Appendix C
Technical Memoranda

Appendix C1 – Long List of Alternatives and Alternative Screening

Jacobs

Technical Memorandum

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Technical Memorandum 1 Final

Project Name	Lake Huron Water Treatment Plant Disinfection and Storage Upgrades EA
Attention	Lake Huron Primary Water Supply System
From	Ray Yu, Monique Waller, and Cassie Stea
Project Number	CE801200
Date	August 30, 2021

1. Introduction

1.1 Problem and Opportunity Statement

The Lake Huron Primary Water Supply System (LHPWSS) owns the 340 megaliters-per-day (ML/d) Lake Huron Water Treatment Plant (WTP), which supplies treated water to eight municipalities via a (partially twinned) 1,200-millimeter-diameter primary transmission main to reservoirs and secondary transmission pipelines. A recently completed update to the Lake Huron Primary Water Supply System Master Water Plan (Jacobs, 2020) identified the need to improve disinfection and increase water storage at the Lake Huron WTP, to meet water demands to the year 2038.

The LHPWSS has therefore initiated a Schedule B Municipal Class Environmental Assessment (EA) to confirm the recommendation for additional storage at the water treatment plant site and refine requirements for enhanced disinfection to provide operational flexibility to implement energy management and other strategies.

The study presents an opportunity to develop alternative solutions, assess their technical viability, and conduct a comprehensive evaluation to select a preferred alternative within the framework of the Schedule B Municipal Class EA process. The assessment is being carried out in accordance with the planning and design process for Schedule B projects under the *Environmental Assessment Act, 1990* as outlined in the Municipal Engineers Association's *Municipal Class Environmental Assessment* (MECA) document (2000, as amended in 2007, 2011, and 2015).

1.2 Purpose of TM1

The purpose of Technical Memorandum (TM) 1 is to present the identification of reasonable and feasible solutions to address the disinfection and storage needs at the Lake Huron WTP. The TM documents the long list of alternatives developed to address the Problem/Opportunity Statement and details the process used to screen these alternatives to a develop a short list of alternatives to be carried forward for further detailed evaluation.

1.3 Schedule B Municipal Class EA Process

The Lake Huron WTP Disinfection and Storage EA project is proceeding as a Schedule B activity, which requires the completion of a screening process involving mandatory contact with directly affected public, relevant review agencies, and Indigenous communities to make them aware of the project and to provide an opportunity to address their concerns. Schedule B projects require that Phases 1 and 2 of the Class EA be followed and that a Project File report be prepared and filed for review by the public and the MECP.

The completion of Phase 1 – Problem or Opportunity is documented in "Problem & Opportunity Statement Memorandum" (January 21, 2021).

Phase 2 of the Class EA process addresses the development of Alternative Solutions to address the problem or opportunity, taking into consideration the existing environment as well as public, review agency, and Indigenous communities' input to establish the preferred solution.

Project decisions are then documented in a Project File, which will be made available for review by public, review agencies, Indigenous communities, and other interest groups for a 30-day period.

Interested parties may provide written comments to the project team and in addition, a request may be made to the Ministry of the Environment, Conservation and Parks (MECP) for an order requiring a higher level of study (i.e. requiring an individual/comprehensive EA approval before being able to proceed), or that conditions be imposed (e.g. require further studies), only on the grounds that the requested order may prevent, mitigate or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights.

At the completion of the comment period, if there are no outstanding concerns raised to the proponent or the MECP, LHWSS may proceed to Phase 5 - Project Implementation of the preferred solution.

1.4 Alternative Development Process

The identification and evaluation of alternative solutions are being undertaken to systematically assess viable disinfection and storage alternatives, with respect to social, technical, and economic criteria, following the Phase 2 Class EA process as outlined in Figure 1-1 and described below.

The alternative development process consists of the following steps:

- Step 1 – Identify objectives for alternatives in alignment with the Problem and Opportunity Statement.
- Step 2 – Identify and evaluate the long list of alternatives to meet project objectives using a screening level assessment.

- Step 3 – Develop a short list of alternatives and evaluate this list using a detailed triple bottom line (TBL) evaluation.
- Step 4 – Consult with and receive input from relevant stakeholders to select the preferred alternative.

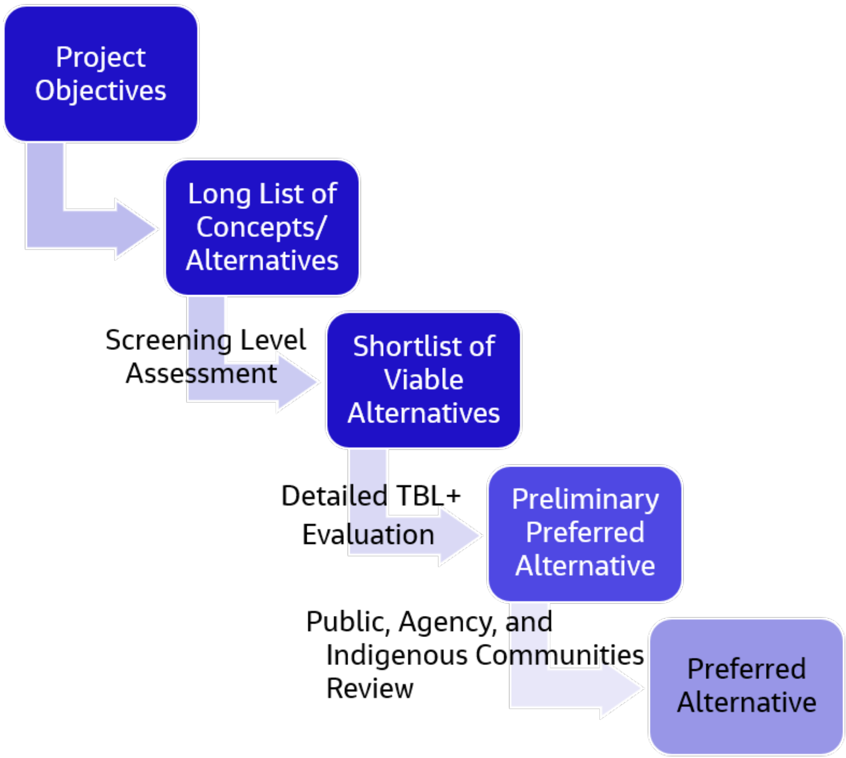

Figure 1-1. Phase 2 Class EA Alternative Solutions Planning Process

1.5 Existing Conditions

The Lake Huron WTP is classified as a conventional chemically-assisted filtration plant, and has a rated capacity of 340 ML/d. The plant draws water for treatment from Lake Huron and employs a combination of pre-chlorination, screening, powder activated carbon addition (seasonally on an as-required basis), coagulation, flocculation, sedimentation, dual-media filtration, post-chlorination, and pH adjustment using sodium hydroxide to produce the treated water. Chlorine gas is used for chlorination at the WTP. Overall primary disinfection goals are achieved via pre-chlorination at the intake (previously on a seasonal basis, now year-round), through pre-treatment and filtration, via post-chlorination in the two clearwells (North and South Clearwells) and the portion of the primary transmission main from the WTP to the B-Line Road monitoring station (referred to as the B-Line chlorine contact pipe). Figure 1-2 demonstrates the disinfection process schematic for the Lake Huron WTP.

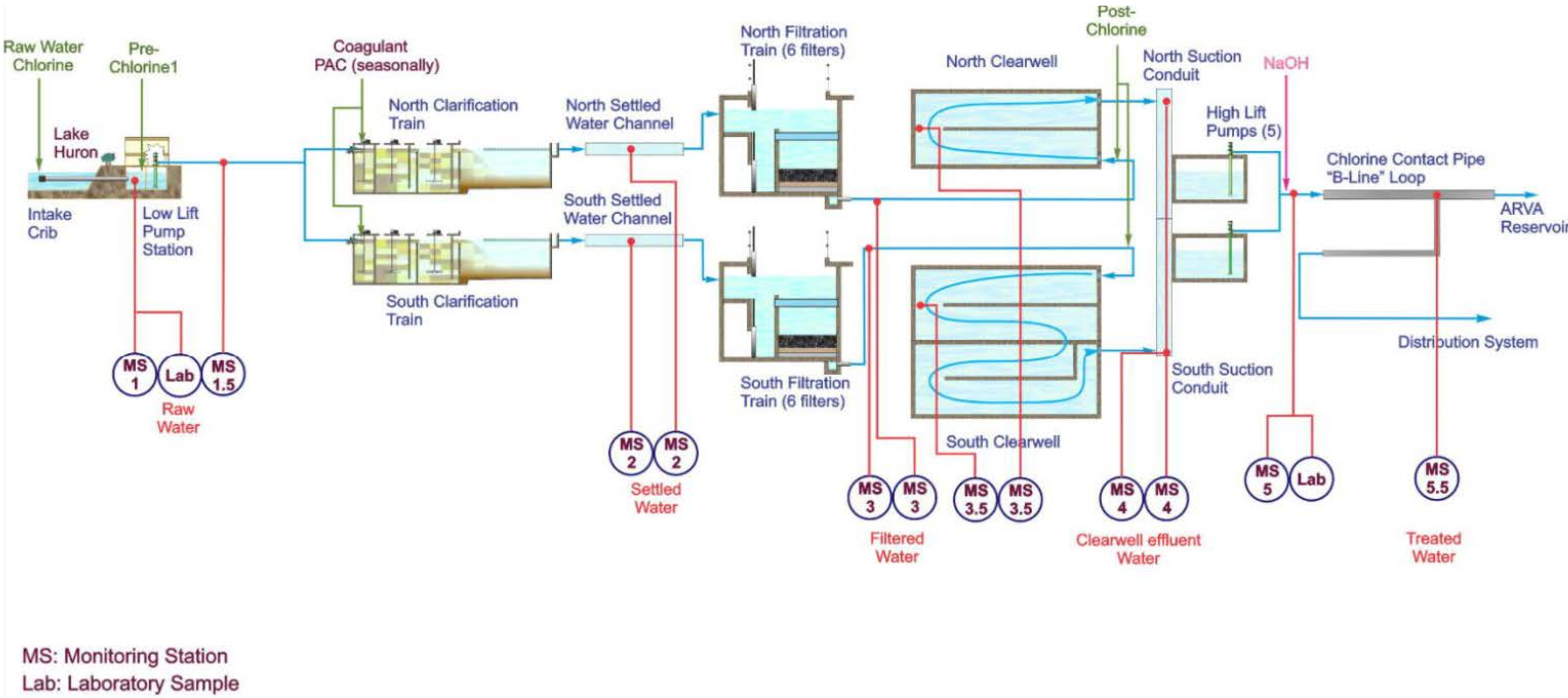

Figure 1-2. Lake Huron Water Treatment Plant Disinfection Schematic

The disinfection performance of the plant is limited by the disinfection credits that can be achieved in the north clearwell, the smaller of the two clearwells at the plant. Access to the volume in the clearwells for water storage purposes is therefore constrained by the level which must be maintained in the clearwells for disinfection purposes.

A review of the primary disinfection process conducted in 2018 noted that the Lake Huron WTP could meet the required MECP *Giardia* and virus inactivation requirements under warm water conditions; however, under cold water conditions, operational interventions would be required to meet the inactivation requirements if demand exceeded 200 ML/d (AECOM, 2018). As the plant has a capacity of 340 ML/d, the need to mitigate the disinfection deficiencies is identified.

As part of the 2020 LHPWSS Master Plan Update, a storage capacity assessment was completed to quantify the water storage deficiency for the regional system, assuming that the responsibility for storage is shared between the LHPWSS and the benefiting municipalities. Regional storage needs were defined as the sum of an equalization volume of 25% of the maximum day demand and an emergency volume of 40% of the average day demand, based on MECP guidelines. The Master Plan Update identified a deficiency in that the Lake Huron WTP lacks regional equalization and emergency storage to supply the municipalities that may rely on the Lake Huron WTP for direct servicing. The assessment identified a conservative storage need of 10.1 ML to meet the regional equalization and emergency storage needs to supply the applicable municipalities. As the analysis was based on conservative assumptions of municipal servicing capabilities, a verification exercise is to be completed as part of this project to determine a refined reservoir volume to meet the water demand-based needs for the Lake Huron WTP.

Further to the insufficient water demand-based storage and disinfection achievement, a Pumping and Storage Optimization Study by AECOM identified operational restrictions and deficiencies for the Lake Huron WTP relating to the operation of the existing high lift pumps. Issues with maintaining an acceptable net positive suction head required (NPSHr) for the high lift pumps was identified (AECOM, 2018). There is insufficient capacity in the existing clearwells to offset the ramp-up requirements of the plant processes to provide stable operation if an additional high lift pump is required to start up with one already in operation.

The review of previous studies and investigations at the Lake Huron WTP identified that the expansion of storage and/or modifications of treatment process at the plant would provide the following:

- Improve disinfection to allow for full utilization of plant capacity under all operating conditions;
- Reduce NPSHr restrictions for the high lift pumps and provide additional buffering volume to mitigate impacts on plant performance stability during pumping regime changes; and,
- Provision of water storage to meet required water demand-based needs of applicable municipalities serviced.

1.6 Project Objectives

The objectives for this project can be categorized into two groups: disinfection objectives and storage objectives. Based on input from LHPWSS, the project objectives have been identified as follows:

1) Disinfection Objectives
   a) Provide adequate disinfection to mitigate water production restrictions under cold water conditions
   b) Increase operational flexibility in achieving CT by reducing reliance on the transmission pipeline and pre-treatment chlorination
2) Storage Objectives
   a) Provide additional storage for meeting present day and future water demands
   b) Provide buffering storage volume for High Lift Pump (HLP) operations under the proposed Energy Management Strategy (EMS)
   c) Improve Net Positive Suction Head available (NPSHa) to the HLPs

2. Long List of Alternative Solutions

The following section describes the process of developing the long list of alternatives to address the project objectives and overall Problem/Opportunity Statement. The process begins with an evaluation of broad strategies to address the project objectives followed by identification of viable alternatives to implement the available strategies. The following strategies have been considered:

- Do nothing
- Limit growth
- Modify operational practices and/or expand maintenance program
- Reduce water demand
- Expand or upgrade existing water system

With the Do Nothing strategy, plant capacity would continue to be limited during cold water conditions due to disinfection constraints and no additional storage would be available to provide buffering volume for operational flexibility to meet the Energy Management Strategy. The Do Nothing strategy is not considered a viable solution but is maintained in the long list of alternatives for the Lake Huron WTP EA as a baseline alternative for comparison purposes.

