP with larger tank, new location	Demolish Indian Road tank, new 7ML elevated tank at new location	Short-listed
3C	Replace Indian Road SP with	Demolish existing Indian Road tank and EL reservoir, new elevated tank on ELBS	Short-listed

Alternative	Action	Description	Result of Pre-Screening
	larger tank at ELBS site	property (7ML) which would serve as both floating storage for Zone 1 and pumped storage for Zones 2 and 3.	
4	Direct feedermain from WTP to WLPS	12 km of new 900mm pipe	Short-listed

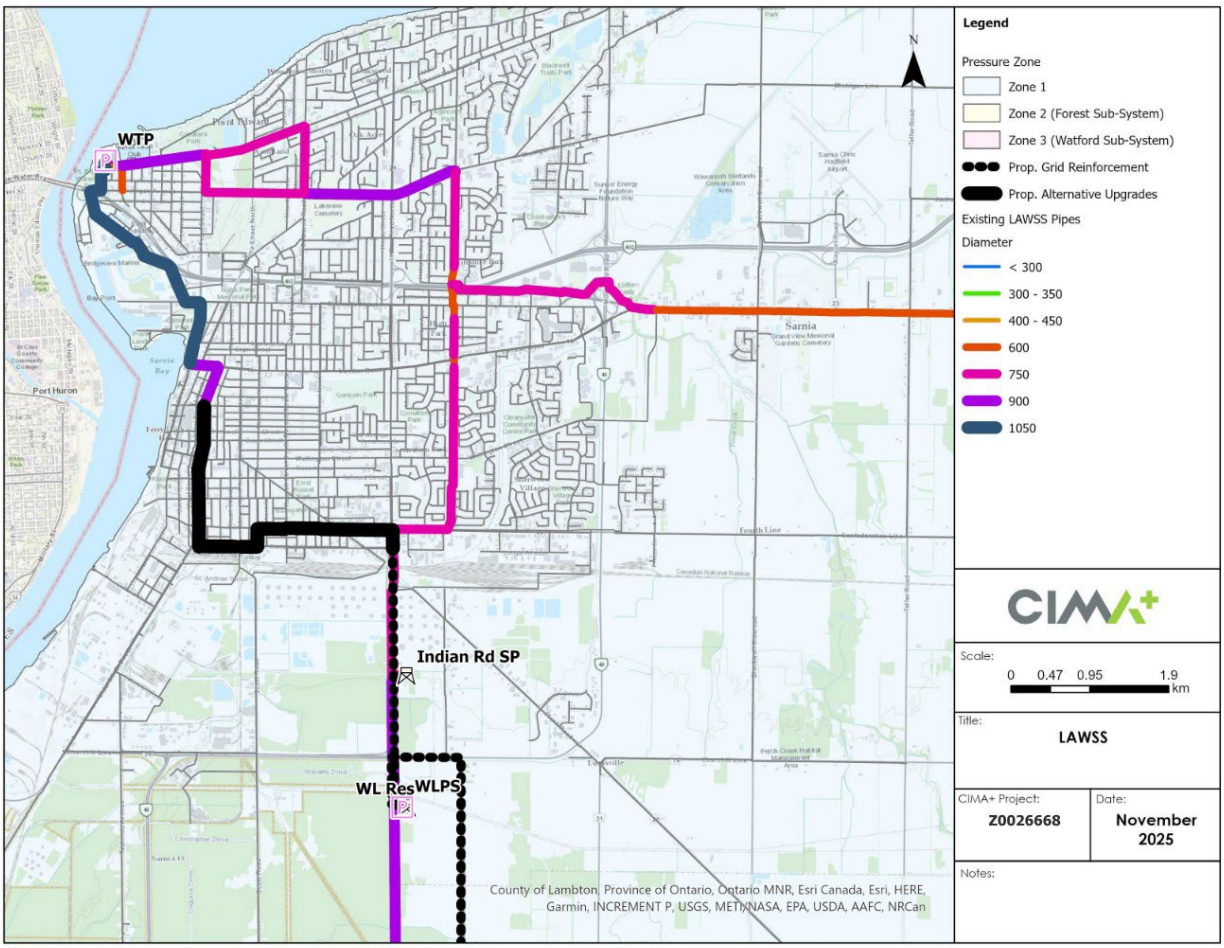

Figure 5-1: Alternative 2 - Zone 1

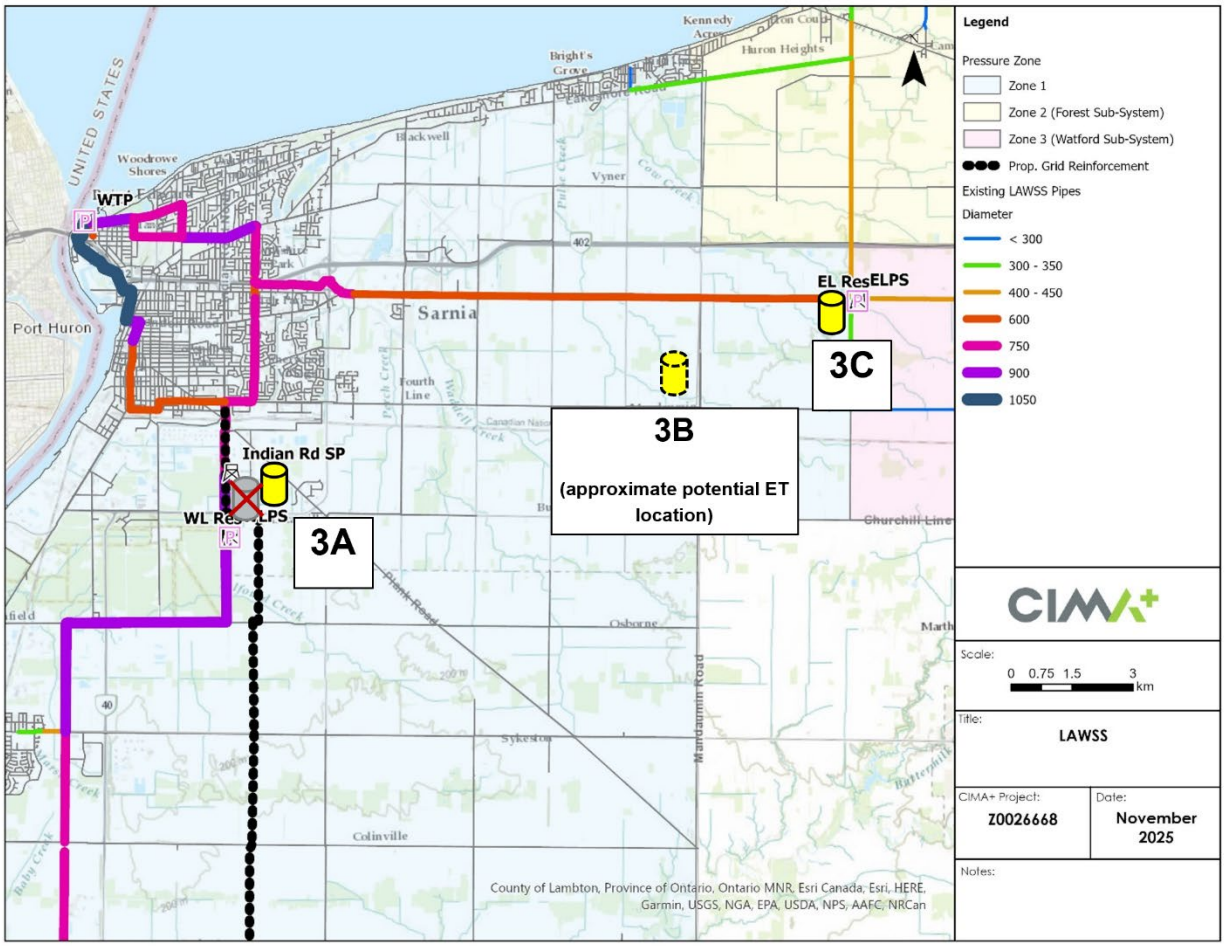

Figure 5-2: Alternative 3 - Zone 1

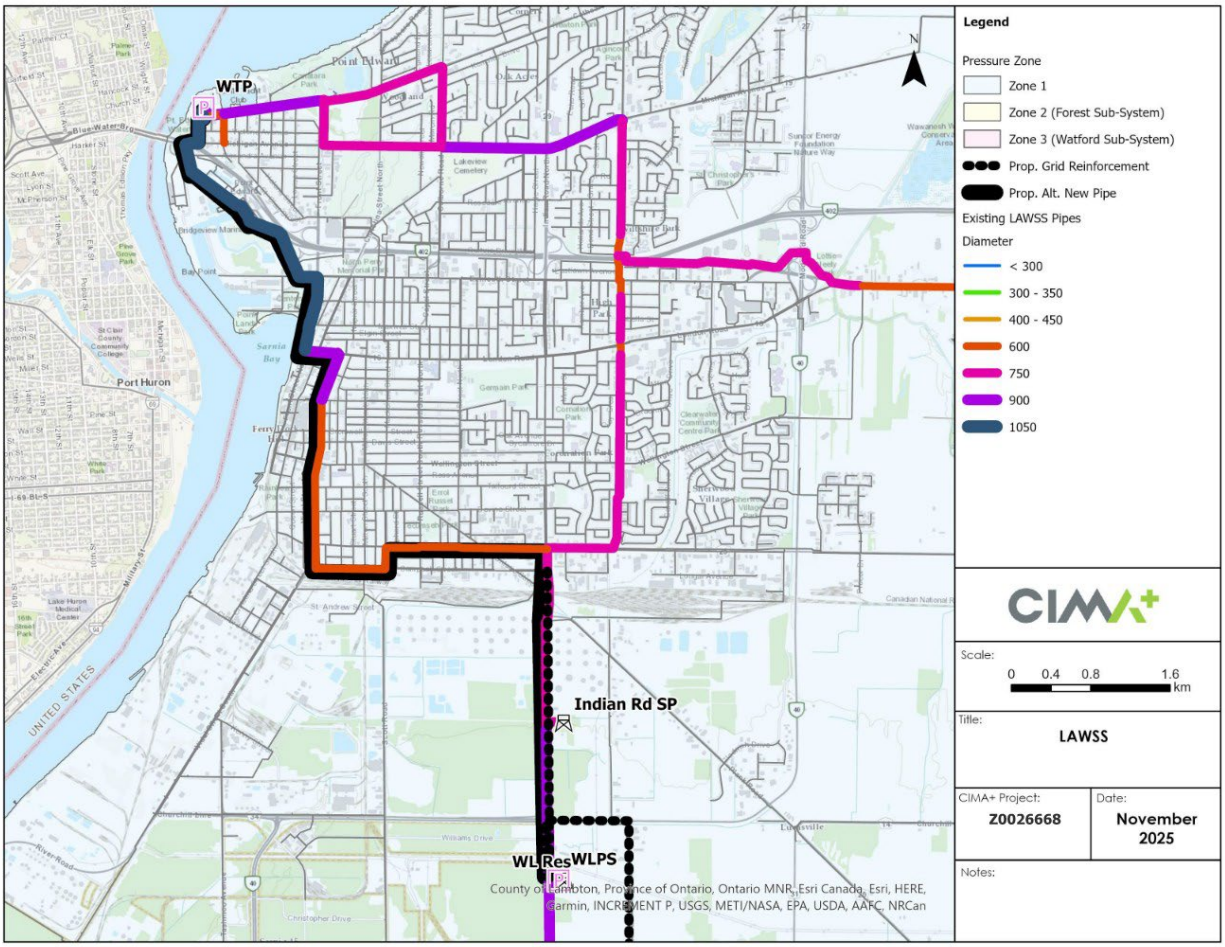

Figure 5-3: Alternative 4 - Zone 1

5.2.1.3 Conceptual Cost Estimates

Conceptual cost estimates for the Zone 1 short-listed alternatives are summarized in Table 5-3 below. Both capital costs and operational costs were compared, as these were important criteria used in evaluating the alternatives.