The non-infrastructure solutions of Limiting Community Growth, Modifying Operations or Expanding Maintenance, or Reducing Water Demand do not provide viable solution in terms of achieving the project objectives of redundancy and operational flexibility, and therefore are not included as part of the long list of alternatives.

Expanding or Upgrading the Existing Water System remains as the only strategy that provides the opportunity to achieve the disinfection and storage project objectives. The following sub-sections outline viable means to implement this strategy.

2.1 Alternative Solutions to Improve Disinfection

The following upgrade concepts have been identified to address the disinfection objectives as detailed in in Section 2.3. The upgrade concepts to address disinfection include:

1) Do Nothing
2) Control Flow Rate through North and South Treatment Trains
3) Modifications to Existing Clearwells
4) Additional Clearwell Volume
5) UV Disinfection
6) Ozonation

2.1.1 Baseline Conditions

To establish baseline parameters for each of the alternatives, a review of the preliminary results of the Quantitative Microbial Risk Assessment (QMRA) currently being conducted for the Lake Huron WTP was completed to evaluate whether changes to the current disinfection requirements are needed. Disinfection requirements are determined by Bin Classification, as outlined within the Long Term 2 Enhanced Surface Water Treatment Rule by the US Environmental Protection Agency (US EPA). The Lake Huron WTP has historically fallen within the Bin 1 classification, meaning that the average source water cryptosporidium concentration is less than 0.075 oocysts/L (US EPA, 2010). Based on the 16 microbial samples collected from June 2019 to February 2021, as detailed in Table 2-1, it is concluded that preliminary cryptosporidium and *Giardia* averages of 0.005 crypto oocysts/L and 0.001 *Giardia* oocysts/L respectively, are still within the existing Bin 1 disinfection category. No changes in the disinfection requirements are needed.

Table 2-1. Preliminary QMRA Results

Parameter	Cryptosporidium	*Giardia*
No. of Samples[1]	16	16
No. of Non-Detect Samples	15	15
Average	0.005 crypto/L	0.001 *Giardia*/L
Maximum	0.083 crypto/L	0.012 *Giardia*/L

Notes:

[1] Samples collected from June 2019 to February 2021. It should be noted that no samples were collected from March to July of 2020 due lab closures during the COVID-19 pandemic.

The plant's CT calculator was then used to assess associated disinfection credits for each alternative and results were compared to the required disinfection credits (0.5 removal credits for *Giardia*, and 2 removal credits for viruses) throughout the entire treatment process. Parameters within the CT calculator were adjusted for each alternative to simulate the conditions of the plant treatment process for the alternative scenario, to determine whether the alternative can achieve the required credits. The parameters used to simulate the baseline condition for the alternatives in the CT calculator are presented in Table 2-2.

Table 2-2. CT Calculator Baseline Conditions

Parameter	Unit	Value
Maximum Treated Water Flow (i.e. to Distribution)	m^3/d	340,000
Water Temperature	ºC	2.3
Free Chlorine Residuals - *Raw Water Pipe to Clearwells*	mg/L	0.5
Free Chlorine Residuals - *Clearwells through to Suction Conduit*	mg/L	1.1
Free Chlorine Residuals - *B-line Loop*	mg/L	1.0
pH - *Raw Water Pipe through to Suction Conduit*	[-]	7.5
pH - *B-line Loop*	[-]	9.5
Minimum Clearwell Operating Depth	m	2.8

Key assumptions made when simulating the disinfection alternatives with the CT calculator include:

- All individual treatment processes throughout the plant as well as the B-Line chlorine contact pipe are contributing to the overall disinfection credits achieved;
- The existing backwash supply and water service pumps are running at full capacity; and
- No restrictions from the treatment plant nor transmission mains in achieving the full plant production capacity of 340 ML/d.

2.2 Alternative Solutions to Improve Storage

Several upgrade concepts are identified to address the storage objectives of the project and which are expanded to develop the specific alternative solutions presented in Section 2.3. The upgrade concepts to address storage include:

1) Do Nothing
2) Large Reservoir to Meet Both Water Demand-based Requirements and Provide Buffering/Operational Volume

2.2.1 Reservoir Sizing Approach

For each specific alternative, the volume of the proposed new reservoir would comprise of the following components: volume for buffering and operational purposes, volume for water demand-based storage requirements, and volume for additional disinfection purposes as demonstrated in Figure 2-1.

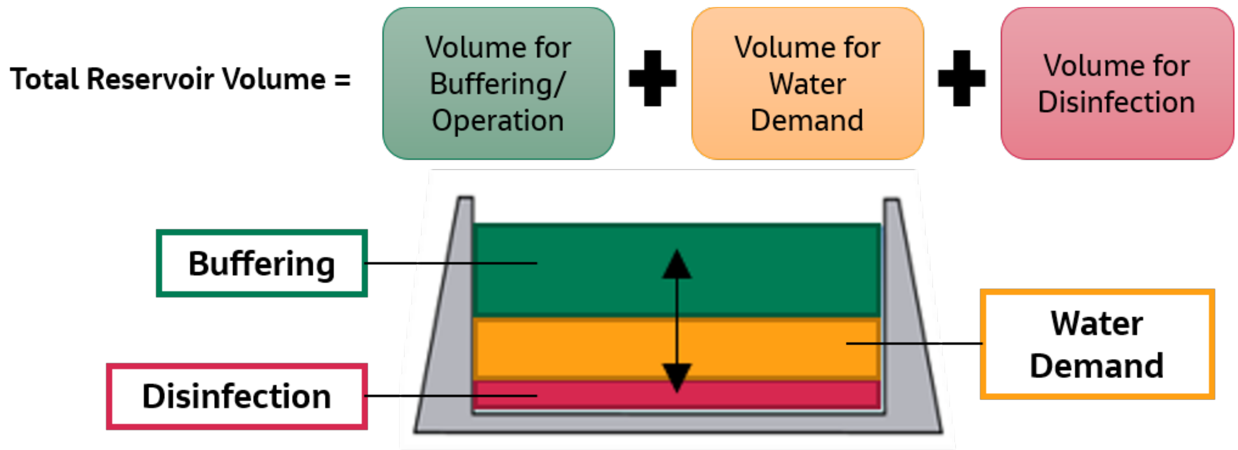

Figure 2-1. Schematic of Reservoir Sizing Approach

The storage volume for viable alternatives will be refined through this EA as follows:

- The volume for buffering and operational purposes will be refined through dynamic hydraulic modelling of the treatment plant.
- The volume for water demand will be refined through revisions to the equalization and emergency storage calculations carried out through the Master Plan, as informed by information collected from the transmission system hydraulic model and a formal water demand surveys of applicable municipalities.
- The volume for disinfection will be refined through process calculations using the plant's CT calculator.

2.3 Combined Long List of Alternatives

The disinfection and storage upgrade concepts presented in Sections 2.1 and 2.2 were combined and expanded into multiple alternative solutions, which are presented and described in the following long list of alternatives.

2.3.1 Alternative 1: Do Nothing

Do Nothing is the baseline non-infrastructure solution considered as part of the Class EA process. In this scenario, the Lake Huron WTP would continue to operate as it currently does, with no changes to the treatment processes or infrastructure at the plant. Figure 2-2 demonstrates a schematic of the existing treatment process for the Lake Huron WTP. Disinfection and storage needs would continue to be limited by the existing treatment plant arrangement and processes.

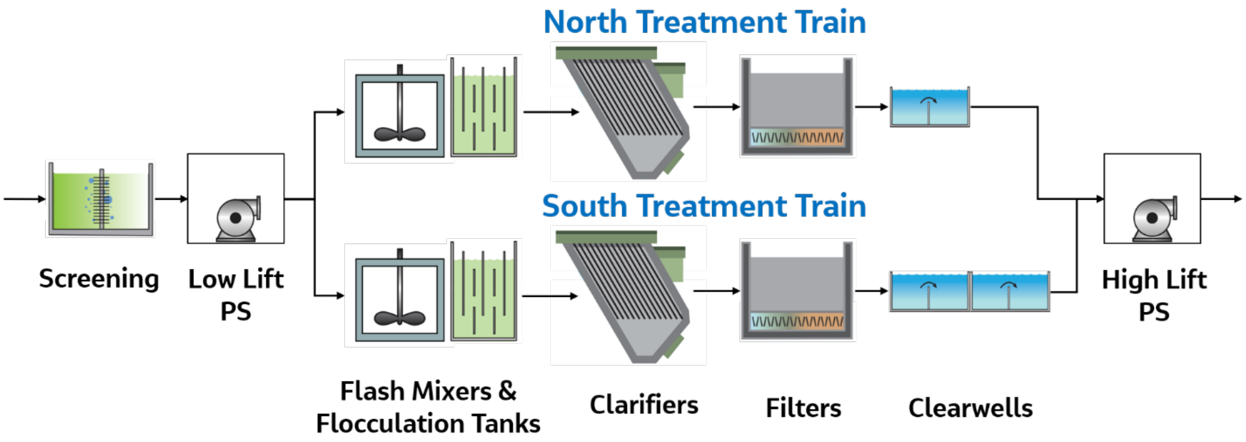

Figure 2-2. Schematic of Existing Lake Huron WTP (Do Nothing Alternative)

2.3.2 Alternative 2: Control Flow to North Clearwell and New Reservoir

Alternative 2 involves controlling the flow through the north and south treatment trains at the Lake Huron WTP such that capacity restrictions due to disinfection currently imposed by the smaller north clearwell are reduced. The alternative would require flow control valves to be implemented upstream of the existing flash mixers, where the plant flow is split into the two treatment trains to balance flow between the clearwells to achieve equal CT disinfection credits in the clearwells. Based on the current clearwell configuration, a 1/3rd to 2/3rd flow split between the north and south clearwells would be required, which would limit plant production capacity to 255 ML/d. Figure 2-3 demonstrates the schematic for Alternative 2.

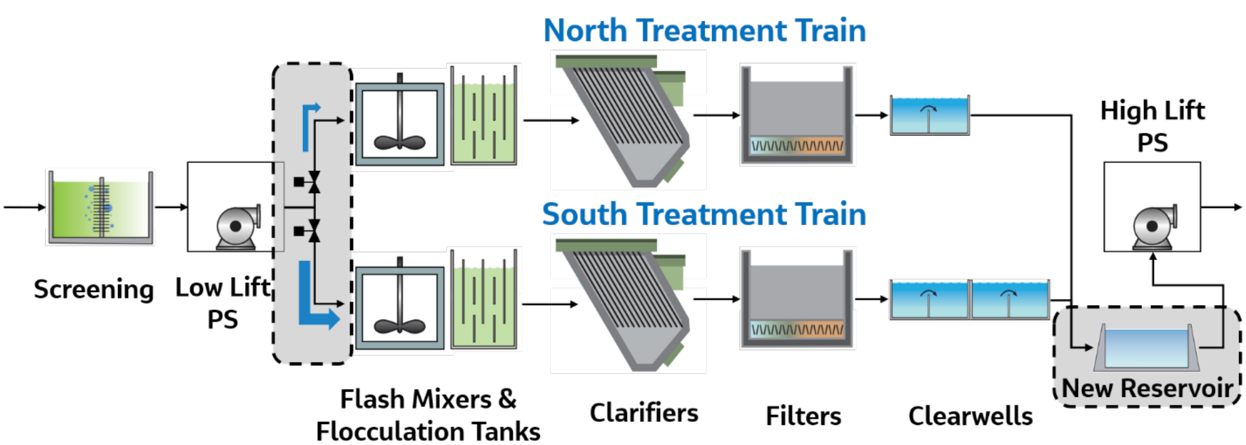

Figure 2-3. Schematic for Alternative 2

Buffering/operational requirements for the plant would be provided in a new reservoir sized to meet the water demand-based needs of serviced municipalities directly downstream of the plant. As disinfection requirements cannot be fully met through controlling the flow to the north clearwell, the new reservoir would also need to have a small volume dedicated for disinfection purposes, in order to utilize full plant capacity in all conditions.

2.3.3 Alternative 3.1: Increase Existing Clearwell Baffle Factor and New Reservoir

Alternative 3.1 involves constructing additional baffle walls and features to increase the existing baffle factors from 0.4 to 0.7 in both the north and south clearwells to improve disinfection CT, as demonstrated in Figure 2-4. Preliminary CT calculations indicate that while this alternative increases the CT disinfection credits achieved relative to the baseline, the *Giardia* inactivation credits achieved do not meet requirements (a deficit of approximately 0.03 inactivation credits remains).

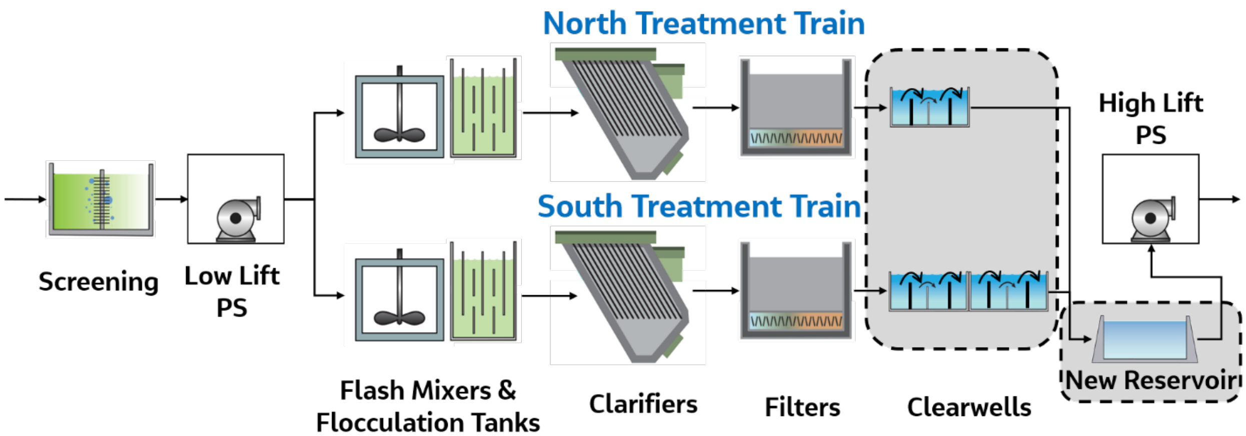

Figure 2-4. Schematic for Alternative 3.1

Buffering/operational requirements for the plant would be provided in a new reservoir sized to meet the water demand-based needs of serviced municipalities directly downstream of the plant. As disinfection requirements cannot be fully met by increasing the baffling factors in the existing clearwells, the new reservoir would also need to have a small volume dedicated for disinfection purposes, in order to utilize full plant capacity in all conditions.

2.3.4 Alternative 3.2: Overflow Weirs at Clearwell Effluent and New Reservoir

Alternative 3.2 involves constructing overflow weirs at the effluent of the clearwells that will maintain a top water level within the clearwells and provide increased disinfection CT on a consistent basis, as demonstrated in Figure 2-5. Preliminary CT calculations indicate that while this alternative increases the CT disinfection credits achieved relative to the baseline, the *Giardia* inactivation credits achieved do not meet requirements (a deficit of approximately 0.08 inactivation credits remains).

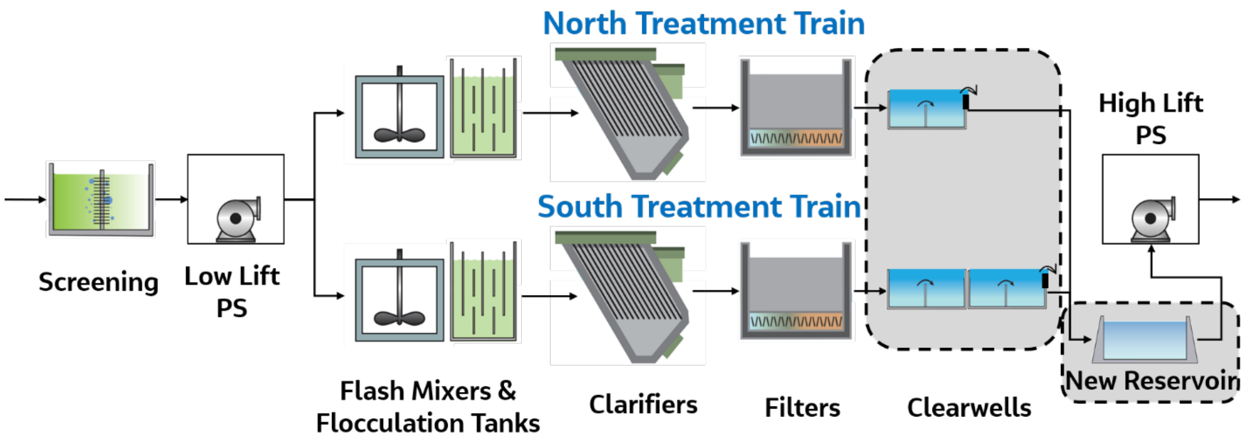

Figure 2-5. Schematic of Alternative 3.2

Buffering/operational requirements for the plant would be provided in a new reservoir sized to meet the water demand-based needs of serviced municipalities directly downstream of the plant. As disinfection requirements cannot be fully met by constructing overflow weirs in the existing clearwells, the new reservoir would also need to have a small volume dedicated for disinfection purposes, in order to utilize full plant capacity in all conditions.

2.3.5 Alternative 3.3: Operate North and South Clearwells in Series and New Reservoir

Alternative 3.3 involves modifying the existing clearwells such that the north and south clearwells operate in series as shown in Figure 2-6, rather than in parallel, to increase disinfection CT. These modifications would consist of removing small portions of the filtered water effluent channel walls and constructing new walls within the clearwells such that water flows from the filter effluent channels through the north clearwell followed by the south clearwell before entering the HLP suction conduit. Preliminary CT calculations indicate that while this alternative increases the CT disinfection credits achieved relative to the baseline, the *Giardia* inactivation credits achieved do not meet requirements (a deficit of approximately 0.05 inactivation credits remains).

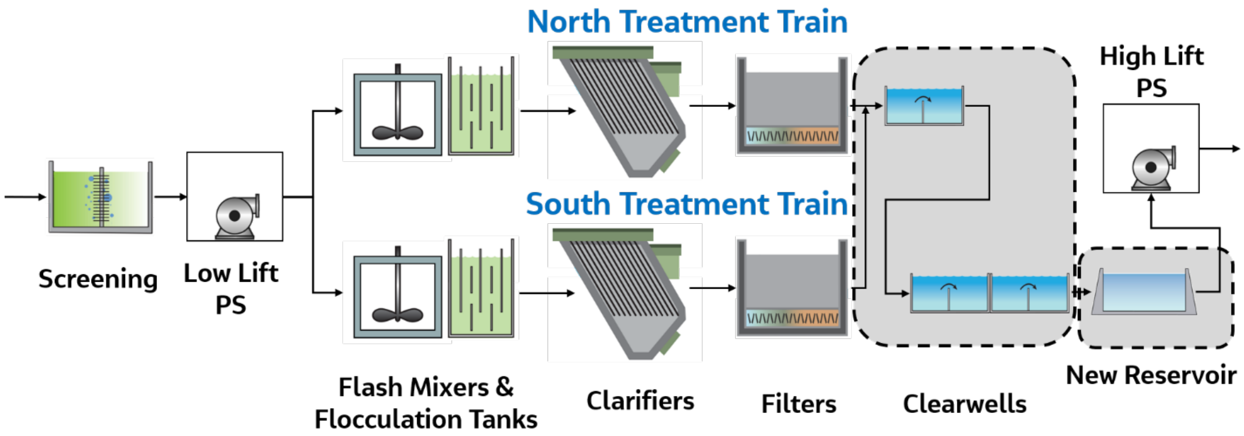

Figure 2-6. Schematic of Alternative 3.3

Buffering/operational requirements for the plant would be provided in a new reservoir sized to meet the water demand-based needs of serviced municipalities directly downstream of the plant. As disinfection requirements cannot be fully met by reconfiguring the existing clearwells, the new reservoir would also need to have a small volume dedicated for disinfection purposes, in order to utilize full plant capacity in all conditions.

2.3.6 Alternative 4.1: Second Cell at North Clearwell and New Reservoir

Alternative 4.1 involves constructing a second cell at the north clearwell to expand the overall clearwell volume and thereby increase disinfection CT to meet that of the south clearwell. The addition of a second cell will remove the plant capacity restrictions currently imposed by the smaller north clearwell. Figure 2-7 demonstrates the schematic of Alternative 4.1.

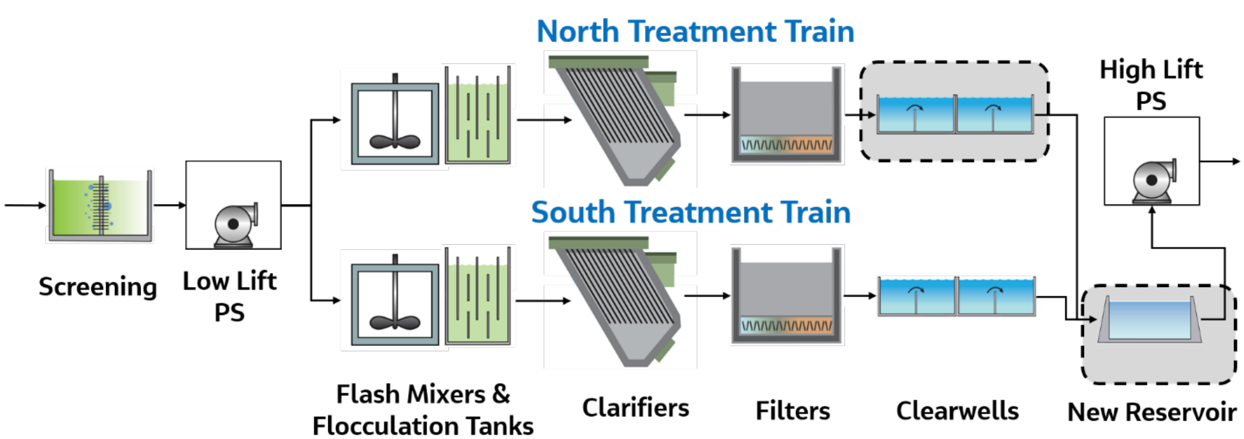

Figure 2-7. Schematic for Alternative 4.1

Buffering/operational requirements for the plant would be provided in a new reservoir sized to meet the water demand-based needs of serviced municipalities directly downstream of the plant.

2.3.7 Alternative 4.2: New Large Reservoir to Meet Disinfection and Storage Needs

Alternative 4.2 consists of constructing a new reservoir to meet all requirements: remaining disinfection needs (not achieved through the existing treatment process), water demand-based needs of serviced municipalities directly downstream of the plant, and buffering/operational requirements for the plant. This alternative will therefore comprise of the largest reservoir volume of all the alternatives. Preliminary CT calculations of the baseline condition indicate that the *Giardia* inactivation credits achieved by the existing plant treatment processes at full capacity of 340 ML/d does not meet requirements (a deficit of approximately 0.1 inactivation credits remains). The disinfection volume component of the new reservoir in this alternative would therefore be sized to remove this deficit.

No major upgrades or modifications to the existing disinfection and treatment processes at the plant will occur, other than those required to route the water to and from the new reservoir. Figure 2-8 demonstrates the schematic for Alternative 4.2.

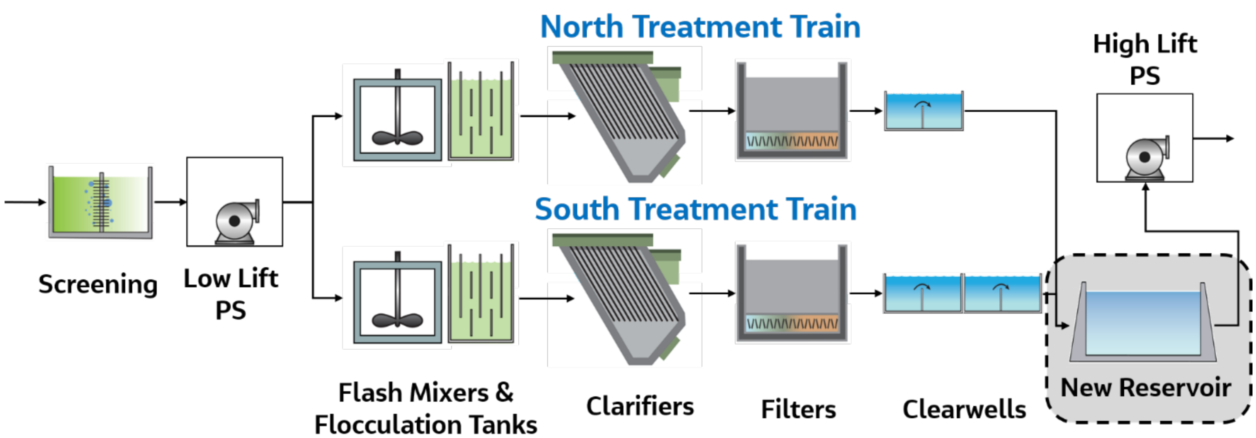

Figure 2-8. Schematic for Alternative 4.2

2.3.8 Alternative 5.1: UV Disinfection at Filter Influent Channels and New Reservoir

Alternative 5.1 involves installing ultra-violet (UV) disinfection reactors within the two filter influent channels at the plant, as shown in Figure 2-9. This would allow for *Giardia* disinfection requirements to be met by the new UV disinfection process and the existing filtration process, and virus disinfection requirements to be met in the existing clearwells.

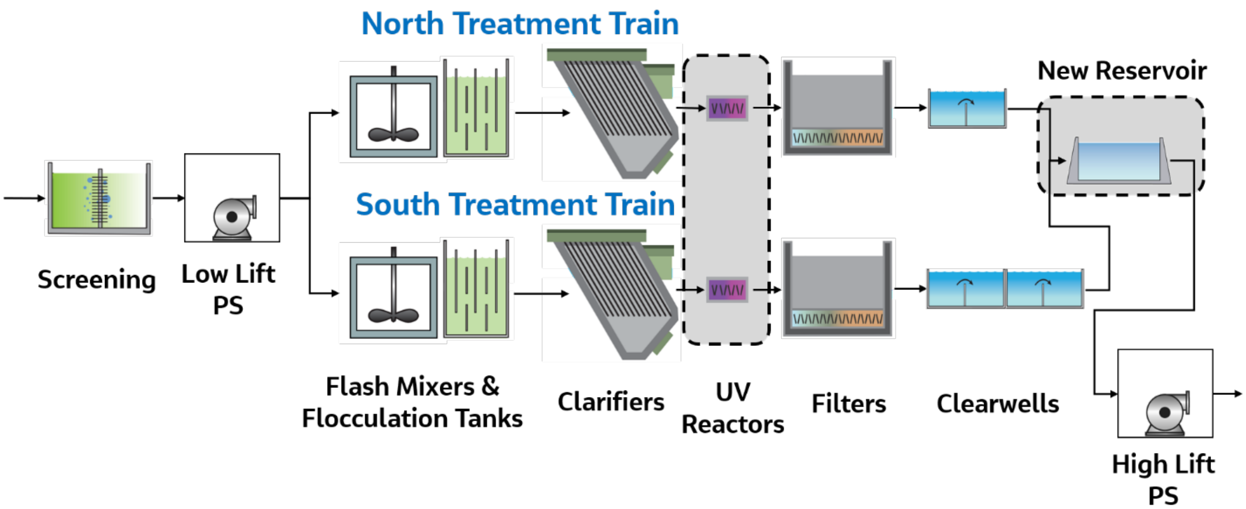

Figure 2-9. Schematic for Alternative 5.1

Buffering/operational requirements for the plant would be provided in a new reservoir sized to meet the water demand-based needs of serviced municipalities directly downstream of the plant.

2.3.9 Alternative 5.2: UV Disinfection at Each Filter Effluent and New Reservoir

Alternative 5.2 involves installing a UV disinfection reactor on the effluent piping of each of the 12 filters at the plant, as shown in Figure 2-10. Similar to Alternative 5.1, this would allow for *Giardia* disinfection requirements to be met by the new UV disinfection process and the existing filtration process, and virus disinfection requirements to be met in the existing clearwells.