Capital cost estimates were based on historical costs from previous projects (with inflation applied as applicable). Costs include 20% engineering fees and a 30% contingency for conceptual-level cost estimation and tariff uncertainty. Estimates of 30-year operating opportunity cost savings associated with improved system efficiency were incorporated into capital costs where anticipated to materialize. Pricing excludes HST and contractor overhead and profit.

Operational cost estimates were primarily based on energy consumption associated with pump operation.

Table 5-3: Preliminary Cost Estimates – Zone 1 Alternatives

Alt. #	Action	Capital Cost Estimate (-15%/+30%)	Relative Operating Cost
1A	Increase pressure at WTP, increase fill rate at WLPS Reservoir. Control programming updates only.	$100K	Similar to other alternatives
2	Increase pipe capacity between WTP and WLPS	$32.1M	Similar to other alternatives
3A	Replace Indian Road standpipe (SP) with larger tank, same location	$11.4M	Similar to other alternatives
3B	Replace Indian Road SP with larger tank, new location	$22.5M	Similar to other alternatives
3C	Replace Indian Road SP with larger tank at ELBS site (and decommission EL Res)	$12.5M	Similar to other alternatives
4	Direct feedermain from WTP to WLPS	$89.7M	Lower than other alternatives

Alternative 1A only requires updates to control programming; no new construction or modification to existing infrastructure is required. As such, the capital cost estimate for this alternative is associated with the engineering services anticipated to be required. Minor increases in energy consumption may result from operating the WTP high lift pumps at a higher discharge pressure, but the associated impact on operating costs cannot be estimated with accuracy at this stage.

5.2.1.4 Alternatives Evaluation

Table 5-4 below presents the comparative evaluation results for Zone 1, showing how each alternative performed against the criteria. Each alternative received a score in each of the five categories. Scores are shown using circles, where fuller circles indicate a higher score and better performance in that category.

Table 5-4: Evaluation of Zone 1 Alternative 1A - Increase Pressure at WTP, Increase Fill Rate at WLPS Reservoir

Category	Score	Notes
Overall	 Very High	This alternative received the highest overall score (preferred)
Land Use	Very High 	Pro: • No new infrastructure or construction required • No impacts on cultural heritage resources
Technical	High 	Pro: • No new infrastructure or infrastructure upgrades needed Con: • Need for increase in discharge pressure at WTP • Lower than preferred pressure (but still above 40 psi)
Natural Environment / Climate Change	High 	Pro: • No new infrastructure or construction required Con: • Upgrades will result in slightly higher energy consumption at the WTP high lift pump station
Socio-Economic	Very High 	Pro: • No property acquisition or easement requirements

Category	Score	Notes
Cost	Very High 	Pro: • No capital cost, no new construction or infrastructure upgrades required Con: • Minimal increase in operating costs associated with higher energy consumption by high lift pumps

Table 5-5: Evaluation of Zone 1 Alternative 2 – Increase Pipe Capacity Between WTP and WLPS

Category	Score	Notes
Overall	 High	
Land Use	High 	Pro: • Anticipated that existing rights of way along roadways can be used for construction, restricting impacts to previously developed land
Technical	Moderate 	Pro: • Minimizes pressure changes by increasing system capacity, benefits the existing system (improves local fire flows if there are additional connections) • Does not require increase in discharge pressure at WTP Con: • Involves replacement of pipe with remaining serviceable life, which increases lifecycle emissions • Likely that construction would be complicated (dense urban area)

Category	Score	Notes
		• Shutdowns may be complicated, would require planning to ensure servicing needs can be met • Utility conflicts anticipated (urban area)
Natural Environment / Climate Change	High 	Pro: • No increase to greenhouse gas emissions of WTP high lift pump station Con: • Construction near St Clair River tributaries likely to be required (potential to impact sensitive ecosystems / habitats, surface water, groundwater
Socio-Economic	High 	Con: • Construction likely to be disruptive (urban area)
Cost	Moderate 	Con: • High capital cost relative to most other alternatives

Table 5-6: Evaluation of Zone 1 Alternative 3A - Replace Indian Road Standpipe with larger Tank at the Same Location

Category	Score	Notes
Overall	 High	
Land Use	High 	Pro: • Use of same property largely eliminates concern about conflicting land use policies and impacts to cultural heritage resources – there is still a need to consider any new regulations or possible new site features (e.g., overflow pond)

Category	Score	Notes
Technical	Moderate 	Pro: • Considerable ease of construction • Site is large enough to keep existing tank in service while constructing new tank • Provides more floating storage in Zone 1, resulting in better balancing of pressures and better ability to meet emergency needs
Natural Environment / Climate Change	High 	Pro: • Increased storage reduces vulnerability to adverse events • Anticipated to allow more efficient operation of Zone 1 pumping stations • Use of a property that is already developed reduces environmental impact Con: • High likelihood that tree removal will be required to allow construction of new facility while existing facility is online • Was not found to resolve WLPS reservoir fill constraint without implementing other control modifications (such as reducing the reservoir PSV setpoint)
Socio-Economic	High 	Pro: • No land acquisition or easement requirements Con: • Construction likely to cause moderate disruption to neighbouring properties • Public buy-in may be lower when replacing a facility that has remaining serviceable life

Category	Score	Notes
Cost	High 	Pro: • Low capital cost relative to several other alternatives, use of existing site reduces capital costs • Anticipated to improve pumping station operating costs

Table 5-7: Evaluation of Zone 1 Alternative 3B - Replace Indian Road Standpipe with Larger Tank at New Location

Category	Score	Notes
Overall	 Moderate	
Land Use	Moderate 	Con: • Higher potential for conflict with approved land uses than alternatives 3A and 3C (using an existing site) • Need for assessment of potential cultural heritage resources in site selection

Category	Score	Notes
Technical	Moderate 	Pro: • Site outside of urban areas can be selected to improve ease of constructability • Provides more floating storage in Zone 1, resulting in better balancing of pressures and better ability to meet emergency needs • Potential to improve fire flow capacity in certain areas • Potential to improve ability of WLPS to supply Sarnia under conditions when WTP is offline Con: • Higher potential for utility conflicts than sub-alternatives using an existing site. • Was not found to resolve WLPS reservoir fill constraint without implementing other control modifications (such as reducing the reservoir PSV setpoint) • Increased WTP discharge pressure likely required to fill tank
Natural Environment / Climate Change	High 	Pro: • Increased storage reduces vulnerability to adverse events • Anticipated to allow more energy-efficient operation of Zone 1 pumping stations Con: • Likely to require development of a new site
Socio-Economic	High 	Pro: • Site outside of urban areas can be selected to minimize disruption to neighbouring properties Con: • Will likely require land acquisition

Category	Score	Notes
Cost	Moderate 	Pro: • Anticipated to improve pumping station operating costs Con: • High capital costs relative to several other alternatives

Table 5-8: Evaluation of Zone 1 Alternative 3C - Replace Indian Road Standpipe with Larger Tank at ELBS site

Category	Score	Notes
Overall	 Moderate	
Land Use	Moderate 	Pro: • Use of an existing LAWSS property reduces concern about conflicting land use policies and impacts to cultural heritage resources – there is still a need to consider any new regulations or possible new site features (e.g., overflow pond) Con: • Expansion of site may be required to provide space (existing reservoir would need to be maintained)
Technical	Moderate 	Pro: • Fairly high ease of construction anticipated with use of an existing site • Potential to improve ability of WLPS to supply Sarnia under conditions when WTP is offline • Potential to improve service pressures and fire flow capacity in east end of system

Category	Score	Notes
		• Improved efficiency of ELBS as head gain requirements would be reduced. • Provides more floating storage in Zone 1, resulting in better balancing of pressures and better ability to meet emergency needs Con: • Likely that upgrades to ELBS piping and (possibly) pumps will be required • Was not found to resolve WLPS reservoir fill constraint without implementing other control modifications (such as reducing the reservoir PSV setpoint) • Increased WTP discharge pressure required to fill tank.
Natural Environment / Climate Change	High 	Pro: • Increased storage reduces vulnerability to adverse events • Anticipated to allow more energy-efficient operation of ELBS pumps • Use of a property that is already developed reduces environmental impact Con: • High likelihood that tree removal will be required to allow construction of new facility while existing facility is online
Socio-Economic	High 	Pro: • No land acquisition or easement requirements anticipated Con: • Construction likely to cause moderate disruption to neighbouring properties

Category	Score	Notes
Cost	High 	Pro: • Moderately low capital cost relative to other alternatives, use of existing site reduces capital costs • Anticipated to improve pumping station operating costs

Table 5-9: Evaluation of Zone 1 Alternative 4 - Direct feedermain from WTP to West Lambton Reservoir

Category	Score	Notes
Overall	 Moderate	
Land Use	High 	Pro: • Anticipated that existing rights of way along roadways can be used for construction, restricting impacts to previously developed land
Technical	Moderate 	Pro: • Highly effective at resolving Zone 1 constraints • Does not require increase in discharge pressure at WTP • Dedicated feedermain could be operated at a lower pressure than discharge to distribution, reducing overall energy demands at WTP Con: • Likely that construction would be extremely complicated (dense urban area) • Shutdowns may be complicated, would require planning to ensure servicing needs can be met • Utility conflicts anticipated (urban area)

Category	Score	Notes
		• HLP and process piping upgrades required at WTP to accommodate separate discharge to WL reservoir vs distribution system
Natural Environment / Climate Change	High 	Pro: • Potential reduction in greenhouse gas emissions of WTP high lift pump station Con: • Construction near St Clair River tributaries likely to be required (potential to impact sensitive ecosystems / habitats, surface water, groundwater • Involves replacement of pipe with remaining serviceable life, which increases lifecycle emissions
Socio-Economic	Moderate 	Con: • Construction likely to be disruptive (urban area)
Cost	Low 	Con: • Very high capital cost relative to other alternatives

The preferred alternative for Zone 1 is to implement a slight increase in discharge pressure from the LAWSS WTP and increase the fill rate at the WLPS Reservoir (Alternative 1A). Implementation of this alternative involves updates to controls programming only; no new construction or infrastructure upgrades are required. However, like all alternatives developed and evaluated herein, this approach assumes prior implementation of WLPS upgrades and Grid Reinforcement and Transmission Main Twinning projects.