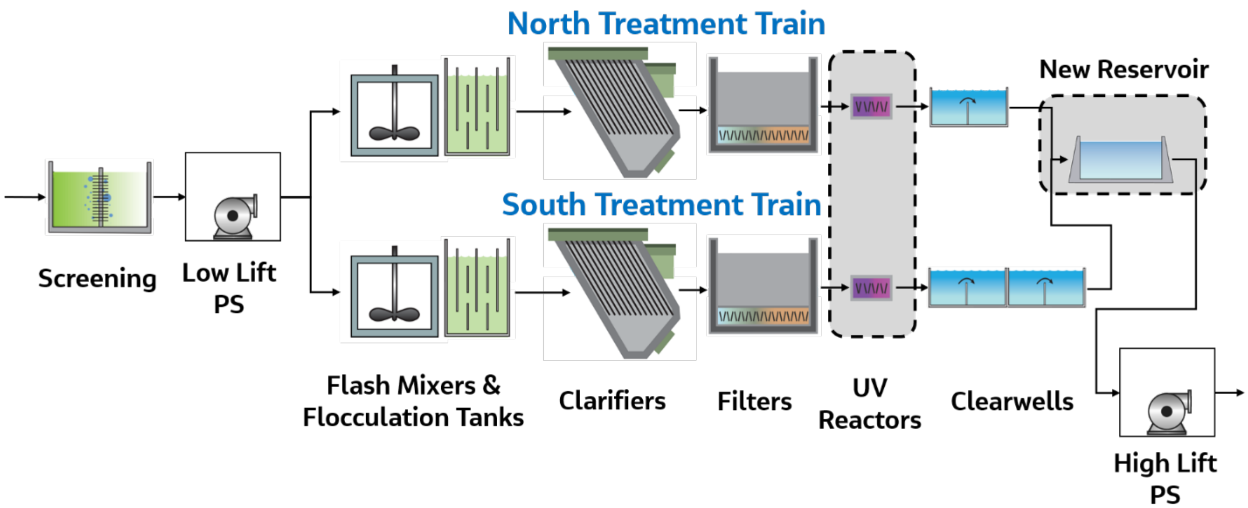

Figure 2-10. Schematic for Alternative 5.2

Buffering/operational requirements for the plant would be provided in a new reservoir sized to meet the water demand-based needs of serviced municipalities directly downstream of the plant.

2.3.10 Alternative 5.3: UV Disinfection in Each Clearwell and New Reservoir

Alternative 5.3 consists of converting a small portion of the south clearwell to a UV chamber and constructing a new UV chamber adjacent to the north clearwell, as demonstrated in Figure 2-11. This would allow for all disinfection requirements to be met within the clearwells and existing treatment processes at the plant.

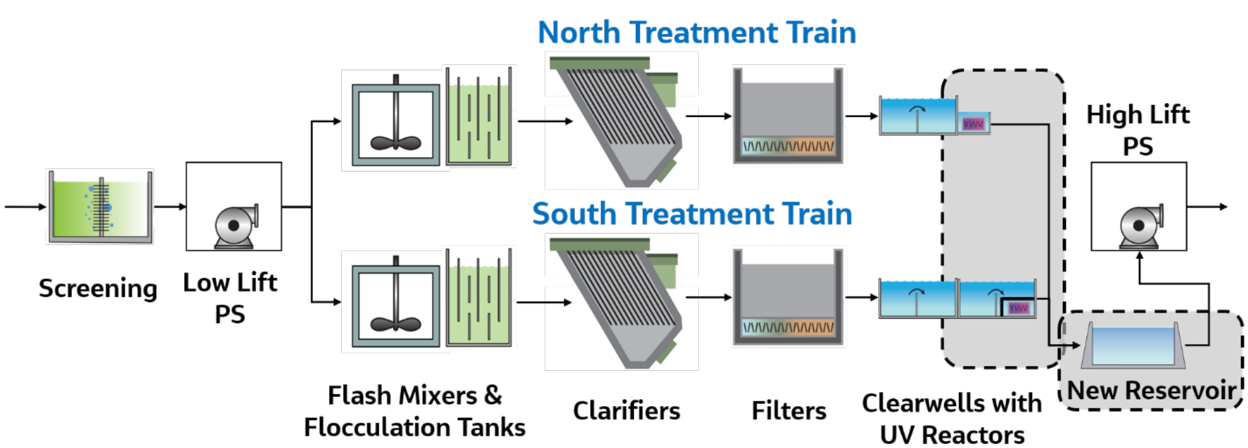

Figure 2-11. Schematic for Alternative 5.3

Buffering/operational requirements for the plant would be provided in a new reservoir sized to meet the water demand-based needs of serviced municipalities directly downstream of the plant.

2.3.11 Alternative 5.4: UV Disinfection at HLP Discharge and New Reservoir

Alternative 5.4 involves the installation of UV reactors on the HLP discharge pipe of the treatment plant, as demonstrated in Figure 2-12. Consideration of the high pressures associated with high lift pumping is required for the selection of UV reactors for this alternative. However, this would allow for virus disinfection requirements to be met in the existing clearwells, and remaining *Giardia* disinfection requirements not met through existing treatment processes to be achieved after the HLPs.

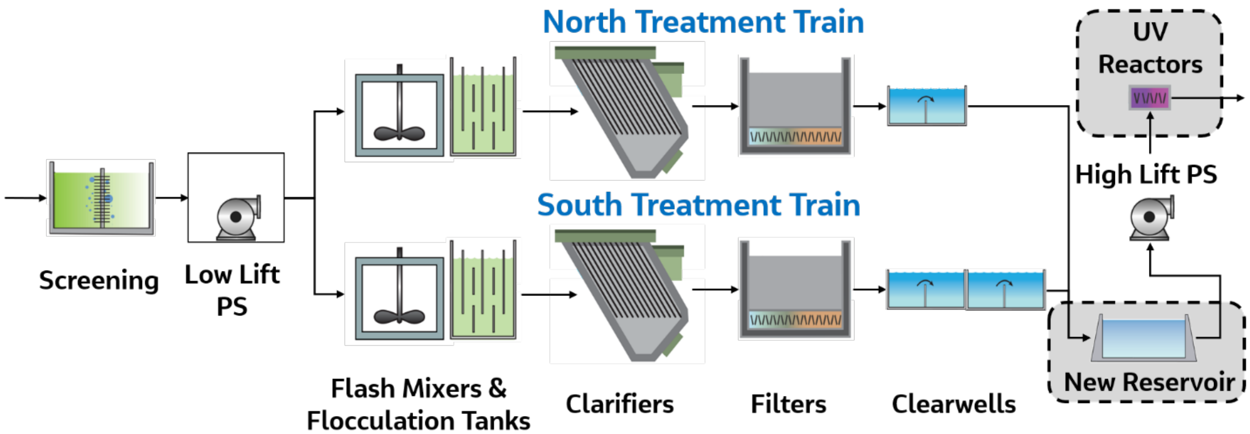

Figure 2-12. Schematic for Alternative 5.4

Buffering/operational requirements for the plant would be provided in a new reservoir sized to meet the water demand-based needs of serviced municipalities directly downstream of the plant.

2.3.12 Alternative 6.1: Ozonation Prior to Coagulation and New Reservoir

Alternative 6.1 involves the introduction of ozonation as an additional treatment process at the Lake Huron WTP. The alternative consists of constructing an ozone contact tank upstream of the coagulation process (i.e. the flash mixers) as shown in Figure 2-13, which would allow for the achievement of *Giardia* inactivation requirements in combination with the filtration process. Virus disinfection requirements would be met in the existing clearwells. As this alternative introduces ozonation, it also requires additional upgrades to the existing filters at the plant, as they would need to be retrofitted for biological filtration.

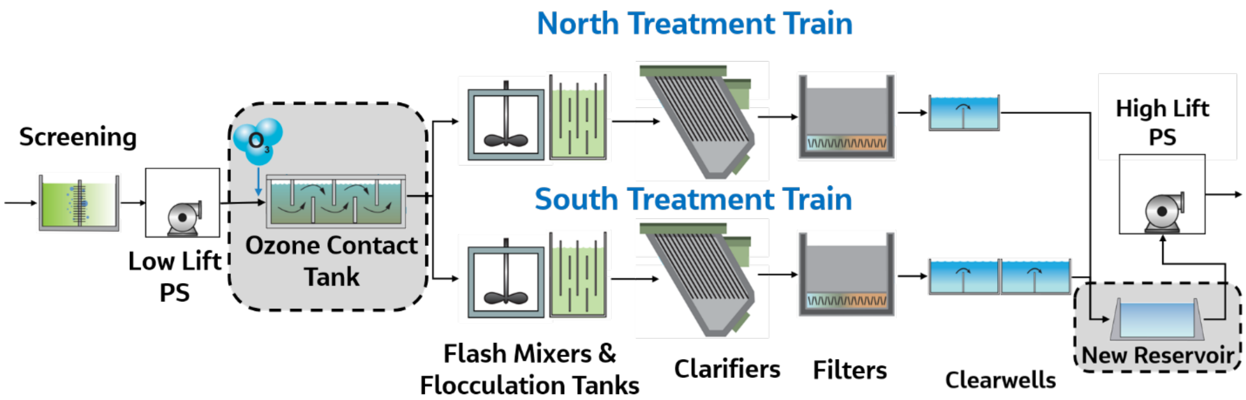

Figure 2-13. Schematic for Alternative 6.1

Buffering/operational requirements for the plant would be provided in a new reservoir sized to meet the water demand-based needs of serviced municipalities directly downstream of the plant.

2.3.13 Alternative 6.2: Ozonation Prior to Filtration and New Reservoir

Alternative 6.2 also involves the introduction of ozonation as an additional treatment process at the Lake Huron WTP. This alternative consists of constructing an ozone contact tank upstream of the filters as shown in Figure 2-14, which would allow for the achievement of *Giardia* inactivation requirements in combination with the filtration process. Virus disinfection requirements would be met in the existing clearwells. Similar to Alternative 6.1, this alternative introduces ozonation as a treatment process, and it therefore requires the existing filters to be retrofitted for biological filtration.

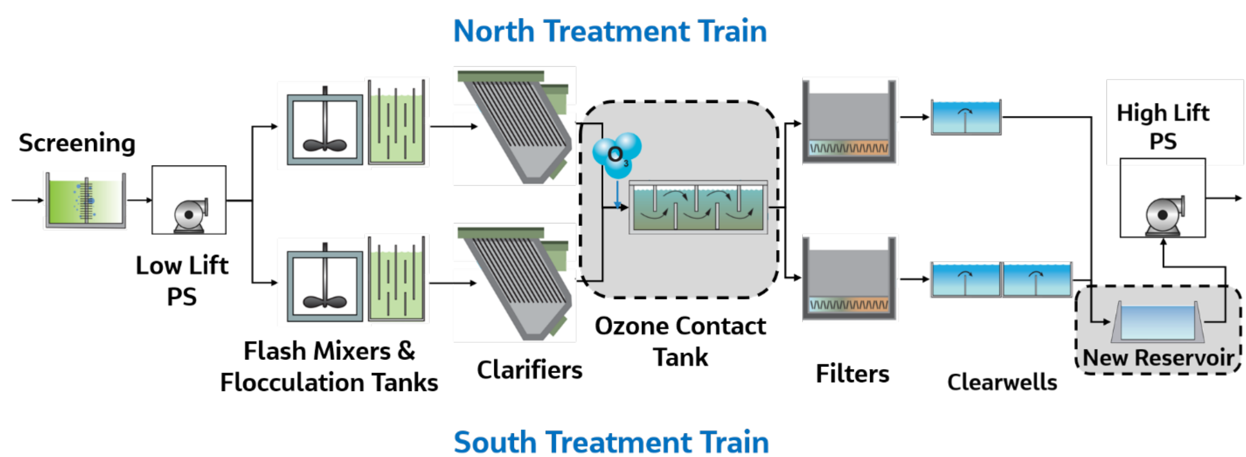

Figure 2-14. Schematic of Alternative 6.2

Buffering/operational requirements for the plant would be provided in a new reservoir sized to meet the water demand-based needs of serviced municipalities directly downstream of the plant.

3. Alternative Screening

To identify viable alternative solutions to address the disinfection and storage objectives, a high-level screening was conducted to determine the short list of alternatives for the project. Workshop #1 was held on March 9, 2021 between LHPWSS and Jacobs to collaboratively select screening criteria as well as to complete the screening exercise. This section presents the criteria used to screen the alternatives, as well as the resulting short list of alternatives that will be developed (including reservoir sizing) and evaluated in detail as the project progresses.

3.1 Screening Criteria

In consultation with LHPWSS, five screening criteria were selected to screen the long list of alternatives. The criteria were implemented using a pass/fail approach, with alternatives being evaluated as either “meets” or “does not meet” each criterion, using the symbology noted in Table 3-1 below.

Table 3-1. Screening Symbology

Symbol	Meaning
○	Does not meet criteria (“Fail”)
●	Meets criteria (“Pass”)

If an alternative fails to meet any of the five criteria it is screened out. The screening criteria are presented in Table 3-2.

Table 3-2. Screening Criteria

Criteria	Criteria Description
Criteria 1: Meet All Objectives	Does the alternative meet all disinfection and storage objectives?
Criteria 2: Operational Flexibility	Relative to baseline condition, does the alternative increase or decrease operational flexibility?
Criteria 3: Constructability	Is it feasible to construct/implement the alternative while maintaining plant capacity requirements?
Criteria 4: Impacts to Existing Treatment Process	Does the alternative result in impacts to existing treatment processes such that additional upgrades would be required at the plant?
Criteria 5: Park/Plant Access	Does the alternative significantly impact park or plant access with no practical mitigation measures available?

3.2 Summary of Short-Listed Alternatives

The screening of the long list of alternatives was completed in collaboration with LHPWSS and is presented in Table 3-3.

Table 3-3. Screening of Long List of Alternatives

Number	Alternative Description	Meet all Objectives	Impact to Operational Flexibility	Constructability	Impacts to Existing Treatment Processes	Park/Plant Access	Outcome
1	Do Nothing	○ Fail	● Pass	● Pass	● Pass	● Pass	○ Fail
2	Control Flow to North Clearwell, New Reservoir	○ Fail	○ Fail	● Pass	● Pass	● Pass	○ Fail
3.1	Increase Existing Clearwell Baffle Factor, New Reservoir	● Pass	● Pass	● Pass	● Pass	● Pass	● Pass
3.2	Overflow Weir at Clearwell Effluent, New Reservoir	● Pass	● Pass	● Pass	● Pass	● Pass	● Pass
3.3	Operate North and South Clearwells in Series, New Reservoir	● Pass	○ Fail	○ Fail	● Pass	● Pass	○ Fail
4.1	Add Second Cell at North Clearwell, New Reservoir	● Pass	● Pass	● Pass	● Pass	○ Fail	○ Fail
4.2	New Reservoir to Meet Disinfection and Storage Needs	● Pass	● Pass	● Pass	● Pass	● Pass	● Pass
5.1	UV Disinfection at Filter Influent Channels, New Reservoir	● Pass	● Pass	● Pass	● Pass	● Pass	● Pass
5.2	UV Disinfection at Each Filter Effluent, New Reservoir	● Pass	● Pass	● Pass	● Pass	● Pass	● Pass
5.3	UV Disinfection in Each Clearwells, New Reservoir	● Pass	● Pass	● Pass	● Pass	● Pass	● Pass
5.4	UV Disinfection at HLP Discharge, New Reservoir	● Pass	○ Fail	○ Fail	● Pass	● Pass	○ Fail

Number	Alternative Description	Meet all Objectives	Impact to Operational Flexibility	Constructability	Impacts to Existing Treatment Processes	Park/Plant Access	Outcome
6.1	Ozonation Prior to Coagulation, New Reservoir	● Pass	● Pass	● Pass	○ Fail	● Pass	○ Fail
6.2	Ozonation Prior to Filtration, New Reservoir	● Pass	● Pass	○ Fail	○ Fail	● Pass	○ Fail

Five alternatives comprise of the resulting short list of alternatives, as presented in Table 3-4, based on the following rationale determined through the screening exercise:

- Alternatives 1 is screened out as it does not meet all of the project objectives.
- Alternative 2 is screened out as it does not meet all the project objectives and it decreases plant operational flexibility relative to the baseline condition, due to flow restrictions through the north treatment train.
- Alternative 3.3 is screened out as operating the clearwells in series removes the flexibility of the plant to operate the trains independently and due to the constructability issues of connecting the clearwells.
- Alternative 4.1 is screened out as the construction of a second cell on the North Clearwell would significantly impact plant operations and access on the north side of the plant. Practical measures are not available to mitigate this plant access issue as the south side of the plant would be occupied by reservoir construction.
- Alternative 5.4 is screened out due to the incompatibility of current UV equipment with the high pressures noted, and plant operational flexibility would be significantly impacted due to increased headloss and/or management of discharge/transient pressures.
- Alternatives 6.1 and 6.2 are screened out as the introduction of ozonation would require significant changes to the treatment process, including reconstruction of the filters to support biological filtration. Alternative 6.2 also presents constructability issues with connecting the ozone contact tank to the existing system.

Each short-listed alternative is to be developed and evaluated in detail including reservoir sizing in a subsequent technical memorandum. It is noted that as Alternative 3.1 and 3.2 are further developed they will be combined into a single alternative reflecting flow regime changes to the clearwells, as determined during Workshop #1.

Table 3-4. Short List of Alternatives

Alternative No.	Alternative Description
3.1 + 3.2	Modify flow through Existing Clearwells by Increasing Baffle Factor & Installation of Overflow Weirs at Clearwell Effluent, and New Reservoir
4.2	New Large Reservoir to Meet Disinfection, Buffering, and Storage Needs
5.1	UV Disinfection at Filter Influent Channels, and New Reservoir
5.2	UV Disinfection at Each Filter Effluent, and New Reservoir
5.3	UV Disinfection at Each Clearwell, and New Reservoir

4. Summary and Next Steps

The long list of alternatives developed to address the Problem/Opportunity Statement, the process used to screen these alternatives, and the resulting short list of five alternatives for the Lake Huron WTP EA were presented in this document. In addition, evaluation criteria were presented that will be used to comparatively assess the short-listed alternatives once they have been further developed.

To continue the Phase 2 of the Class EA process, the next steps will include the following tasks:

- Develop each of the short-listed alternatives in detail. This will consist of the following sub-tasks:
  - Complete hydraulic modelling of the plant with Replica to define buffering and operational volume requirements.
  - Consult with applicable municipalities serviced by LHPWSS (specifically those directly serviced by the Lake Huron WTP) to confirm water demand-based storage volume requirements.
  - Refine CT calculations to confirm disinfection volume requirements.
  - Complete the preliminary layouts and cost estimates.
- Conduct and complete Stage 1 Archeological and Cultural Heritage Assessments (Golder Associates).
- Confirm evaluation criteria and complete the evaluation of the short list of alternatives to select the preferred alternative solution.

5. References

AECOM. 2018. Lake Huron WTP Disinfection Review. Prepared for Regional Water Supply. October.

AECOM. 2018. Lake Huron Water Treatment Plant – CT Calculation at Worst Scenario. Prepared for Regional Water Supply. May.

AECOM. 2018. Pumping and Storage Optimization – Lake Huron Primary Water Supply System (LHPWSS). Prepared for Regional Water Supply. June.

Jacobs. 2020. Lake Huron PWSS Master Water Plan Update. Prepared for Regional Water Supply. June.

US Environmental Protection Agency. 2010. Long Term 2 Enhanced Surface Water Treatment Rule Toolbox Guidance Manual. Retrieved April 2020. Retrieved from: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1009JLI.txt

Appendix C2 – Short-Listed Alternative Evaluation and Preferred Solution

Jacobs

Technical Memorandum

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Technical Memorandum 2 – Preferred Alternative Solution (Final)

Project Name	Lake Huron Water Treatment Plant Disinfection and Storage Upgrades EA
Attention	Lake Huron Primary Water Supply System
From	Ray Yu, Monique Waller, and Cassie Stea
Project Number	CE801200
Date	July 25, 2022
Revision	2

1. Introduction

The Lake Huron Primary Water Supply System (LHPWSS) has retained Jacobs to conduct a Schedule B Municipal Class Environmental Assessment (EA) to develop and assess alternative solutions to improve disinfection and increase water storage at the Lake Huron Water Treatment Plant (WTP) in Grand Bend, Ontario. Specifically, the objectives for this project include:

1) Disinfection Objectives
   a) Provide adequate disinfection to mitigate water production restrictions under cold water conditions
   b) Increase operational flexibility in achieving CT by reducing reliance on the transmission pipeline and pre-treatment chlorination
2) Storage Objectives
   a) Provide additional storage for meeting present day and future water demands
   b) Provide buffering storage volume for High Lift Pump (HLP) operations under the proposed Energy Management Strategy (EMS)
   c) Improve Net Positive Suction Head available (NPSHa) to the HLPs

Two technical memorandums (TM) have been developed previously as part of this project:

- The Problem/Opportunity Statement TM describes the Municipal Class EA process, documents some of the existing conditions of the Study Area, and identifies constraints and opportunities related to the water supply system to form the basis of developing the Problem/Opportunity Statement for the project.
- TM 1 presents the long list of alternatives developed to address the Problem/Opportunity Statement and details the process used to screen these alternatives to a develop a short list of alternatives to be carried forward for further detailed evaluation.

The purpose of TM 2 is to document the development and design concepts of the short-listed alternatives, including layouts, key equipment and structure sizing, and costing information. TM 2 also summarizes the comparative evaluation of the alternatives used to provide a recommended solution to move forward into preliminary design.

2. Additional Background and Supplemental Studies

The following sub-sections outline supplemental studies and additional information that was collected in addition to the existing conditions review documented in the Problem/Opportunity Statement TM to inform the development and evaluation of the short-listed alternatives.

2.1 Ecological Assessment

A desktop ecological assessment was completed to identify natural heritage features which may occur within the limits of the proposed project site, to assess potential impacts from an ecological perspective, and to provide recommendations for required field studies. The collection and review of available natural features data was completed, including relevant information pertaining to the physical environment, terrestrial systems, wildlife, aquatic habitats, and species at risk (SAR). The Ministry of the Environment, Conservation, and Parks (MECP) was also contacted directly to confirm potential SAR that may occur within the project site.

The key findings from the desktop ecological assessment include:

- Each proposed alternative (except for the "Do Nothing" approach), slightly encroaches the Ausable Bayfield Conservation Authority (ABCA) Regulated Area. This occurs at the proposed alignment from the existing WTP clear wells to the new reservoir for each alternative. An Environmental Impact Study (EIS) may be requested by the ABCA at the detailed design stage.
- Numerous SAR have been identified as potentially occurring within the proposed project site (refer to Figure 6 showing the extent of the project site in the full ecological assessment report titled "Desktop Natural Features Assessment"). A SAR assessment is therefore recommended even if an EIS is not requested by ABCA. The SAR investigation should include field surveys during the growing season and analysis of potential SAR occurrences against existing habitat. Since all alternatives will affect the same area albeit at different footprints, it is suggested that the SAR survey be conducted at the preliminary design stage to confirm the desktop study results, and determine if an EIS is needed to provide the mitigation recommendations to be considered in the detailed design.
- No changes to the current discharge effluent quantity or quality from the plant are anticipated, therefore no impacts to fish and fish habitat are predicted at this stage of the project.
- Wildlife may be impacted from the proposed vegetation and tree removals, particularly from the proposed reservoir and associated alignment. Plans should be developed to avoid the breeding and nesting season for the area, or mitigation should be applied to avoid or reduce impacts. A landscape plan and/or tree inventory may also be required for the proposed vegetation removals. Given the previously disturbed features at the location of the proposed

works, it may be acceptable to carry out these tasks at the detailed design stage rather than baseline field surveys at the EA stage.

- The preferred alternative from an ecological perspective would be the alternative with the smallest footprint with respect to the proposed piping alignment and reservoir/UV building size, as it would result in less impacts to vegetation and wildlife, including potential grassland avifauna nesting and/or herptile movements, for example.

Note that additional field studies (SAR assessment or EIS) against existing conditions may yield confirmation of additional natural features. The protection and/or avoidance of the impacts on these features should be considered at the detailed design stage. Natural environment permitting efforts, with ABCA, MECP (Endangered Species Act), and DFO (Fisheries Act) could then be outlined at that stage of the project.

For more information on the findings from the desktop assessment, refer to the ecological report by Jacobs, titled "Desktop Natural Features Assessment". A baseline field survey to confirm the findings from the desktop assessment will be completed prior to preliminary design. The findings from the survey will be available as part of the Project File report.

2.2 Cultural Heritage Assessment

A desktop assessment of the local study area was completed by Golder Associates to assess whether there are properties or buildings with cultural heritage significance as defined by the *Ontario Regulation 9/06 Criteria for Determining Cultural Heritage Value or Interest*. The methods used to conduct the assessment followed the checklist developed by the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI) titled *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes: A Checklist for the Non-Specialist.*

The assessment identified that two properties located to the east of the Lake Huron WTP property, 71106 and 711176 Bluewater Highway, have the potential to meet the criteria for having cultural heritage value or interest due to the age of buildings located on these properties. It is noted however that neither of these properties will experience direct physical impacts resulting from any of the alternatives being assessed as part of this EA, and therefore no further cultural heritage studies are required.

For more information, refer to the full report titled "Cultural Heritage Screening Report – Lake Huron Primary Water Supply System, Municipal Class Environmental Assessment" completed by Golder Associates.

2.3 Archeological Assessment

A Stage 1 Archeological Assessment was undertaken by Golder Associates to assess the potential for archaeological features within the local study area, as defined by the MHSTCI's *Standards and Guidelines for Consultant Archaeologists* (2011). Based on the review, which consisted of both a desktop review of available resources as well as a site visit to confirm desktop findings, it was determined that some areas within the study area have archeological potential for both pre-contact Indigenous and historical period sites. Specifically, areas undisturbed by previous construction or development activities like the areas of manicured lawn and forested areas within Port Blake Day Park south-west of the Lake Huron WTP were identified as having archeological potential. Development in these areas resulting from any of the alternatives will require a Stage 2 Archaeological Assessment using the test pit survey method to be completed prior to this occurring. For more information, refer to the full report titled “Stage 1 Archeological Assessment” completed by Golder Associates. The MHSTCI confirmed their acceptance of the report on September 13, 2021.

Based on design concepts of the short-listed alternatives, the new reservoir will be constructed partially within undisturbed areas and therefore a Stage 2 Archeological Assessment will be required regardless of which alternative is selected as the preferred solution. The Stage 2 Archeological Assessment using the test pit survey method will be required to be conducted ahead of implementation of the preferred alternative. The Stage 2 Archeological Assessment is planned to be completed in a later stage of the preliminary design phase of the preferred solution.

2.4 UV Sampling Program

Three of the five short-listed alternatives (excluding the Do Nothing option) involve the implementation of UV disinfection as a component of the solution. Historical daily ultra-violet transmittance (UVT) data from the plant was analyzed from January 2020 to June 2021 to support the development and evaluation of the UV disinfection alternatives. Based on the data, 95% of the time the UVT is above 94.8% and 94.6% in the north and south settled water conduits, respectively.

In addition to the historical UVT data, a short-term water quality sampling program was conducted in the fall of 2021 at the Lake Huron WTP to confirm and refine the UV design concepts. Grab samples were collected from September 13, 2021 to October 5, 2021, to measure UVT and several other water quality parameters which have impacts on the design and performance of UV reactors. Refer to the full sampling plan (dated June 4, 2021) for more information. Samples were collected from two stages of the treatment process at the plant:

- Post Clarifiers: Grab samples were collected from both the north and south settled water conduits, to support the UV design of Alternative 4.1.
- Post Filtration: Grab samples were collected from the filtered water taps of both the north and south train filter combined effluents, to support the UV design of Alternatives 4.2 and 4.3. Specifically, a composite sample for the north train filters and a composite sample for the south train filters were collected.

Table 2-1 summarizes the key results from the sampling program, including UVT and total suspended solids (TSS) data collected. A total of 10 grab samples were collected for each parameter and at each sampling location.

Table 2-1 Lake Huron WTP UV Sampling Program Results

Parameter	Sampling Location	Average	Range
UVT (%)	North Settled Water Conduit	97.7	94.9 - 98.9
	South Settled Water Conduit	97.6	95.0 - 98.3
	North Filtered Water Analyzer	97.8	95.4 - 98.7
	South Filtered Water Analyzer	98.0	95.2 - 99.4
TSS (mg/L)	North Settled Water Conduit	3.7	2.0 - 10.0
	South Settled Water Conduit	5.8	2.0 – 15.0
	North Filtered Water Analyzer	2.7	2.0 - 4.0
	South Filtered Water Analyzer	2.0	2.0 – 2.0

As shown in Table 2-1, during the short-term sampling period, the settled water samples and the filtered water did not have significant difference in terms of UVT, while the TSS values show apparent difference at the two process stages.

The results were shared with UV vendors to confirm their proposed reactors and UV design. Based on the historical and sampling program data provided, a UVT of 95% was utilized as the basis for the UV reactors design at this stage of the project. Note that the settled water UVT is affected in more extent by the raw water quality than the water downstream of filters. Based on the historical data and the recent sampling data, a UVT value of 95% appears reasonable at the high-level design concept stage. However, further confirmation by a long-term sampling program will be needed in case that the UV installation at settled water conduits is preferred.