Hydraulic analysis of Zone 1 alternatives was completed considering maximum allowable takings from three existing major ICI customers in St Clair (Nova Corunna, Nova Moore, Eastern Power). The preferred alternative was also modelled with the tentative maximum takings for two proposed ICI customers (Future Plants #1 and #2). Under 2046 MDD conditions with the additional customers, the West Lambton Reservoir was observed to drain fully after approximately 7 days. This result may form the basis of usage restrictions established in future servicing agreements with those new customers, as well as potential amendments to existing service agreements, if required.

5.2.1.5 Required Timing of Grid Reinforcement Projects

It has been established that the previously proposed grid reinforcement projects are necessary immediately if St Clair large users are permitted simultaneous use of their maximum allowable taking amounts. If no St Clair large users are taking beyond their typical daily usage amount, the grid reinforcement projects were found to be partially required by 2046 to maintain pressures above 275 kPa (40 psi). Further analysis was completed to establish the required timing of the grid reinforcement projects. Results are summarized under different demand conditions in Table 5-10 and Table 5-11. For each demand conditions summarized, a check-mark indicates that that portion of the grid-reinforcement project is required to maintain pressure above 275 kPa.

Table 5-10: Grid Reinforcement Timing Analysis - Without St Clair Large Users

Grid Reinforcement Extent	Existing MDD	2036 MDD	2046 MDD
Confederation St to WLPS			
WLPS to Lasalle Line		✓	✓
Lasalle Line to Petrolia Line		✓	✓
Petrolia Line to Courtright Line			
Tecumseh Road to Greenfield Road			

Table 5-11: Grid Reinforcement Timing Analysis - With St Clair Large Users

Grid Reinforcement Extent	Existing MDD	2036 MDD	2046 MDD
Confederation St to WLPS	✓	✓	✓
WLPS to Lasalle Line	✓	✓	✓
Lasalle Line to Petrolia Line	✓	✓	✓
Petrolia Line to Courtright Line	✓	✓	✓
Tecumseh Road to Greenfield Road	✓	✓	✓

5.2.2 Zone 2

With the restoration of ELBS firm pumping capacity (see Section 5.4 for this and other MCEA-exempt recommended upgrades), existing infrastructure in Zone 2 is projected to continue to meet pressure, flow, and storage needs to the Master Plan horizon (2046). However, immediate upgrades would be required should the community of Chippewas of Kettle and Stony Point First Nation (CKSPFN) connect to LAWSS. The seven alternative solutions developed for Zone 2 are therefore provisional in nature and only applicable should CKSPFN come online.

5.2.2.1 Screening of Long-List Alternatives

In addition to the “Do Nothing” alternative, Alternative 4 (Major Pump Upgrades) was also screened out, as pressure requirements were not met in future scenarios and the increased HGL near the ELBS presented a risk of maximum pressures exceeding feedermain pressure allowance in low-lying areas.

5.2.2.2 Short-List Alternatives

A new watermain is proposed along Lakeshore Road, from Townsend Line to the northern edge of the subsystem, to reduce head losses in the upper portion of the system. Because this new northern main is included in all Zone 2 alternatives, it was not directly compared in the evaluation.

Alternative 1

Alternative 1 involves extensive upsizing of the existing feedermain from the ELBS to the community of Forest. This upgrade reduces the capacity constraint and reduces head losses in the feedermain, which allows the Forest Standpipe to fill. As a result, pressures in Forest are improved.

Alternative 2

Alternatives 2A and 2B combine varying degrees of feedermain upsizing with pump upgrades at the ELBS to achieve the required service pressures under future demand conditions. Both upgrades reduce the capacity constraint to lower head losses in the feedermain and raise the Zone 2 HGL at the ELBS. As a result, pressures in Forest are improved.

Alternative 3

Alternatives 3A and 3B include constructing a new 300 mm twinned watermain. One option proposes a full twin feedermain from the ELBS to the intersection of Lakeshore Road and Townsend Line, where it would connect to the new northern main. The twin watermain reduces the capacity constraint and improves pressures in Forest. The second option involves constructing only a partial twin combined with minor pump upgrades at the ELBS to raise the Zone 2 HGL near the ELBS and increase service pressures in Forest.

Table 5-12 below summarizes the different alternatives for Zone 2. Figure 5-4 to Figure 5-8 below show the proposed upgrades for the different alternatives in Zone 2.

Table 5-12: Solution Alternatives – Zone 2 (Provisional [1])

Alternative	Action	Description	Result of Pre-Screening
0	Do Nothing	No upgrades or new infrastructure. Existing operations continue.	Eliminated - Not viable with CKSPFN connected (minimum service pressures not met, high head losses)
1	Extensive feedermain upsizing	Upsize existing watermain: • 18 km to 400 mm • 6.25 km to 350 mm	Short-listed
2A	Minor feedermain upsizing, moderate pump upgrades	Upsize 7.5 km of watermain to 400 mm Increase ELBS pump pressure by 11 psi.	Short-listed
2B	Major feedermain upsizing, minor pump upgrades	Upsize 12 km of watermain to 400 mm Increase ELBS pump pressure by 2 psi.	Short-listed
3A	Full twin to subsystem north end	21 km of new 300 mm watermain	Short-listed
3B	Partial twin, minor pump upgrades	11 km of new 300 mm watermain Increase ELBS pump pressure by 4 psi	Short-listed

Alternative	Action	Description	Result of Pre-Screening
4	Major Pump Upgrades		Eliminated - Pressure requirements not met with CKSPFN connected, presents significant risk of maximum pressures exceeding feedermain capacity

Notes:

1) Zone 2 upgrades are provisionally required only in the event of a new municipal connection for CKSPFN.