2.5 Additional Background

2.5.1 Zoning

The Project Site contains land with designated zonings of Community Facility (CF) and Natural Environment Zone 2 (NE2) per the Municipality of South Huron Zoning By-Law (Municipality of South Huron, 2021), as shown in Figure 2-1. Specifically, short-listed alternatives for the project include proposed modifications to the land designed as CF, as part of the Port Blake Park and existing Lake Huron Water Treatment Plant. No physical modifications are proposed within the NE2 area, as this is along a shoreline protection area of Lake Huron. Permitted uses for CF zones include erecting or altering any building or structure for the purpose of a "utility service building", including structures and building accessory to the permitted uses (Section 31.1 of Bylaw). It is therefore anticipated that rezoning approvals and land use changes will not be required for any of the short-listed alternatives. To inform the various layouts of the proposed new reservoir, key setback requirements and provisions for new buildings and structures within CF zones are summarized in Table 2-2.

Table 2-2. Summary of CF Zoning Provisions (Section 31.3 of South Huron Zoning Bylaw)

Zone Provision	Value
Property frontage (minimum)	20 m
Zone coverage (maximum)	40 %
Front yard (minimum)	25 m from a County Road or Provincial Highway
Rear yard (minimum)	7.5 m
Interior side yard (minimum)	5 m
Exterior side yard (minimum)	20 m from municipal street
Landscaped open space (minimum)	20 %
Building height (maximum)	20 m

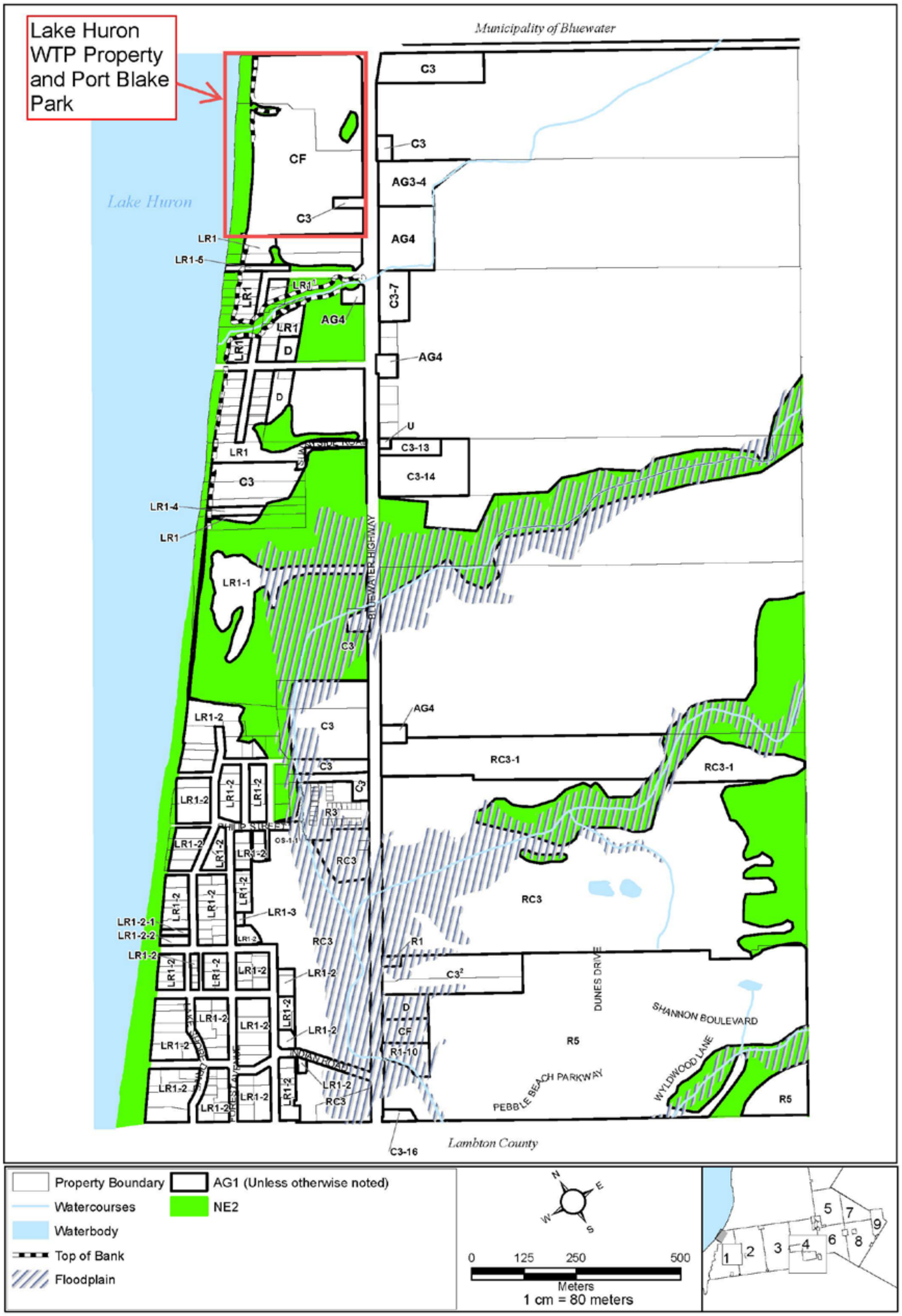

Figure 2-1 Lake Huron WTP and Port Blake Park Zoning Map
(Source: Municipality of South Huron, 2021)

2.5.2 MTO Policies

As Bluewater Highway (Highway 21) and Provincial Highway 83 meet at the northeast corner of the Lake Huron WTP, Highway Corridor Management policies of the Ministry of Transportation of Ontario (MTO) may be applicable, depending on the proposed locations of new works. However, it is anticipated that MTO permits (e.g. Highway Corridor Management Permits) will not be required as the proposed locations for the new reservoir and other assets of each short-listed alternative are not in proximity to the provincial highway nor the highway right-of-way (ROW).

3. Development of Storage Needs

As previously described in TM 1, the general approach for determining the overall total volume needed in the reservoir component for each short-listed alternative was to determine what volume is required for the following three components:

- Volume for buffering/operational purposes, specifically for implementation of the Energy Management Strategy (EMS)
- Volume for water demand-based storage to supply LHPWSS customers in the event of an emergency when plant production is shutdown
- Volume for disinfection purposes in order to meet the project’s two disinfection objectives (providing adequate disinfection under cold water conditions and reducing reliance on the transmission pipeline and pre-treatment for achieving CT)

3.1 Water Demand-Based Storage

As part of the 2020 LHPWSS Master Plan Update, a high-level storage capacity assessment was completed to quantify water storage deficiencies for the LHPWSS regional system. The LHPWSS’s existing storage facilities include the Arva Terminal Reservoir (109.2 ML), the McGillivray Reservoir (18.2 ML, which is used for boosting water from the Lake Huron WTP to the Arva terminal reservoir during high demand periods), and the Exeter-Hensall Reservoir (8.0 ML). The Master Plan Update identified that in the event of a plant shutdown, the LHPWSS would not be able to supply water to customers that are partially or fully serviced from points in the primary transmission system upstream of existing LHPWSS storage facilities. Consequently, the Master Plan Update recommended adding storage at the Lake Huron WTP, the volume for which was estimated based on available information and conservative assumptions.

A more detailed storage analysis was completed as part of this EA to refine the storage volume required to meet these regional water supply needs. This assessment was informed by data obtained from the LHPWSS transmission system hydraulic model (which was not available for the Master Plan Update) and from questionnaires completed by four member municipalities (Municipality of Bluewater, Lambton Shores, North Middlesex, and South Huron) that are partially or fully serviced from points in the primary transmission line upstream of existing LHPWSS storage facilities. The remainder of the LHPWSS member municipalities are serviced from a point in the transmission system that is downstream of other LHPWSS reservoirs and therefore were not included in the assessment.

Typically, municipalities determine their storage needs by computing the sum of the volume required for fire flow storage, equalization storage, and emergency storage per Section 8.4.2 of the *MECP Design Guidelines for Drinking Water Systems*. Fire flow storage is computed on a population basis, equalization storage is calculated as 25% of the maximum day demand (MDD), and emergency storage is calculated as 25% of the sum of the combined volume for fire flow and equalization, as shown by Equation 1 (MECP, 2008).

$$Municipal\ Storage = A + B + C \tag{1}$$

A = Fire Flow (based on MECP recommendations for equivalent population size, Table 8-1 from the design guidelines)

B = 25 percent of MDD

C = 25 percent of (A + B)

These municipal storage needs were not considered in the sizing of the new Lake Huron WTP regional storage facility, as it was assumed that all member municipalities maintain and supply their own respective fire flow, equalization, and emergency storage. However, a high-level verification exercise was completed to confirm that the existing (and future confirmed) municipal storage available appears to be sufficient to meet the needs of the member municipalities, based on documented information in annual drinking water reports and through the questionnaires distributed.

Sizing of the new Lake Huron WTP reservoir was based solely on regional water supply needs, consisting of equalization (to provide operational flexibility with respect to water production) and emergency storage (in the event of a plant shutdown). For systems such as the LHPWSS that do not supply volumes and flows for fire protection, Section 8.4.3 of the MECP guidelines outline that the volume of regional storage should be 25% of the maximum day demand (MDD) plus 40% of the average day demand (ADD), as shown by Equation 2 (MECP, 2008).

$$Regional\ Storage = A + B \tag{2}$$

A = 25 percent of MDD

B = 40 percent of ADD

Equation 2 was used to calculate the storage volume needed for the new Lake Huron WTP reservoir based on the Master Plan Update's medium-growth 2038 projected water demands for individual member municipalities. A factor was applied to account for the percentage of the demand for each municipality that is serviced from points upstream of existing LHPWSS regional storage facility (as visually demonstrated by the demand nodes circled in red in Figure 3-1), such that sizing of the new Lake Huron WTP reservoir is based on addressing the deficiency in regional storage. This factor was determined using the LHPWSS Transmission System Model and confirmed via the questionnaires, which can be referred to in Attachment A.

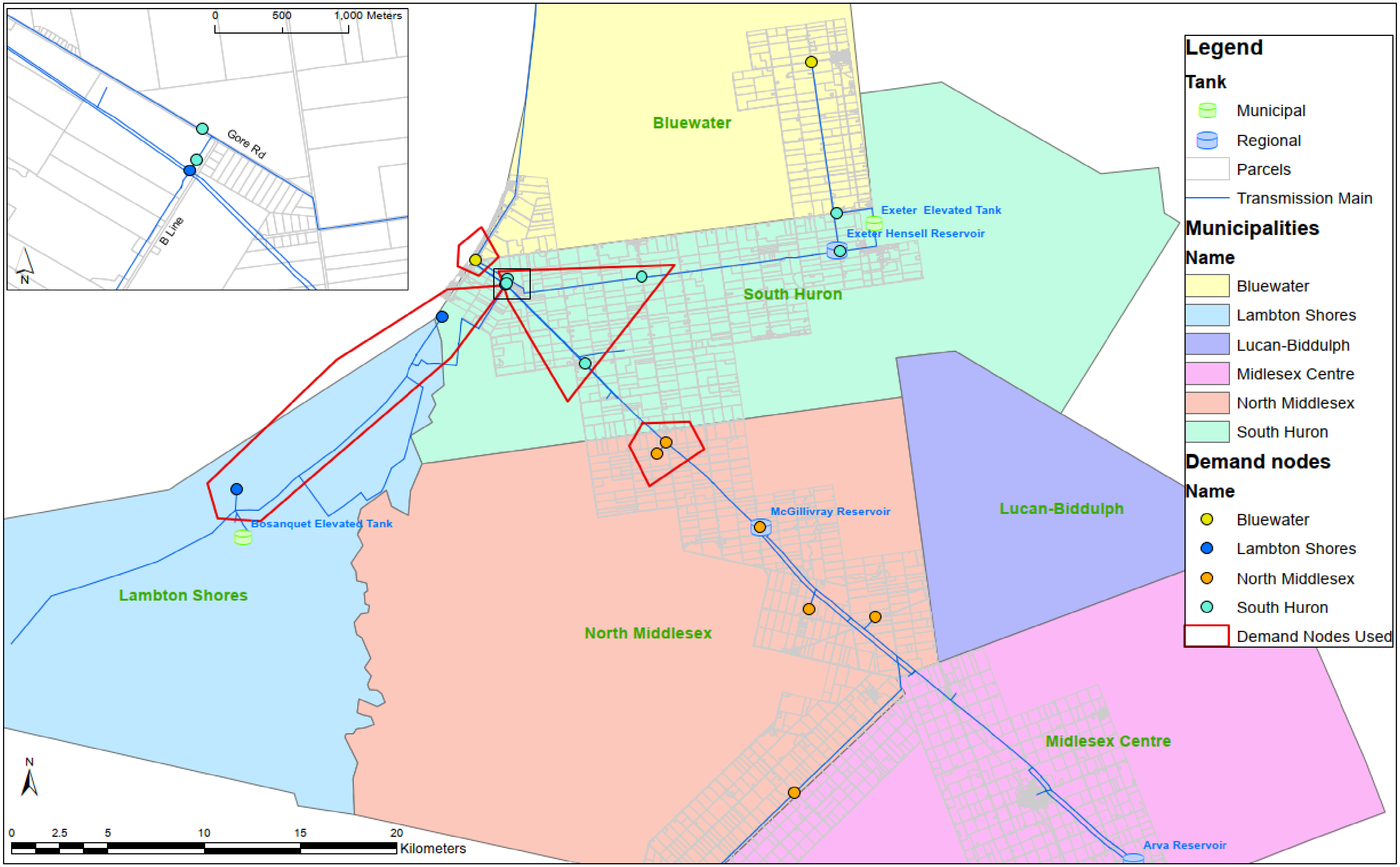

Figure 3-1 LHPWSS Transmission Model Demand Nodes Used in Lake Huron WTP Storage Calculation

Table 3-1 presents the computed regional storage needs for the new Lake Huron WTP reservoir. Based on the assessment, the volume component of the reservoir for regional supply needs is 6.9 ML (rounded up to 7 ML for the purposes of this report).

Table 3-1 Lake Huron WTP Regional Storage Needs

Municipality	2038 Projected Water Demands Average Day Demand (ML/d)	2038 Project Water Demands Maximum Day Demand (ML/d)	% of Demand Upstream of Existing Regional Storage Facilities	Lake Huron WTP Regional Storage Needs (40% of factored ADD + 25% of factored MDD)
Bluewater	3.42	5.99	79%	2.27
South Huron	2.99	5.23	77%	1.93
Lambton Shores	2.53	4.43	100%[1]	2.12
North Middlesex	1.87	3.27	36%	0.57
Total				**7 ML [2]**

Notes:

[1] Specifically the East Lambton Shores Distribution System (as the West Lambton Shores Distribution System is supplied by the Lambton Area Water Supply System (LAWSS)).

[2] Rounded up to the nearest integer for the purposes of this report.

3.2 CT-Based Storage

A review of the microbial sampling interim results from the Quantitative Microbial Risk Assessment (QMRA) conducted for the Lake Huron WTP was completed as part of TM 1, in order to evaluate whether changes were anticipated to the current disinfection requirements. The current disinfection requirements for the Lake Huron WTP include 2 log reduction for cryptosporidium, 3 log reduction for *Giardia*, and 4 log reduction for viruses. The review was conducted based on the Bin Classification outlined within the Long Term 2 Enhanced Surface Water Treatment Rule by the US Environmental Protection Agency (US EPA). Based on the sample results collected from June 2019 to February 2021, it was concluded that no changes in the disinfection requirements are anticipated. Refer to TM 1 for more details.

A review of the final results once the QMRA was completed in July 2021, including samples from February 2021 to July 2021, show that updated cryptosporidium and *Giardia* averages of 0.005 crypto oocysts/L and 0.004 *Giardia* oocysts/L respectively, are still within the Bin 1 disinfection category. Bin 1 for filtered systems is classified as having an average cryptosporidium sample concentration of <0.075 oocyst/L (US EPA, 2006). Therefore, no changes in the disinfection requirements are needed. Table 3-2 presents the finalized summary of QMRA results, including the samples obtained since February 2021.

Table 3-2. Final QMRA Results

Parameter	Cryptosporidium	*Giardia*
No. of Samples[1]	20	20
No. of Non-Detect Samples	18	17
Average	0.005 crypto/L	0.004 *Giardia*/L
Maximum	0.083 crypto/L	0.064 *Giardia*/L

Notes:

[1] Samples collected from June 2019 to July 2021. It should be noted that no samples were collected from March to July of 2020 as well as April and May of 2021 due to lab closures during the COVID-19 pandemic.

In order to determine if and to what extent the new storage reservoir needs to include a volume component for disinfection purposes for each of the short-listed alternatives, the plant's CT calculator was utilized to update the previously computed disinfection credits presented in TM 1 and the results were compared to the required credits (i.e. 0.5 removal credits for *Giardia*, and 2 removal credits for viruses) throughout the primary disinfection process for each short-listed alternative.

Table 3-3 presents the estimated volume required for disinfection purposes in the new reservoir for each of the short-listed alternatives, computed using the CT calculator and based on the following key conservative assumptions:

- Cold water or "winter" conditions were assumed.
- The raw water intake pipe and the primary pipeline to B-Line Road are not included as contributing to overall primary disinfection credits achieved. It should be noted that the raw water within the intake pipe is being continuously chlorinated (for zebra mussel control) and therefore could be included, however it was excluded from volume calculations with a purpose of reducing reliance on both the raw water intake pipe and the primary pipeline to B-Line Road for primary disinfection. All other individual treatment processes throughout the plant are assumed to be contributing to the overall disinfection credits achieved.
- It was also assumed that the existing backwash supply and water service pumps were running at full capacity.
- There would be no restrictions from the treatment plant nor transmission mains in achieving the full plant production capacity of 340 ML/d.

Table 3-3. Estimated Disinfection Based Storage Volume

Alternative Number	Alternative Description	Estimated Minimum Volume for Disinfection in Reservoir
1	Do Nothing	-
2	Modify Flow Through Existing Clear Wells, and New Reservoir for Additional Storage Needs	3.7 ML
3	New Large Reservoir to Meet Disinfection, Buffering, and Storage Needs	5.3 ML
4.1	UV Disinfection at Settled Water Conduits, and New Reservoir for Additional Storage Needs	N/A
4.2	UV Disinfection at Each Filter Effluent, and New Reservoir for Additional Storage Needs	N/A
4.3	UV Disinfection at New Reservoir, and New Reservoir for Additional Storage Needs	N/A

Notes:

ML = Megaliters

" – " = Not applicable as no physical changes to the existing plant are being made under the Do Nothing alternative.

N/A = Not applicable. These alternatives do not require a component of the new reservoir to be sized for disinfection purposes as the implementation of UV disinfection allows the achievement of disinfection requirements under the modelled conditions.

Refer to Attachment B for the detailed CT calculations completed for each of the short-listed alternatives.

3.3 Buffering/Operational Based Storage

A hydraulic model of the Lake Huron WTP was developed using Jacobs' Replica™ modelling software to dynamically simulate the existing conditions and determine the volume needed for buffering purposes in order to allow for high lift pump (HLP) operations under defined EMS scenarios. The hydraulic model was also used to simulate the short-listed alternatives to determine their impacts on plant hydraulics.

Two operating scenarios were defined through a series of workshops with the LHPWSS and the plant's operation authority, Ontario Clean Water Agency (OCWA):

1) Scenario 1 – Average Flow Scenario: This scenario simulates an average high lift pumping condition, ramping up the flow at the Lake Huron WTP from 110 to 160 ML/d, with the plant pumping directly to the Arva Reservoir and bypassing the McGillivray Reservoir (i.e. without McGillivray pumps running).

2) Scenario 2 – High Flow Scenario: This scenario involves ramping up the flow at the Lake Huron WTP from 110 ML/d (pumping directly to the Arva Reservoir), to 282 ML/d (pumping to Arva Reservoir through booster pumping at McGillivray Reservoir).

The two scenarios were simulated in both the baseline model (to represent existing conditions) and the short-listed alternative models, providing the following key conclusions:

- No additional buffering/operational volume is needed at the plant under any of the modelled scenarios with the appropriate operation of ramping up the low-lift pumps at a minimum of approximately 35 minutes in advance of starting additional high-lift pumps. This operational change would be required in all of the alternatives, including the Do Nothing alternative.
- A critical water level of 5.4 m was identified for the HLP suction conduit to meet NPSHr. For reference, the maximum water depth in the HLP suction conduit is 10.36 m based on record drawings. This critical water level was used in the conceptual design to determine the required reservoir depth and footprint in different alternatives.
- It is anticipated that all short-listed alternatives can be accommodated within the existing plant HGL, with manageable headlosses through the treatment train ranging from 4.6 m for the Do Nothing Alternative to 6.5 m for Alternative 2 at the high flow rate (282 ML/d).

For more information refer to the TM by Jacobs, titled "Replica™ Modelling Technical Memorandum". The Replica™ hydraulic modelling may be updated during preliminary design to optimize the control strategy of the high-lift pumps.

3.4 Reservoir Routing Feasibility Assessment

Regardless of the selected preferred alternative, a method for conveying treated water from the outlets of the existing clear wells to the new reservoir and back to the HLP suction conduit is required as part of the design. Four options for connecting the existing plant to the new reservoir were therefore identified and preliminarily assessed for feasibility. The four options identified include:

1) Separating the existing HLP suction conduit into two separate levels (an upper and lower level) by installing a concrete slab. The upper portion of the suction conduit would convey water from the clear wells to a new pipe which connects to the reservoir, and the lower level would receive water from the reservoir (via piping) for HLPs.
2) Installing a pipe within the existing HLP suction conduit to convey the water from the north clear well to the southern portion of the suction conduit (where it would then be conveyed via piping to the reservoir). A separate pipe would then convey water back to the suction conduit, similar to Option 1.
3) Repurposing an existing raw water cross conduit channel which is below the existing clear wells (as shown on record drawings) to convey water from the north clear well to the southern portion of the HLP suction conduit (where it would then be conveyed via piping to the reservoir). A separate pipe would then convey water back to the suction conduit, similar to Options 1 and 2.

4) Installing a pipe on the west side of the existing clear wells in the lower level of the Pre-treatment Building to convey water from the clear wells to the new reservoir. A separate pipe would then convey the water back from the new reservoir into the HLP suction conduit, similar to the other options.

The feasibility review drew the following preliminary conclusions:

- It was identified that Option 1 would have a higher construction complexity and longer downtime (compared to Option 2) and therefore was screened out.
- Through consultation with LHPWSS and OCWA, it was determined that the existing raw water cross conduit channel is being actively used to balance the clarified water between the north and south filter banks, therefore Option 3 is not a viable option.
- Option 4 is also not a viable option due to the insufficient available space to accommodate a new pipe of the size required for conveying the water from the clear wells to the new reservoir.
- In conclusion, Option 2 was determined as the preferred method for conveying the water from the clear wells to the new reservoir and back to the HLP suction conduit. Refer to the drawings in Attachment C which show the proposed piping configuration within the existing clear well to convey the water to the new reservoir. It is noted that the design will be refined during preliminary design and may be modified as needed.

A constructability review meeting was conducted with LHPWSS and OCWA to review the above options, and discuss feasibility, operational, and design considerations of Option 2. Option 2 was confirmed to be the preferred method for the connection, subject to a more detailed risk and constructability review in the further design phase. Therefore, for the purpose of this EA, Option 2 is included in the design concepts of all short-listed alternatives.

3.4.1 Modifications to Clear Well Outlets for New Reservoir Connection

To implement Option 2, the following modifications will be required to the existing clear well outlets:

- Installation of a connection plate and pipe fitting to replace the existing slide gate at the exit of the north clear well cell.
- Modify the flow path through the south clear well cell and the expansion cell via the addition of a solid baffle wall in the expansion cell and by closing the slide gates that are normally open. This is to change the flow direction such that the water exits the south clear wells at the south-east corner of the south expansion cell (as opposed to into the HLP suction conduit at the north-east corner as is done currently).
- Addition of a new below-grade, concrete clear well outlet chamber at the south-east corner of the south clear well expansion cell. The new chamber will collect flows from the north clear well and south clear wells prior to conveying water to the new reservoir via piping.

Refer to the drawings in Attachment C for more information.

It is noted that the modifications to the existing clearwells and suction conduit as a result of the new reservoir connection pose some constructability issues. The following should be considered in the further design stages:

- Confirming the structural integrity of the existing suction conduit, including the wall that separates the north and south sections of the conduit. A condition assessment should be performed. Structural repairs and reinforcement may be needed during the construction dependent on the findings from the condition assessment.
- Opportunities to reduce the number and duration of full plant shutdowns need to be studied in the further design. It has been indicated that a maximum plant shutdown duration is 24 hours. The use of divers and thimbles may be considered when installing the new pipe within the suction conduit to reduce the shutdown time.
- Maintaining the required disinfection contact time within the existing clearwells should be further studied and implemented during construction.

Refer to minutes from the meeting held on March 23, 2022 for more information.

3.4.2 Other Modifications

As a result of the proposed alignment of the 1,800 mm diameter pipes to and from the new reservoir for each of the alternatives, the following changes will be required:

- Removal and relocation of two large (40,000 and 45,000 L) underground fuel tanks which are just south of the expansion clear well cell. It is proposed that these tanks are relocated approximately 35 metres south-west of their current location, west of the existing Radio Building.
- Relocation of a gas line from the existing Standby Generator Building to a 5,000 L underground fuel tank to the south of the HLP Station.
- Relocation of minor stormwater drainage piping and culverts below the existing access road to the Flocculation Building and Standby Generator Building.

It is noted that the 5,000 L underground fuel tank located to the south of the HLP Station is not required to be relocated due to the proposed alignment of the reservoir piping, however LHPWSS has indicated a preference to relocate this tank for other reasons. This modification, as well as refinement of the reservoir piping alignment, may be completed during preliminary design development of the preferred alternative solution.

In addition to the modifications above, for all of the short-listed alternatives (excluding “Do Nothing”), a new reservoir drain/overflow pipe will be needed to allow for planned maintenance activities as well as for in the case of an emergency overflow event. The drainpipe from the new reservoir will connect to the existing plant effluent drain via a new reservoir drainage and dechlorination chamber to be installed near or at the plant outlet maintenance hole. The existing plant storage shed will need to be relocated to accommodate the new dechlorination chamber.

3.5 Reservoir Siting Considerations

Various considerations were made in the selection of the proposed location of the new reservoir It is noted that the same location is proposed for the reservoir for each of the short-listed alternatives, with only the reservoir dimensions varying across the alternatives. The following are some of the key considerations:

- Proximity to the existing plant (for hydraulic purposes)
- Limiting the permanent area lost within Port Blake Park
- Limiting the areas of disruption within the park during construction
- Potential areas allotted for future plant expansion (i.e. area to the east of the Residue Management Facility (RMF) and to the south of the main Sedimentation/Flocculation/Filter Building)
- The planned relocation of the Port Blake Park access road from its current location just south of the electrical substation to the south property line of the park. This is anticipated to be completed in summer of 2022.

The proposed location of the new reservoir is to the south of the RMF of the existing WTP, within the north edge of Port Blake Park. Refer to Section 4 for details and figures demonstrating the proposed location. The exact reservoir layout and siting will be refined during the preliminary design of the preferred alternative solution.

4. Development of Short-Listed Alternatives

Based on a preliminary screening exercise of the long list of alternatives completed in collaboration with LHPWSS, five alternatives (plus the Do Nothing Alternative) were carried forward to the short list of alternatives. The following section establishes the design concepts and the technical considerations for each of the short-listed alternatives. Conceptual level cost estimates for each short-listed alternatives are presented in Section 5. The design concepts were developed to establish a basis for the comparative evaluation for the purpose of the Class EA study. The design concept for the preferred alternative will be confirmed through Public and Stakeholder consultation and documented in the Project File Report of the Class EA Study. The design concept for the preferred alternative will then be further developed during Phase 5 of the EA process (Implementation) via Preliminary Design.

4.1 Alternative 1: Do Nothing

Do Nothing is the baseline alternative considered as part of the Class EA process in which no physical infrastructure changes are made. Disinfection and storage needs would continue to be limited by the existing treatment plant arrangement and processes. However, in order to meet the Project Objectives, operational changes to the existing plant operation would need to be made and are assumed for the purposes of this EA:

- As discussed in Section 3.3, changes in low-lift pumping operation (i.e. early ramp up) are needed ahead of increases in high-lift pumping.

- The inclusion of the raw water intake pipe and primary pipeline to B-Line Road for primary disinfection contact time will be discontinued.
- An increase in chlorine residual levels applied at the clear wells at the plant will be required at certain times of the year (winter) in order to meet disinfection under all conditions.

4.2 Alternative 2: Clear Well Upgrades, and New Reservoir for Additional Storage Needs

Alternative 2 involves modifying the flow through the existing clear wells to improve disinfection contact time, through the addition of baffle walls and overflow effluent weirs in the existing clear wells. Alternative 2 also consists of a new reservoir sized to meet additional storage requirements for the plant, including water demand-based needs (equalization and emergency supply).