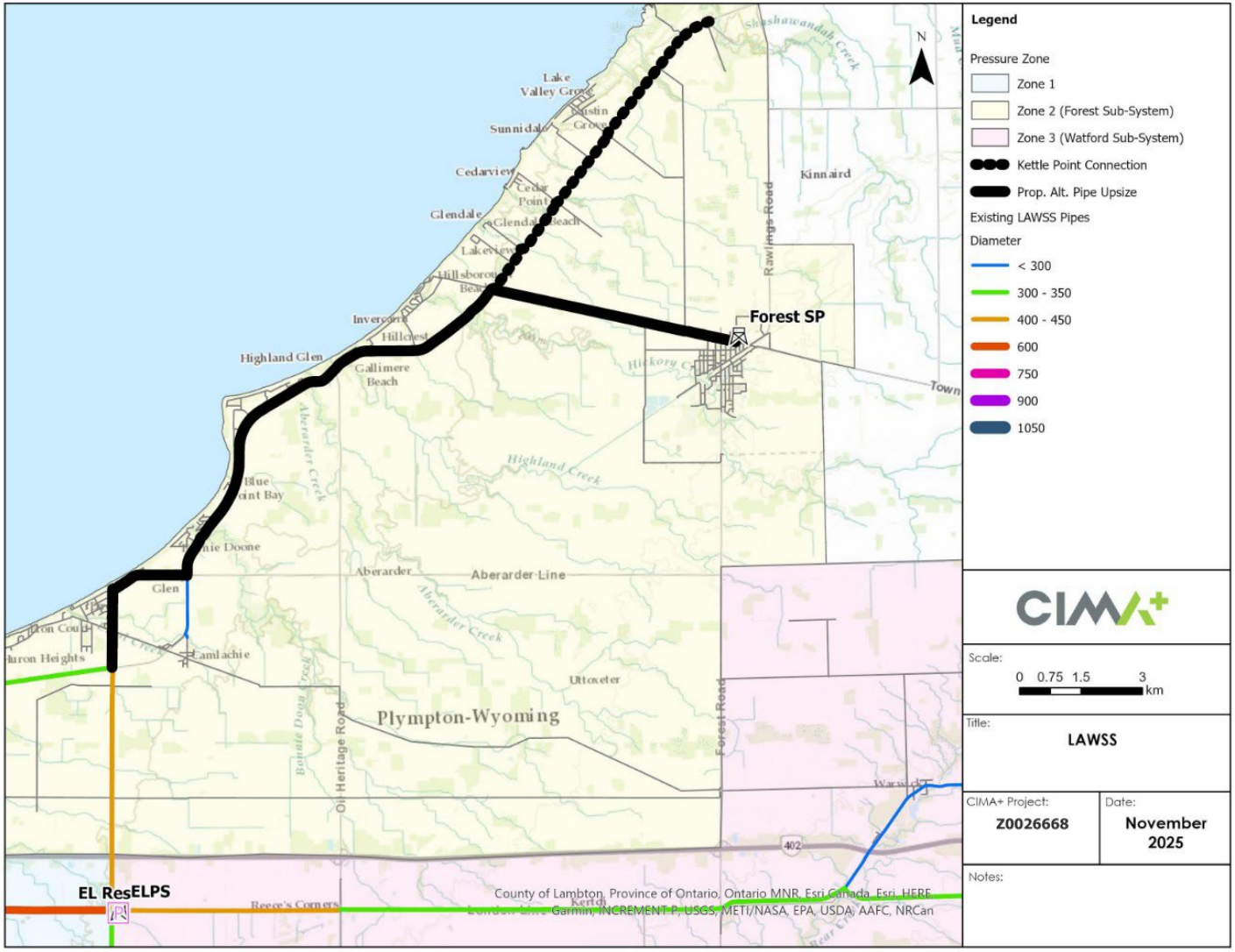

Figure 5-4: Alternative 1 - Zone 2

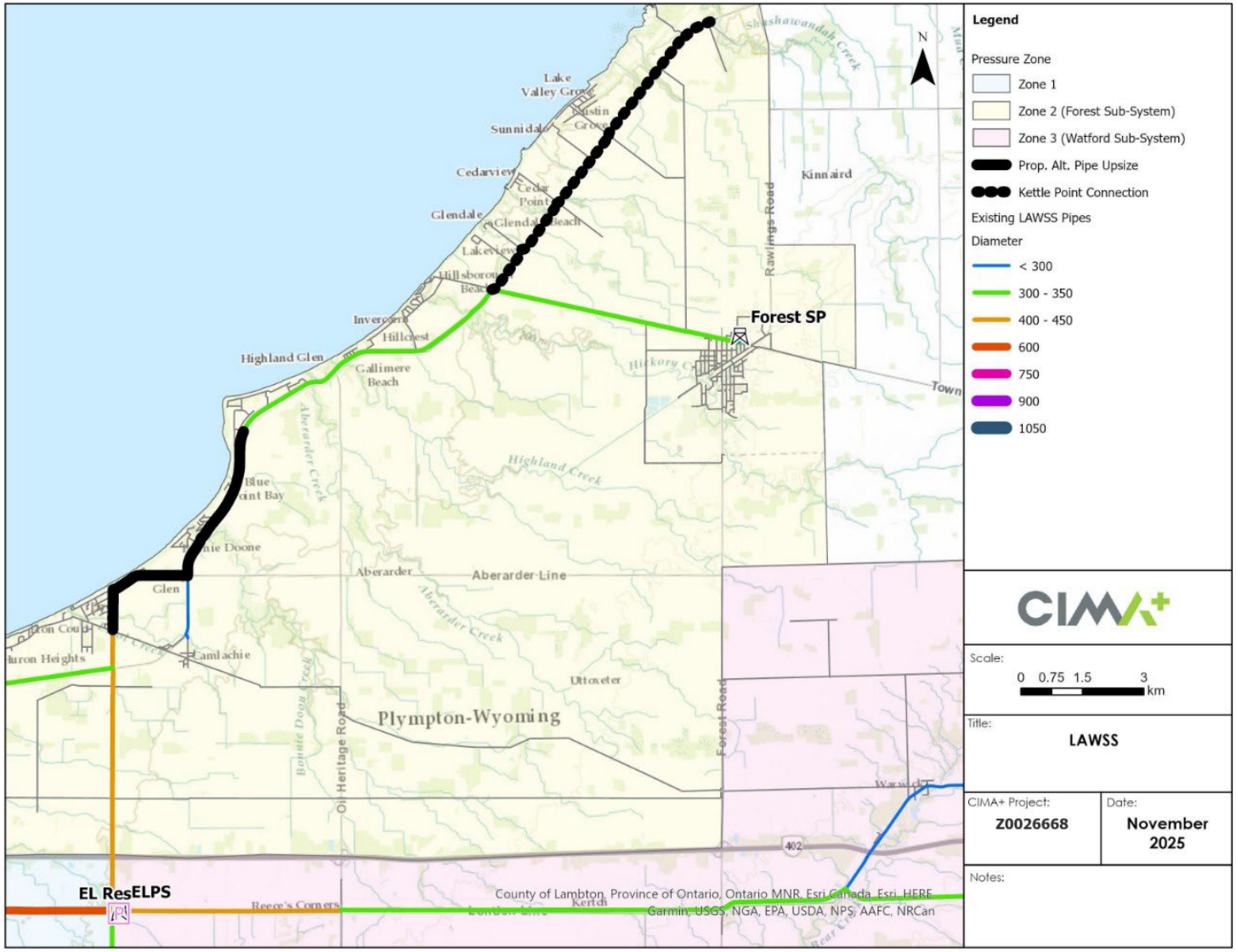

Figure 5-5: Alternative 2A - Zone 2

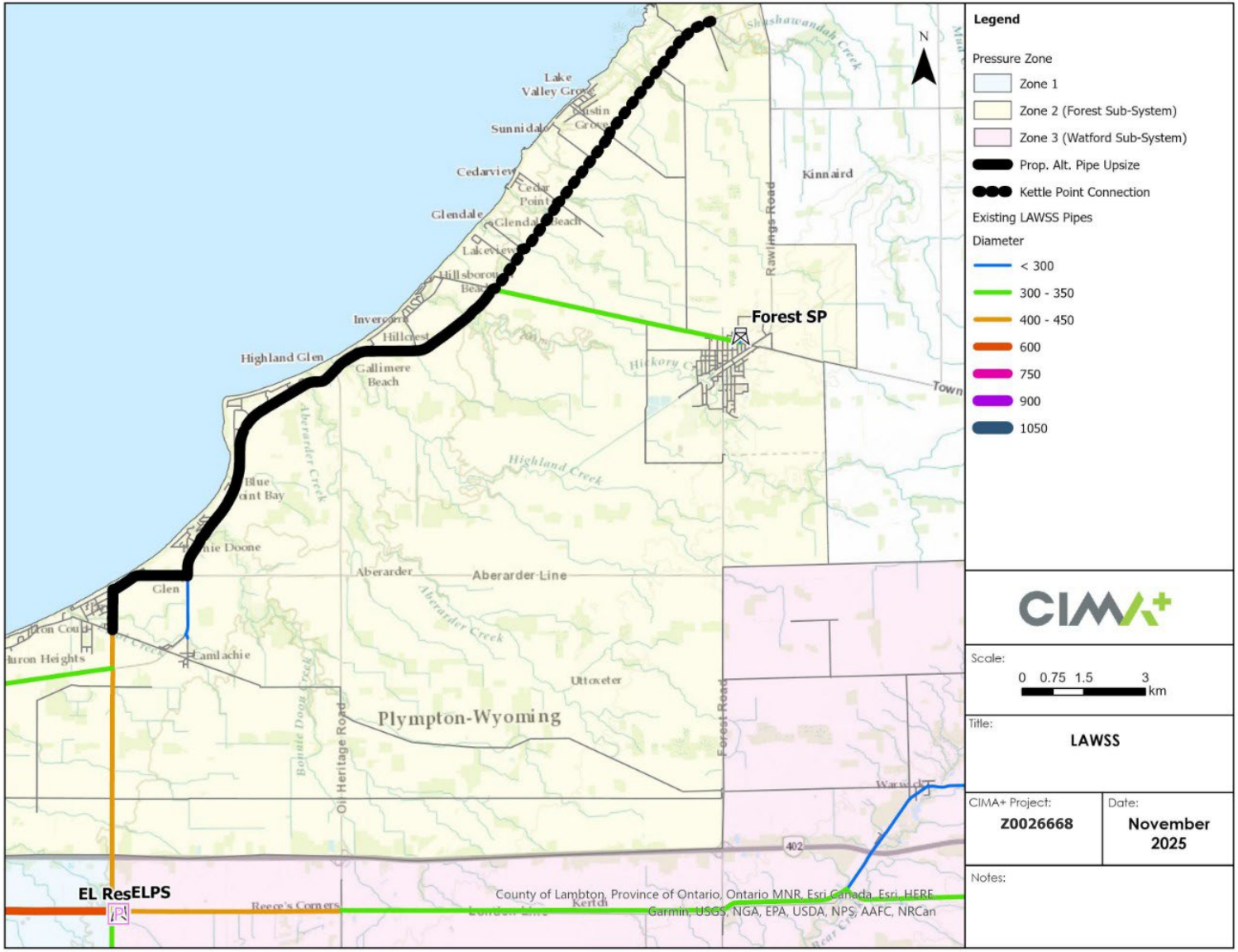

Figure 5-6: Alternative 2B - Zone 2

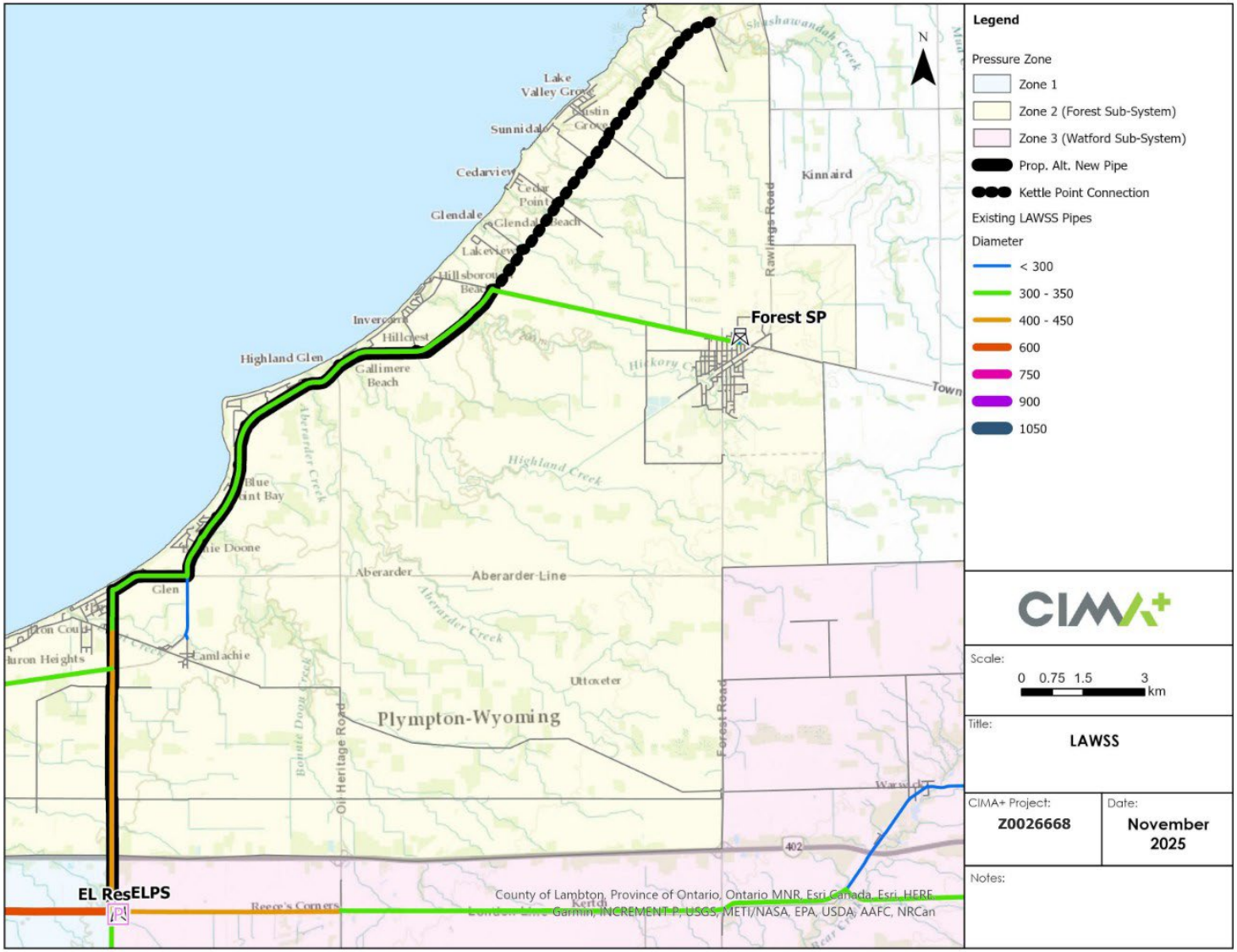

Figure 5-7: Alternative 3A - Zone 2

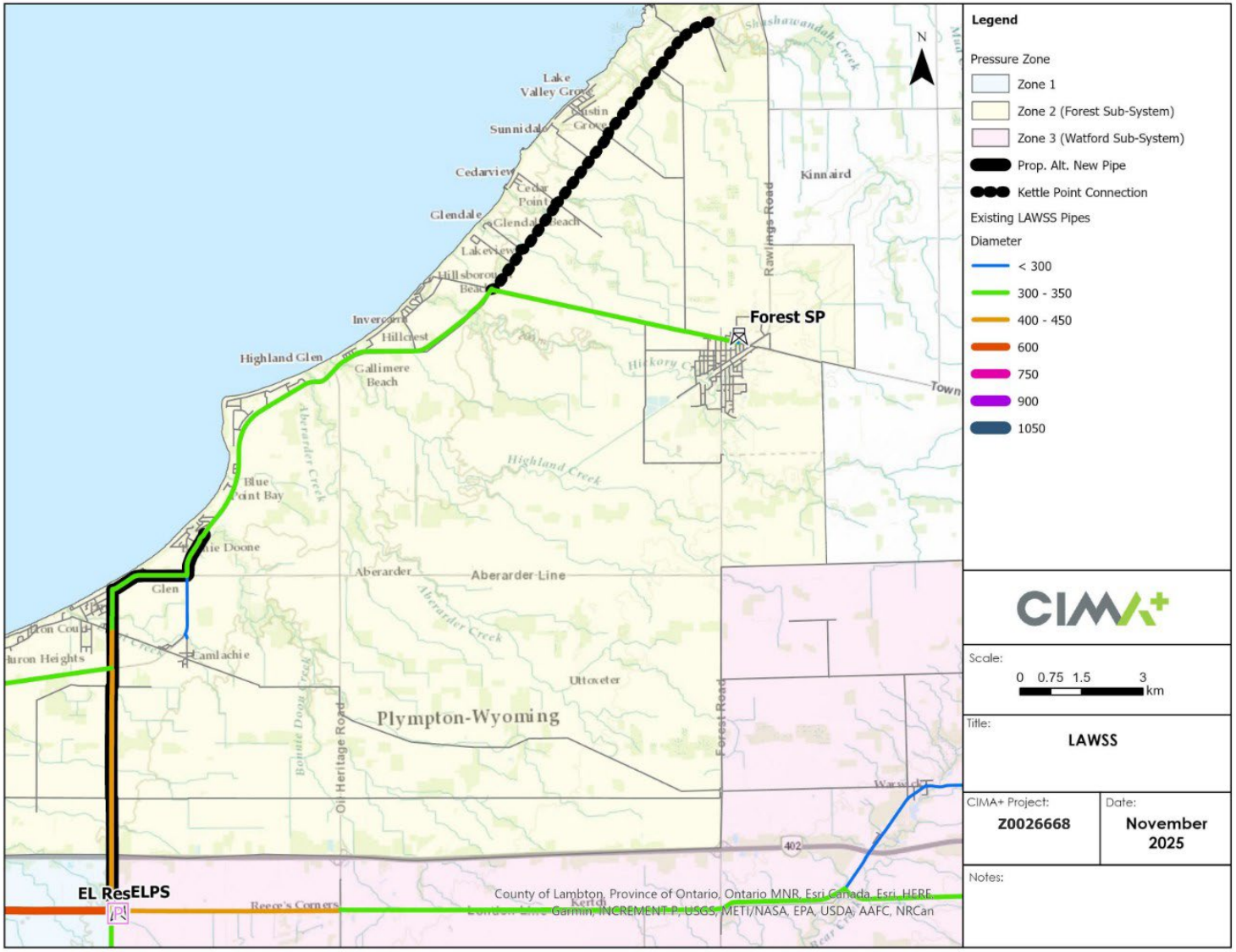

Figure 5-8: Alternative 3B - Zone 2

5.2.2.3 Conceptual Cost Estimates

Conceptual cost estimates for the Zone 2 short-listed (provisional) alternatives are summarized in table below. Both capital and operational costs were considered in comparing the alternatives. All Zone 2 options include the construction of a new 300 mm watermain from Townsend Line to the north end of the subsystem, with an estimated capital cost of approximately $26.4 million.

Capital cost estimates were based on historical costs from previous projects (with inflation applied as applicable). Costs include 20% engineering fees and a 30% contingency for conceptual-level cost estimation and tariff uncertainty. Pricing excludes HST and contractor overhead and profit.

Table 5-13: Preliminary Cost Estimates – Zone 2 Alternatives (Provisional [1])

Alternative	Action	Capital Cost Estimate (-15%/+30%)	Relative Operating Costs
1	Extensive feedermain upsizing	$86.9M	Lower
2A	Minor feedermain upsizing, moderate pump upgrades	$28.8M	Higher
2B	Major feedermain upsizing, minor pump upgrades	$45.5M	Moderate
3A	Full twin to subsystem north end	$62.7M	Lower
3B	Partial twin, moderate pump upgrades	$35.6M	Higher
All alternatives	Main from Townsend Line to CKSPFN Connection	$26.4M	N/A

Notes:

1) Zone 2 upgrades are provisionally required only in the event of a new municipal connection for CKSPFN.

5.2.2.4 Alternatives Evaluation

The results of the comparative evaluation for Zone 2 provisional alternatives are presented in Table 5-14 to Table 5-18. Alternative 3A, which proposes constructing a full twin to the north end of the subsystem, achieved the highest score

among all Zone 2 alternatives. Though similar in scoring, alternative 3A provides better redundancy and presents a lower risk of pressures exceeding the maximum pressure allowance of feedermains.

Table 5-14: Evaluation of Zone 2 Alternative 1 – Extensive Feedermain Upsizing

Category	Score	Notes
Overall	 Moderate	
Land Use	Very High 	Pro: • No anticipated conflicts with approved local, county, or provincial plans and policies or land uses • Anticipated that existing rights of way along roadways can be used for construction, restricting impacts to previously developed land
Technical	Moderate 	Pro: • Same path as existing watermain infrastructure will be used, so no additional utility conflicts anticipated • Minimum pressures in certain areas are lower than ideal, but within acceptable range (>40 psi) Con: • Construction would require phased shutdowns and upgrades of the existing pipe, which has little to no redundancy • Provides no added redundancy • Construction anticipated to cause substantial disruption to roadways, but impacts would largely be outside urban areas

Category	Score	Notes
Natural Environment / Climate Change	Moderate 	Pro: • Impact to natural environment expected to be minimal once construction is completed • Minimal system vulnerability to climate change effects • No change in operational emissions relative to existing infrastructure Con: • High number of stream crossings required • No change in system vulnerability to adverse events relative to existing infrastructure, but feedermain has no redundancy • Involves replacement of pipe with remaining serviceable life, which results in increased lifecycle emissions
Socio-Economic	Moderate 	Pro: • No anticipated need for property acquisition or additional easements Con: • Substantial disruption to residential areas over the duration of construction due to the scale of upgrades and extension into Forest—construction will be required along roads with few detour opportunities
Cost	Moderate 	Pro: • Low operating cost relative to other alternatives Con: • High capital cost relative to other alternatives

Table 5-15: Evaluation of Zone 2 Alternative 2A - Minor Feedermain Upsizing, Moderate Pump Upgrades

Category	Score	Notes
Overall	 Moderate	
Land Use	Very High 	Pro: • No anticipated conflicts with approved local, county, or provincial plans and policies or land uses • Anticipated that existing rights of way along roadways can be used for construction, restricting impacts to previously developed land
Technical	Moderate 	Pro: • Partial feedermain replacement reduces requirement for shutdowns of non-redundant pipes and reduces construction complexity • Some disruption of roadways outside urban areas, but substantially less than alternative 1 Con: • Increase in pump head showed diminishing returns for pressure improvements—possibility that as maximum flows increase, watermain size will be increasingly limiting • May result in maximum pressures above ideal thresholds during low-demand periods • Risk of pump oversizing if CKSPFN do not connect or connect then reverse decision • Provides no redundancy

Category	Score	Notes
Natural Environment / Climate Change	Moderate 	Pro: • Several stream crossings required, but impact expected to be minimal once construction is completed • Minimal system vulnerability to climate change effects • No change in system vulnerability to adverse events relative to existing infrastructure, but feedermain has no redundancy Con: • Substantial increase in pump energy consumption anticipated • Involves replacement of pipe with remaining serviceable life, which results in increased lifecycle emissions
Socio-Economic	High 	Pro: • No anticipated need for property acquisition or additional easements Con: • Some disruption to residential areas over the duration of construction—construction will be required along roads with few detour opportunities
Cost	High 	Pro: • Lowest capital cost relative to other alternatives Con: • High operating cost relative to other alternatives

Table 5-16: Evaluation of Zone 2 Alternative 2B - Major Feedermain Upsizing, Minor Pump Upgrades

Category	Score	Notes
Overall	 Moderate	
Land Use	Very High 	Pro: • No anticipated conflicts with approved local, county, or provincial plans and policies or land uses • Anticipated that existing rights of way along roadways can be used for construction, restricting impacts to previously developed land
Technical	Moderate 	Pro: • Addresses pipe size limitations on service better than alternative 2A, reduces risk of maximum pressures exceeding feedermain capacity Con: • Construction would require phased shutdowns and upgrades of large portions of the existing pipe, which has little to no redundancy • Construction anticipated to cause disruption to roadways, but primarily outside urban areas—same path as existing infrastructure will be used, so no additional conflicts anticipated • Provides no redundancy

Category	Score	Notes
Natural Environment / Climate Change	Moderate 	Pro: • Minimal system vulnerability to climate change effects • No change in system vulnerability to adverse events, relative to existing infrastructure, but feedermain has no redundancy • Impact on waterways expected to be minimal once construction is completed Con: • Several stream crossings required, including highland creek, a waterway of concern • Moderate increase in pump energy consumption anticipated • Involves replacement of pipe with remaining serviceable life, which results in increased lifecycle emissions
Socio-Economic	Moderate 	Pro: • No anticipated need for property acquisition or additional easements Con: • Substantial disruption to residential areas over the duration of construction due to the length of upgrades and extension into Forest—construction will be required along roads with few detour opportunities
Cost	High 	Pro: • Low capital cost relative to other alternatives Con: • Moderate operating costs relative to other alternatives

Table 5-17: Evaluation of Zone 2 Alternative 3A – Full Twin to Sub-system North End

Category	Score	Notes
Overall	 Very High	This alternative received the highest overall score (preferred)
Land Use	Very High 	Pro: • Anticipated that existing rights of way along roadways can be used for construction, restricting impacts to previously developed land Con: • Greater potential for conflict with land use plans and policies than alternatives 1, 2A, and 2B
Technical	High 	Pro: • Construction is less complex than alternatives 1 and 2 because existing feedermain can remain in operation • Same path as existing infrastructure will be used, so no additional utility conflicts anticipated • Effectively addresses capacity limitations associated with pipe size, reduces risk of maximum pressures exceeding feedermain capacity • Provides greatest degree of redundancy Con: • Construction anticipated to cause substantial disruption to roadways, but impacts will largely be outside urban areas

Category	Score	Notes
Natural Environment / Climate Change	High 	Pro: • Minimal system vulnerability to climate change effects • Reduced system vulnerability to adverse events such as watermain breaks due to greater redundancy • Impact on waterways expected to be minimal once construction is completed • May allow more energy-efficient operation of the ELBS pumps Con: • Several stream crossings required, including highland creek, a waterway of concern
Socio-Economic	High 	Pro: • No anticipated need for property acquisition or additional easements but possibility is greater than alternatives 1, 2A, or 2B Con: • Substantial disruption to residential areas over the duration of construction due to the length of upgrades and extension into Forest—construction will be required along roads with few detour opportunities
Cost	High 	Pro: • Low operating cost relative to other alternatives Con: • High capital cost alternative relative to other alternatives

Table 5-18: Evaluation of Zone 2 Alternative 3B – Partial Twin and Minor Pump Upgrades

Category	Score	Notes
Overall	 High	
Land Use	Very High 	Pro: • Anticipated that existing rights of way along roadways can be used for construction, restricting impacts to previously developed land Con: • Greater potential for conflict with land use plans and policies than alternatives 1, 2A, and 2B
Technical	High 	Pro: • Construction is less complex than alternatives 1 and 2 because existing feedermain can remain in operation • Addresses capacity limitations associated with pipe size • Provides partial redundancy Con: • Construction anticipated to cause substantial disruption to roadways, but impacts will largely be outside urban areas • Same path as existing infrastructure will be used, so no additional utility conflicts anticipated • Effectively addresses capacity limitations associated with pipe size, but there is a greater risk of maximum pressures exceeding feedermain capacity than in alternatives with no pump upgrades (1, 3A)

Category	Score	Notes
Natural Environment / Climate Change	High 	Pro: • Minimal system vulnerability to climate change effects • Reduced system vulnerability to adverse events such as watermain breaks due to greater redundancy • Impact on waterways expected to be minimal once construction is completed, no wetlands in construction area Con: • Several stream crossings required • Substantial increase in pump energy consumption anticipated
Socio-Economic	High 	Pro: • No anticipated need for property acquisition or additional easements but potential is greater than alternatives 1, 2A, or 2B Con: • Some disruption to residential areas over the duration of construction—construction will be required along roads with few detour opportunities
Cost	High 	Pro: • Low capital cost relative to several other alternatives Con: • High operating costs relative to other alternatives

5.2.3 Zone 3

Three alternative solutions were considered for Zone 3 to address pressure, flow, and storage needs within the subsystem. The full demand growth associated with proposed Schouten development in Alvinston was included in the analysis; however, upgrades were found to be required both with and without this provisional demand applied.

5.2.3.1 Screening of Long-List Alternatives

For Zone 3, only the “Do Nothing” alternative was screened out as it does not address the low pressures in the Watford area.

5.2.3.2 Short-List Alternatives

Alternative 1

Alternative 1 includes twinning an 18 km long segment of the existing London Line feedermain from the ELBS to Zion Line (Warwick). This increases the linear capacity in the system and reduces headloss, thus resulting in improved pressure in Watford.

Alternative 2

Alternative 2 consists of the construction of a new booster pump station and reservoir to facilitate transmission to the east side of the subsystem, in combination with 12 km of new 350 mm parallel feedermain on London Line. The addition of the in-ground reservoir removes the need for a dedicated feedermain from the Wyoming Standpipe to the new booster pump station, and acquisition of the standpipe by LAWSS is therefore not required.

This alternative requires a modified control strategy at the ELBS Watford pumps to be based on a discharge pressure setpoint. The proposed inground reservoir inlet would require a control valve to maintain adequate pressure in Wyoming. The new BPS controls would be based on the Watford standpipe level.

Under this alternative, the discharge head out of the ELBS Watford pumps could be reduced compared to existing conditions, as the pumps are required to overcome less headloss by only pushing water as far east as the proposed in-ground reservoir. It was found that if the area between the ELBS and the proposed BPS was supplied at the HGL of the Wyoming Standpipe and the Wyoming PRVs were opened, pressures within this area would be within the acceptable range. Details as to how to best operate the Wyoming area under this alternative can be confirmed at a later date.

Table 5-19 summarizes the proposed alternatives and Figure 5-9 and Figure 5-10 show the proposed upgrades.

Table 5-19: Solution Alternatives – Zone 3

Alternative	Action	Description	Result of Pre-Screening
0	Do Nothing	No upgrades or new infrastructure. Existing operations continue.	Eliminated - does not meet servicing requirements in future scenarios
1	Feedermain Upgrades Only	18 km of feedermain twin on London Line from ELBS towards Watford	Short-listed
2	BPS And Reservoir with Feedermain Upgrades	New BPS and reservoir and 12 km of feedermain twin on London Line	Short-listed

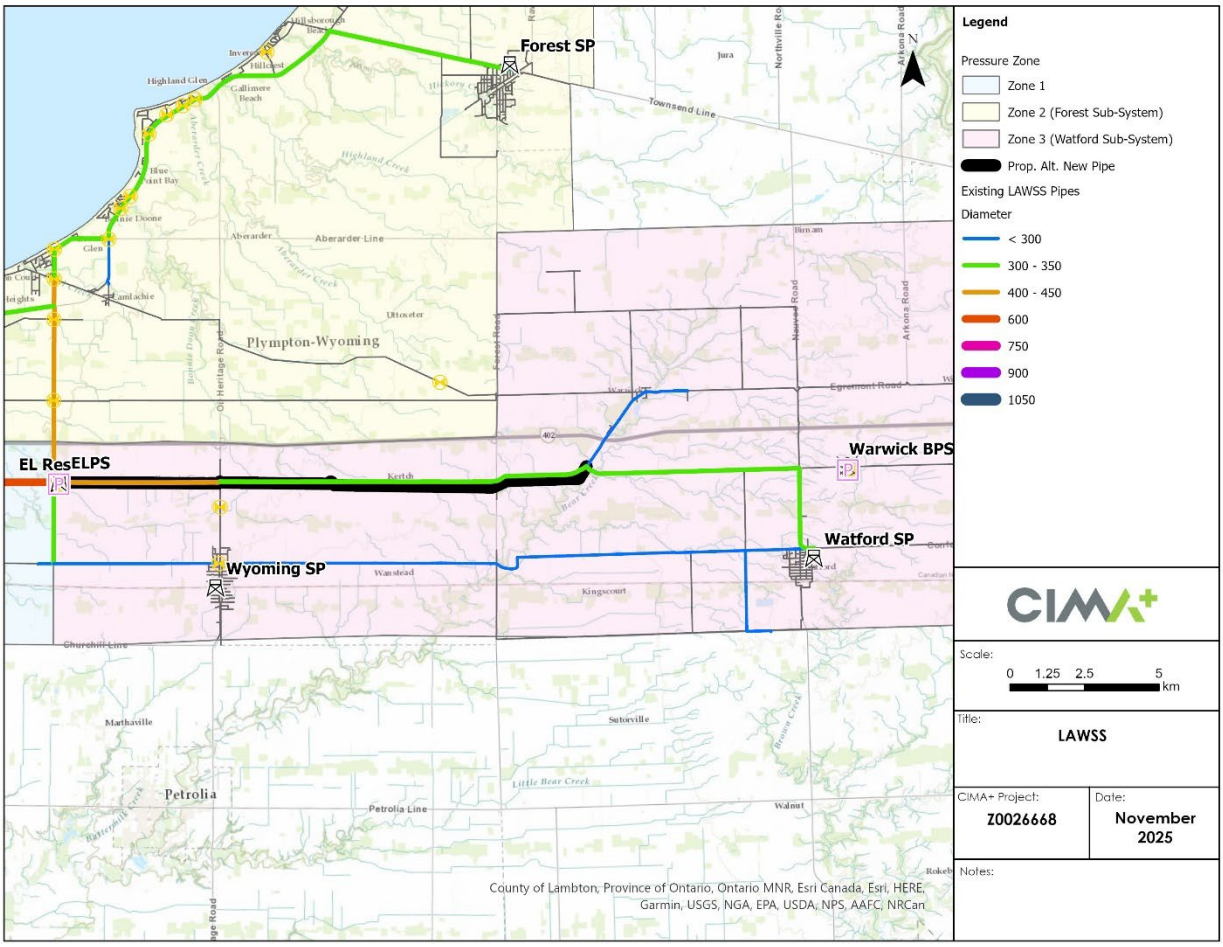

Figure 5-9: Alternative 1 – Zone 3

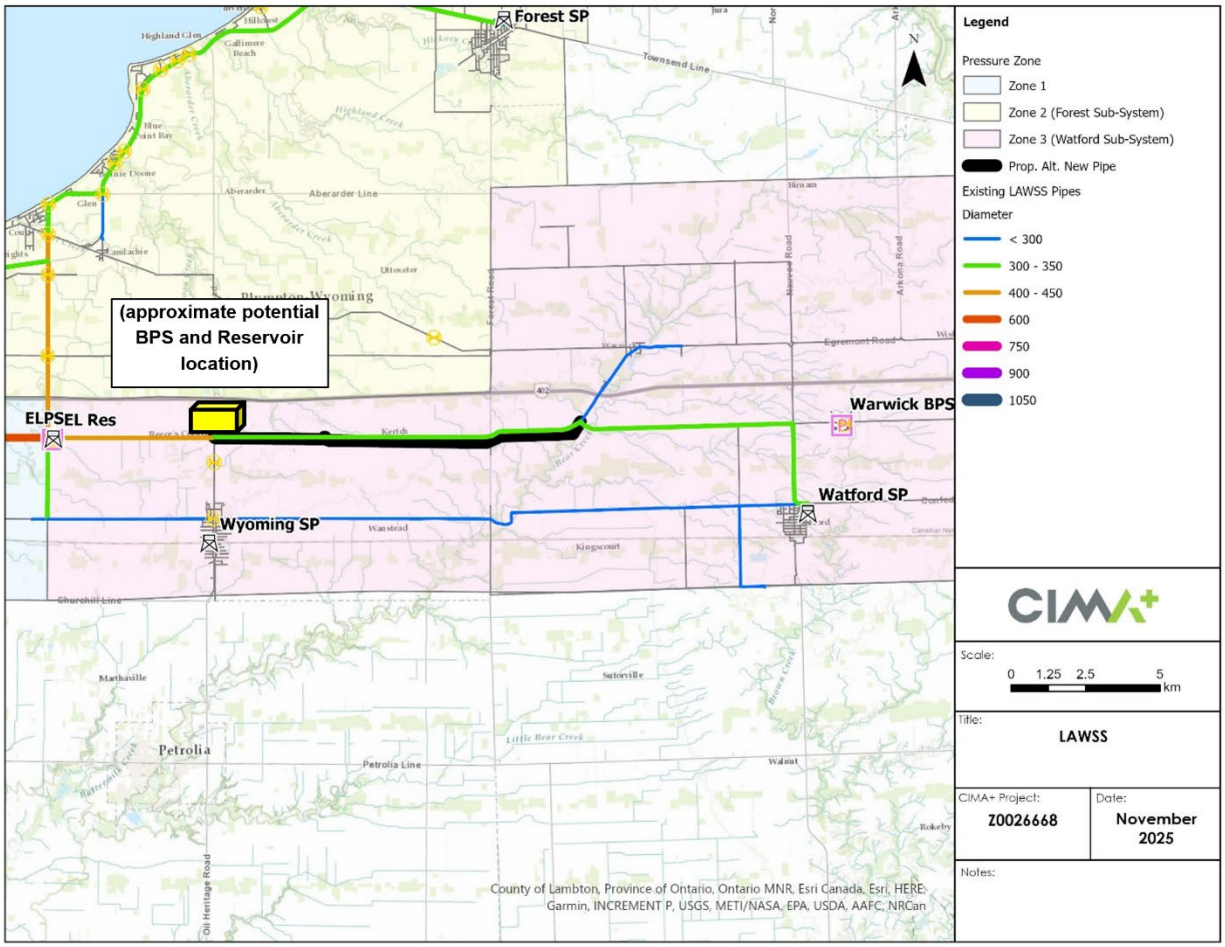

Figure 5-10: Alternative 2 – Zone 3

5.2.3.3 Conceptual Cost Estimates

The conceptual cost estimates for the Zone 3 short-listed alternatives are summarized in Table 5-20 below. Both capital and operational costs were considered in the evaluation of the alternatives.

Capital cost estimates were based on historical costs from previous projects (with inflation applied as applicable). Costs include 20% engineering fees and a 30% contingency for conceptual-level cost estimation and tariff uncertainty. Estimates of 30-year operating opportunity cost savings associated with improved system efficiency were incorporated into capital costs where anticipated to materialize. Pricing excludes HST and contractor overhead and profit.

Table 5-20: Preliminary Cost Estimates – Zone 3 Alternatives

Alternative	Action	Capital Cost (-15%/+30%)	Operating Cost for Maximum Day ($/year)
1	Feedermain twin (18 km)	$76.1M	Lower
2	New BPS and Reservoir and Feedermain (13 km)	$65.1M	Higher

5.2.3.4 Alternatives Evaluation

The comparative evaluation results for Zone 3 are summarized in Table 5-21 and Table 5-22 below, showing how each alternative scored against the established criteria.

Table 5-21: Evaluation of Zone 3 Alternative 1 – Feedermain Upgrades

Category	Score	Notes
Overall	 High	
Land Use	Very High 	Pro: • Anticipated that existing rights of way along roadways can be used for construction, restricting impacts to previously developed land
Technical	High 	Pro: • No shutdowns required for construction
Natural Environment / Climate Change	Moderate 	Con: • Extent of pipe upgrades is larger than alternative 2
Socio-Economic	High 	Con: • More potential for disruption to neighbouring properties than alternative 2, as the extent of pipe upgrades is larger
Cost	Moderate 	Pro: • Lower operational and maintenance cost than alternative 2 Con: • Higher capital cost than alternative 2

Table 5-22: Evaluation of Zone 3 Alternative 2 – New BPS and Reservoir

Category	Score	Notes
Overall	 Very High	This alternative received the highest overall score (preferred)
Land Use	High 	Con: • New site required for BPS and Reservoir—conflicts with approved land uses / plans / policies and impacts to cultural heritage resources are possible
Technical	Very High 	Pro: • No shutdowns required for construction • Provides additional storage and pump capacity, improving system resiliency Con: • More complex operation and additional assets to maintain
Natural Environment / Climate Change	High 	Pro: • Extent of pipe upgrades is smaller than alternative 1 • Increased storage reduces vulnerability to adverse events (e.g., contamination) Con: • Increased GHG production due to additional pumping
Socio-Economic	High 	Pro: • Less disruption to neighbouring properties than alternative 1, as the extent of pipe upgrades is smaller

Category	Score	Notes
Cost	High 	Pro: • Lower capital cost than alternative 1 Con: • Higher operations and maintenance costs than alternative 1

Alternative 2, which proposes constructing a new booster pump station and reservoir, achieved the highest score among the two Zone 3 alternatives. As discussed in Section 5.4.3, flow testing is recommended before confirming the preferred alternative.

5.3 2021 Master Plan Project Update

Hydraulic analysis with updated existing conditions verified the continued need for several projects proposed or assumed under the 2021 Master Plan. Projects in-progress or planned for implementation starting within one year were not subject to full re-evaluation, rather the need for upgrades were confirmed in the existing (2024) scenario and updated high-level cost estimates were provided. The 2021 Master Plan upgrades included in Table 2-1 are re-listed below with conclusions of the updated analysis and updated recommendations where applicable.

- **ELBS Fill Line Upgrades (New 150mm local distribution watermain from East Lambton BS (Forest) to Mandaumin Road):** Upgrades to remove the customers serviced by the EL reservoir fill line with the addition of a Zone 2 watermain along London Line east of the ELBS were determined to be required in 2026 to improve low service pressures for Zone 1 customers. No changes to the existing project scope were recommended. Costing was updated to account for inflation and is estimated at approximately $5.1 million.
- **New 350mm transmission main on London Line:** Proposed under the Zone 3 preferred alternative in this Master Plan update.
- **New Booster Pumping Station and Associated Upgrades:** A new BPS in Plympton-Wyoming is proposed under the Zone 3 preferred alternative in this Master Plan update. The new watermain on Oil Heritage Road and acquisition of the Wyoming Standpipe (recommended under the 2021 Master Plan) are no longer required with the proposed addition of a reservoir to the project scope.
- **New 200mm watermain on Stewardson Road:** Not proposed under this Master Plan update, as this upgrade was not found to be required to resolve system constraints in Zone 3.
- **West Lambton Pumping Station Modifications (interior):** Detailed engineering design is underway for interior equipment upgrades at the WLPS. Reservoir upgrades are currently nearing completion. The need for these upgrades was confirmed to allow simultaneous reservoir filling and pumping, as well as increase discharge pressure to St Clair without overfilling the Indian Road standpipe. Preliminary cost estimates for this project are between $7 million and $10 million.

- **Grid Reinforcement and Transmission Main Twinning:** The need for grid reinforcement and twinning projects was confirmed to address low service pressures in the St Clair area during periods of high ICI demand. While previously proposed for the purpose of improving redundancy, these upgrades are now recommended for implementation in the near-term to meet servicing criteria across Zone 1. Alternatively, LAWSS may seek to establish amended servicing agreements for existing ICI customers that limit maximum takings. Updated watermain construction costs were used to revise the cost estimate to approximately $172 million. It was found that even with servicing agreements with ICI customers to limit max takings, the grid reinforcement and twinning projects are required from WLPS to Petrolia Line by 2036.

5.4 Additional Recommendations

In addition to the proposed capital project alternatives evaluated in the previous section, the following additional recommendations resulted from the 2025 Master Plan Update. The infrastructure modifications included in these recommendations are not included in the scope of the environmental assessment for this Master Plan, for the reasons indicated:

1) Pump testing and pump upgrades at the ELBS – recommended to confirm and restore the design firm capacity of the facility. These upgrades are not anticipated to require an expansion of the ELBS, and as such will likely not be subject to requirements under the MCEA process.
2) Pump optimization at the WTP high lift pumping station (discussed further in Section 7) – as these equipment replacements are proposed within an existing pumping facility, they are anticipated to be exempt from the MCEA process.
3) WTP Capacity Study – no infrastructure upgrades recommended at this time.
4) Watford Flow Testing – no infrastructure upgrades recommended at this time.

5.4.1 East Lambton Booster Station Pump Testing and Upgrades

Analysis of 2024 and 2025 SCADA data showed a misalignment between the performance of pumps at the ELBS and their design operating points. This observation was made for pumps servicing both Zone 2 and Zone 3. Pump testing is recommended for the immediate term to confirm that pump operations match rated capacities.

Four pumps at the ELBS draw water from the reservoir (two servicing Zone 2 and two servicing Zone 3). Two additional inline pumps at the facility draw water from the reservoir fill line. Operation of these pumps creates low pressures upstream of the ELBS, and as such, is avoided. Upgrades are recommended to either retrofit both

pumps to operate more efficiently or convert both inline pumps to reservoir pumps to ensure their operation is viable at all times (and can thus contribute to the firm capacity of the facility).

5.4.2 Water Treatment Plant Capacity Study

Industry best practice for drinking water systems is to undertake expansion of water treatment facilities once total system maximum day demands reach between 80% and 90% of treatment capacity. Maximum day demands in 2046 for existing customers (i.e., excluding demands for Future Plant #1 and #2 in St Clair and Chippewas of Kettle and Stony Point First Nation) are projected to reach 77% of the total treatment capacity of the LAWSS WTP (2100 L/s). The MDD values for this future scenario assume all 3 major ICI customers in St Clair simultaneously draw the maximum allowable rates permitted in LAWSS servicing agreements. With all provisional cases applied (and assuming Future Plant #1 and #2 draw the maximum allowable taking of 115 L/s), the total system MDD for 2046 is estimated at 84% of the plant capacity.

Due to the potential for the trigger threshold of 80% treatment capacity to be exceeded within the Master Plan horizon, it is recommended that LAWSS undertake a WTP capacity study in the next five years. Such a study would examine the LAWSS treatment system to identify capacity constraints, repair needs, expansion opportunities, and logical phasing of upgrades. A key consideration will be estimating the total additional capacity that can be obtained at the existing LAWSS WTP site and assessing the need for expansion or construction of a new facility.

5.4.3 Watford Flow Testing

Hydraulic modelling in Zone 3 indicated that existing infrastructure may continue to meet servicing requirements to 2046. Desktop analysis concluded that sufficient storage and pumping capacity will be available to the system to 2046 once ELBS firm capacity is restored; however, OCWA staff operating the LAWSS system have experienced challenges with filling the Watford Standpipe on high-demand days. This limitation is not reflected in the modelled scenarios. Possible reasons for this include:

- Presence of system demands that are not captured in the model or not assigned at the correct location (especially in the case of large, localized demands like ICI users)
- The adjusted balance of the Zone 2 to Zone 3 demand split ratio for Plympton-Wyoming, which allocated more demand to Zone 2 in the model

- System properties in the model not consistent with existing infrastructure due to recent upgrades, new construction, or outdated/ incomplete information on municipally-owned infrastructure

Before confirming the preferred alternative to address hydraulic challenges in Zone 3, it is recommended that LAWSS conduct testing on the Zone 3 system including pump curve verification and potentially flow testing on the watermain feeding the Watford Standpipe to better understand the true hydraulic conditions in the area.

6 Implementation Plan

6.1 Zone 1

The preferred alternative for Zone 1 is to implement a slight increase in discharge pressure from the LAWSS WTP and increase the fill rate at the WLPS Reservoir.

It is recommended that operational trials be commenced following the completion of planned upgrades at the WLPS. Trials would involve implementing incremental increases in high lift pump discharge pressures at the WTP and monitoring hydraulic conditions (particularly pressures) throughout the Zone 1 system.

As this alternative is not anticipated to require new infrastructure, it is not anticipated that further assessment under the Class EA process is required for the proposed work.

6.2 Zone 2

With the restoration of ELBS firm pumping capacity, existing infrastructure in Zone 2 is projected to continue to meet servicing requirements with estimated population-driven demand increases to the Master Plan horizon (2046). Upgrades would only be required should the community of CKSPFN connect to LAWSS. The preferred alternative for these provisional upgrades is the construction of a full twin of the feedermain to subsystem north end and pump upgrades at the ELBS.

Under existing conditions, LAWSS can support a new municipal connection for CKSPFN while maintaining acceptable servicing conditions. By 2036, however, a new connection would trigger a need for infrastructure upgrades to alleviate low pressures in the Forest area and high head losses in the LAWSS feedermain, as well as in (current) local pipes between Townsend Line and the new connection point. Local pipes from Townsend line to the connection would be acquired by LAWSS. It is recommended that construction of the twin watermain be phased so that segments from 1) the ELBS to the Bonnie Doon South area and 2) Townsend line to the new CKSPFN connection point are completed before 2036. The remaining segment of the twin should be constructed by 2046 to continue meeting servicing requirements for the growing population.

As it is assumed that the feedermain can be constructed within existing road allowances, it is not anticipated that further assessment under the Class EA process is required for the proposed work. However, some construction activities may take place within Event Based Areas identified under the Thames - Sydenham & Region Drinking Water Source Protection Plan. The local Source Protection Authority (Thames - Sydenham & Region Drinking Water Source Protection) should be contacted during the planning phase for this work, and mitigation measures may be required.

6.3 Zone 3

Once restoration of ELBS firm pumping capacity is complete, additional upgrades to the ELBS are not expected to be required within Master Plan horizon (2046). Hydraulic modelling of Zone 3 (Watford subsystem) indicated that the low-pressure issue in Watford is not expected to occur until projected 2046 growth is realized. The timing of the Schouten development in Alvinston was not found to significantly impact the required timing of the upgrades trigger. Under existing conditions, LAWSS can support the additional Alvinston demand while maintaining acceptable servicing conditions.

The proposed London Line feedermains associated with this alternative are not expected to be required until growth beyond 2046 is realized.

In the short term, it is recommended that the Zone 3 pump curves are verified through field testing and temporary pressure data logger be installed along London Line between the ELBS and Watford to improve the understanding of the existing hydraulic limitations in this area.

It is recommended that the preferred alternative (BPS and reservoir) be commissioned by 2046. A separate Schedule B environmental assessment or EA addendum will likely be required to confirm the preferred site and properly assess potential impacts of the proposed the facility. Potential considerations for future EA work are discussed below.

6.3.1 Source Water Protection

The MCEA process requires consideration of Source Water Protection for projects proposed in vulnerable areas, as defined by local Source Water Protection Authorities. The 2021 Master Plan evaluated potential impacts of drinking water through the consideration of policies in the Thames - Sydenham & Region Drinking Water Source Protection Plan. The updated review completed for this Master Plan involved using the Ontario Source Protection Information Atlas and Source Protection Authority mapping, which showed the following:

- As in 2021, there are no Intake Protection Zones or Well Head Protection Areas within or adjacent to the study area for proposed infrastructure in Zone 3.
- The study area for proposed linear infrastructure on London Line intersects a designated vulnerable area where Activities may pose low to moderate threats. Future EA analysis should consider the risks posed by the proposed work in this area.

6.3.2 Archaeological Assessment

As recommended in the 2021 Master Plan, a Stage 2 archeological assessment should be completed as part of the detailed design phase for infrastructure proposed for Zone 3. The location and alignments for Zone 3 infrastructure proposed herein remain consistent with the study area limits identified in the 2021 Master Plan; no additional lands are proposed for inclusion, and thus no archaeological assessments were carried out under this Approach #1 Master Plan update. The Stage 2 assessment should cover all areas within the Stage 1 assessment limits that were identified as having archaeological potential. Other recommendations of the Stage 1 assessment report (summarized in Section 2.2.1) must also be followed. The Ministry of Citizenship and Multiculturalism recommends the assessment be undertaken as early as possible in the detailed design phase.

6.3.3 Cultural Heritage Assessment

Zone 3 infrastructure proposed under the 2025 Master Plan update is not anticipated to require expansion of the 2021 Cultural Heritage Report study area. As the previous recommendation for a dedicated feedermain from the Wyoming Standpipe to the proposed pumping station facility was not maintained in this report, potential CHRs identified in the Town of Wyoming or along Oil Heritage Road may no longer be impacted. Recommendations from the Existing Conditions and Preliminary Impact Assessment Report (included in Appendix D and summarized in Section 2.2.2) should be followed in other parts of the study area.

6.3.4 Other Considerations

Further assessment of the proposed work should consider potential impacts, implications, and mitigation measures in the following areas:

- Air quality, dust and noise
- Land use planning policies
- Climate change impacts
- Species at Risk habitat and Ecosystem Protection & Restoration
- Excess soils management (should be completed in accordance with O. Reg. 406/19 and “Management of Excess Soil – A Guide for Best Management Practices” (MECP, 2014))
- Site stormwater management
- Impacts to surface water or groundwater
- Drinking Water Source Protection

7 WTP High Lift Pump Station Optimization

LAWSS and OCWA identified an opportunity to improve the operability of the WTP High Lift Pump Station (HLPS) and increase redundancy in the treatment process through optimization of pumps at the HLPS. Several existing pumps are oversized for the system, which introduces operational challenges. The HLPS has a design firm capacity which exceeds both the treatment capacity of the WTP and the peak demands of the system. The WTP high lift pump station also houses a single backwash pump for the four filters at the WTP. LAWSS staff highlighted the importance of installing a second backwash pump at the HLPS East Clearwell to improve treatment process redundancy. Upgrade alternatives for the HLPS are explored in the *Technical Memorandum WTP High Lift Pump Station Optimization*, which is attached in Appendix B.

The recommended preferred alternative involves the phased replacement of all six existing high lift pumps with fixed-feed vertical turbine pumps of design capacity 525 L/s, as well as the addition of one new pump of the same design at a spare location. An additional backwash pump is recommended to be installed in the East Clearwell to ensure one backwash pump remains available if either Clearwell is taken offline. A conceptual estimate of the capital costs (-15/+30%) for these upgrades is $15.5M, not including HST or contractor overhead and profit. It is recommended that upgrades be phased to allow the continued use of existing high lift pumps HLP-2 and HLP-6 until the end of their serviceable life. Refer to Appendix B for additional details.

8 Summary of Recommendations

The information provided in this report constitutes an Approach #1 Master Plan analysis.

Projects that are exempt from the Municipal Class Environmental Assessment (MCEA) process can be considered to have met the requirements for public and stakeholder consultation to allow initiation of the design and construction phase (i.e., Schedule A/A+ projects). No additional analysis under the MCEA process is anticipated to be required for the following projects:

- ELBS fill line upgrades – EA completed under 2021 Master Plan
- West Lambton Pumping Station Modifications (interior)– EA completed under 2021 Master Plan
- ELBS pump upgrades to restore firm capacity – Schedule A/A+
- Zone 1 control programming updates (Increase pressure at WTP, increase fill rate at WLPS Reservoir) – Schedule A/A+
- Zone 2: New twin feedermain twin to subsystem north end – Schedule A/A+

The following projects would require a Schedule B or C MCEA before design and implementation:

- Zone 2: New twin feedermain twin to subsystem north end
    - Schedule B if the feedermain cannot be constructed fully within existing road allowances or existing utility corridors (situation not anticipated)
- Zone 3: New booster pump station and reservoir
    - Schedule B if new facility is not located in or adjacent to an environmentally sensitive natural area, residential or other sensitive land use, or on land with cultural heritage or archaeological potential.
    - Schedule C, otherwise

Table 8-1 provides a summary of the capital projects identified through hydraulic analysis completed for the 2025 Master Plan update.

Table 8-1: Summary of Recommended Capital Projects and Studies Proposed in 2025 Master Plan

Zone	Description	Capital Cost Estimate (-15%/+30%)	Trigger Year or Condition
1	Zone 1 control programming updates and testing (Increase pressure at WTP, increase fill rate at WLPS Reservoir)	$100K	Operational trials to commence after completion of planned WLPS upgrades
2[1]	Full Forest feedermain twin to subsystem north end	$89.1M	Phase 1: 2036 Phase 2: 2046
3	New BPS and Reservoir and feedermain	$65.1M	BPS and Res.: 2046 Feedermains: 2046+
1	WTP Pump Optimization	$16.4M	Phased, beginning in 2027
2 & 3	ELBS Pump Upgrades (restore firm pumping capacity)	$1.7M	Immediate pump testing Upgrades in 2030, or sooner
1	WTP Capacity Study	$150K (include findings in next Master Plan)	2030
3	Watford Flow Testing	$10K	2026

Notes:

1) Upgrades in Zone 2 are only required if Chippewas of Kettle and Stony Point First Nation connect to LAWSS

Recommended timelines and high level cost estimates of several capital projects proposed in the 2021 LAWSS Master Plan and subsequent studies were updated in parallel with the analysis of new alternative solutions. Projects planned for implementation in the next 1–4 years were reviewed (updated details summarized in Table 8-2 below). Where 2021 Master Plan preferred alternatives aligned with those developed in this analysis, updated capital costing and timelines are provided in Table 8-1 above.

Table 8-2: Summary of Updated Costing and Timing of Planned Upgrades

Zone	Project Description	Updated Capital Cost (-15%/+30%)	Recommended Implementation Timing or Trigger Condition
1	WLPS Interior Upgrades (1)	$7–$10M	Before 2046(2)
1	Grid Reinforcement and Transmission Main Twinning	$172M	Detailed engineering underway, construction planned for 2027
3	New 350mm transmission main on London Line	$5.1M	Detailed engineering complete, construction approved for 2026

Notes:

1) Cost of reservoir upgrades (already complete) not included
2) With revised agreements established for new and existing industrial / commercial customers.

A

Appendix A: Record of Consultation

B

Appendix B: Technical Memorandum - WTP High Lift Pump Station Optimization

C

Appendix C: Population Technical Memorandum

D

Appendix D: Cultural Heritage Screening

E

Appendix E: Cost Estimates

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