Clear Well Upgrades Design Concept

In order to improve primary disinfection contact time (t10) within the existing clear wells, it is recommended that several new baffle features are installed within the north, south, and south expansion clear wells (three clear wells total). For the purpose of this EA, a solid baffle wall is proposed to be installed in the south expansion cell to promote local plug flow conditions, and a perforated baffle wall at the inlet of each clear well and at the mid-way flow point through each clear well are proposed to reduce hydraulic dead zones. In addition to the baffle walls, an overflow weir at the outlets of the north and south expansion clear wells is proposed to be installed such that a certain water level within the clear wells is always maintained. To be conservative, a weir depth of 2.0 m was assumed for Alternative 2. However, the set weir levels will need to be refined if the alternative is selected as the preferred solution. The existing rubber baffle curtain within the south expansion clear well will need to be replaced with a solid baffle wall, in order to be able to install the overflow weir at the south-east corner of the expansion cell. With these improvements, it is estimated that the baffling factor (BF) within the existing clear wells would increase from 0.4 to 0.7 based on the Disinfection Profiling and Benchmarking Guidance Manual (US EPA, 1999). Note that the actual BF values may be further determined through tracer tests or computational fluid dynamic (CFD) studies.

Refer to Figure 4-1 for a representation of the retrofitted clear wells with the proposed baffle wall and overflow weir locations.

With the incorporation of the improved BF value, CT calculations indicate that the *Giardia* inactivation credits achieved by the existing plant treatment processes at full capacity of 340 ML/d still do not fully meet the disinfection requirements. A deficit of approximately 0.16-log *Giardia* inactivation credits remains, excluding the disinfection credits contributed from the raw water intake pipe and primary pipeline to B-Line Road. A disinfection volume component of the new reservoir under this alternative is therefore included to remove this deficit.

Reservoir Design Concept

A below-grade reservoir is proposed to meet the additional storage needs of the Lake Huron WTP. For Alternative 2, a reservoir with a total volume of 10.7 ML is proposed, which includes the

3.7 ML required for disinfection (refer to Section 3.2) and the 7 ML required for water demand-based storage needs (refer to Section 3.1). The location of the proposed reservoir is south of the RMF of the existing WTP within Port Blake Park, as shown in Figure 4-1.

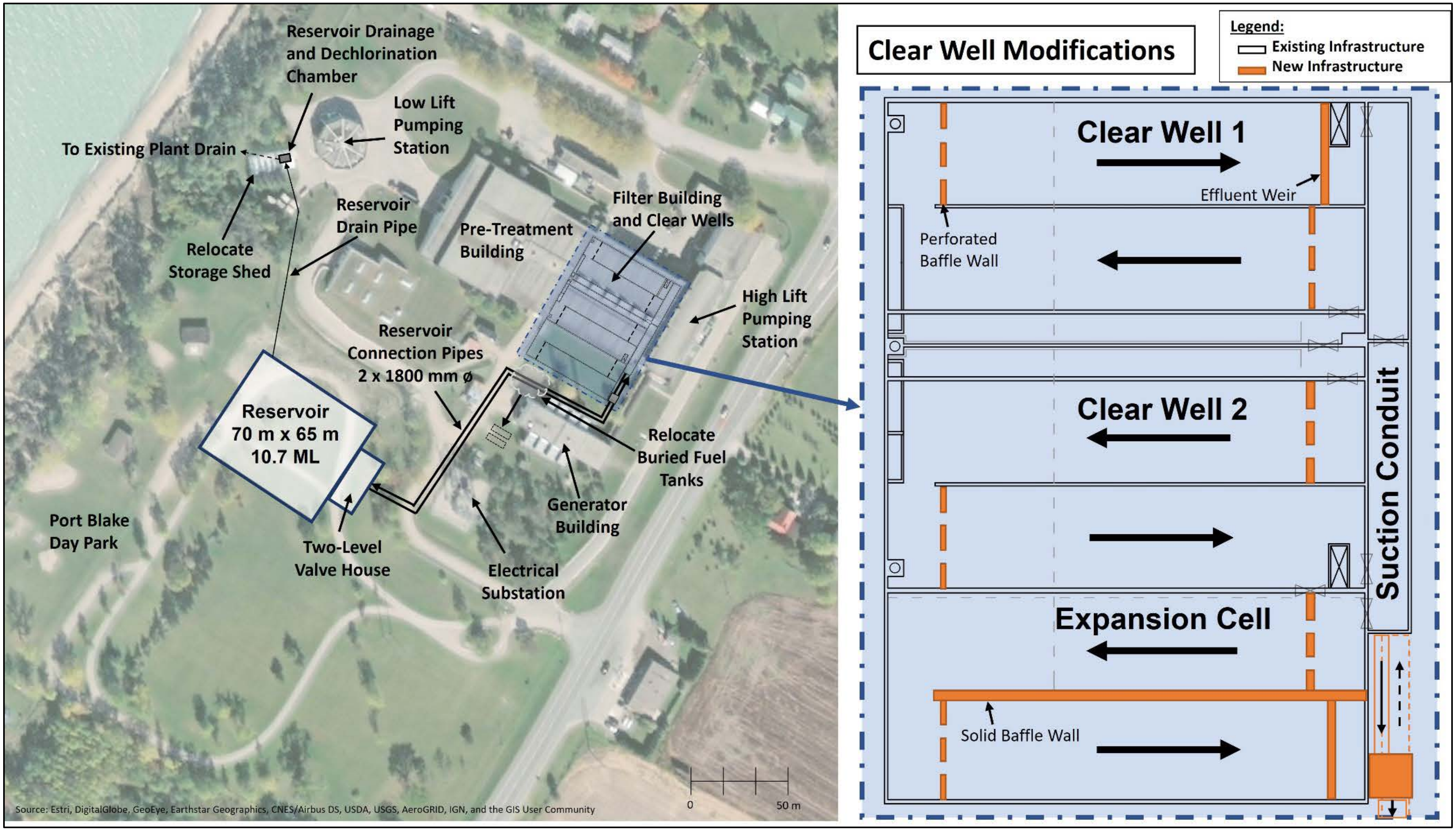

Figure 4-1 Alternative 2 Graphic

The reservoir design concept includes:

- Below-grade, concrete, two rectangular cell reservoir.
- A reservoir footprint of approximately 4,500 m^2.
- The reservoir will have a two-level, below-grade valve house adjacent on the east side which will house the influent piping from the existing clear wells and effluent piping back to the HLP suction conduit.
- A drainpipe from the reservoir will connect to the existing plant effluent drain, in the event of an emergency overflow event or scheduled reservoir maintenance. The drainpipe will connect from the new reservoir to a new reservoir drainage and dechlorination chamber to be located near the plant outlet maintenance hole.

The design concept details of the reservoir for Alternative 2 are summarized in Table 4-1. Refer to Attachment D for a more detailed table of the critical elevations for the reservoir and associated piping. A conceptual diagram of the proposed inner configuration of the new reservoir and the adjacent valve-house is also included in Attachment D.

Table 4-1 Alternative 2 – Design Criteria of Reservoir

Parameter	**Unit**	**Value**
Required Minimum Total Volume	ML	10.6
Proposed Total Volume	ML	10.7
Number of Cells	-	2
Reservoir Total Length	m	70
Reservoir Total Width	m	65
Total Footprint	m^2	4,550
Reservoir Height (including Freeboard)	m	3.5
Reservoir Depth (Below Ground Level) [1]	m	4.5
Reservoir Floor Elevation	m	182.50
Low Water Level	m	183.34
Top Water Level	m	184.86
Reservoir Top Slab Elevation	m	186.00

Notes:

[1] Assuming an approximate average ground elevation of 187 m obtained via Google Earth®. Existing ground elevation to be confirmed during pre-design via a topographic survey.

4.3 Alternative 3: New Reservoir

Alternative 3 consists of constructing a new reservoir to meet all requirements: remaining disinfection needs (i.e. primary disinfection deficit through the existing treatment process), and water demand-based needs (equalization and emergency supply). This alternative therefore comprises of the largest reservoir volume of all the alternatives. CT calculations of the baseline condition indicate that the *Giardia* inactivation credits achieved by the existing plant treatment processes at full capacity of 340 ML/d does not meet disinfection requirements. A deficit of approximately 0.23-log inactivation credits remains, excluding the credits from the raw water intake pipe and primary pipeline to B-Line Road. The disinfection volume component of the new reservoir in this alternative is therefore sized to supplement this deficit. No major upgrades or modifications to the existing primary disinfection treatment processes at the plant will be needed, other than those required to route the water to and from the new reservoir. Refer to Section 3.4 for details pertaining to the conveyance of the water from the existing clear wells to the new reservoir and back to the existing HLP suction conduit.

For Alternative 3, a reservoir with a total volume of 13.0 ML is proposed, which includes the 5.3 ML remaining volume required for disinfection (refer to Section 3.2) and the 7 ML volume required for water demand-based storage needs (refer to Section 3.1). The location for the proposed reservoir is south of the WTP (the same as for Alternative 2), as shown in Figure 4-2.

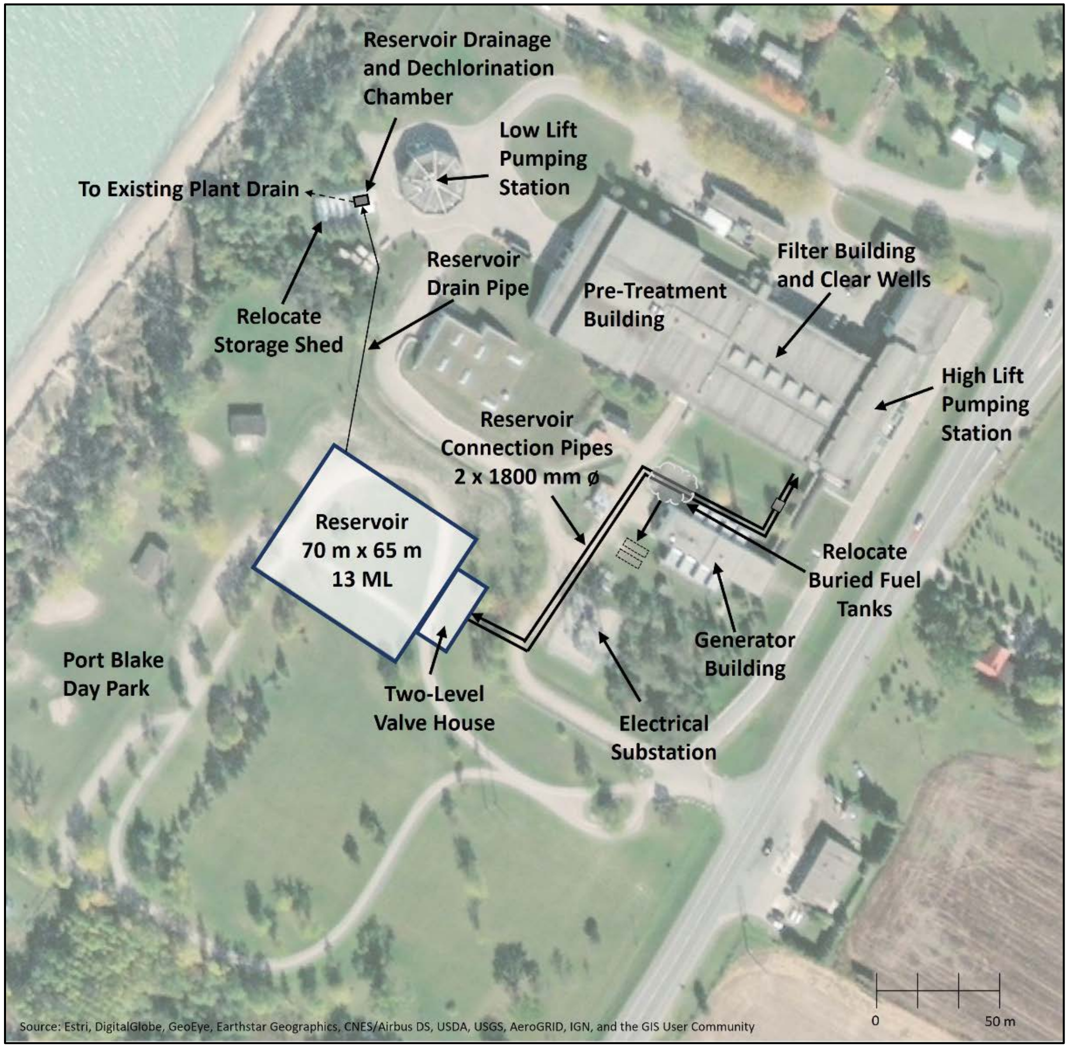

Figure 4-2 Alternative 3 Graphic

As with Alternative 2, the proposed reservoir concept for Alternative 3 includes:

- A below-grade, concrete, two rectangular cell reservoir.
- A reservoir footprint of approximately 4,500 m^2.
- The reservoir will have a two-level, below-grade valve house adjacent on the east side which will house the influent piping from the existing clear wells and effluent piping back to the HLP suction conduit.
- A drainpipe from the reservoir will connect to the existing plant effluent drain, in the event of an emergency overflow event or scheduled reservoir maintenance. The drainpipe will connect from the new reservoir to a new reservoir drainage and dechlorination chamber to be located near the plant outlet maintenance hole.

Table 4-2 summarizes the design concept details of the reservoir for Alternative 3. Refer to Attachment D for a more detailed table of the critical elevations for the reservoir and associated piping. A conceptual diagram of the proposed inner configuration of the new reservoir and the adjacent valve-house is also included in Attachment D.

Table 4-2 Alternative 3 – Design Criteria of Reservoir

Parameter	Unit	Value
Required Minimum Total Volume	ML	12.2
Proposed Total Volume	ML	13.0
Number of Cells	-	2
Reservoir Total Length	m	70
Reservoir Total Width	m	65
Total Footprint	m^2	4,550
Reservoir Height (including Freeboard)	m	4.0
Reservoir Depth (Below Ground Level) [1]	m	5.0
Reservoir Floor Elevation	m	182.00
Low Water Level	m	183.34
Top Water Level	m	184.86
Reservoir Top Slab Elevation	m	186.00

Notes:

[1] Assuming an approximate average ground elevation of 187 m obtained via Google Earth®. Existing ground elevation to be confirmed during pre-design via a topographic survey.

4.4 Alternative 4.1: UV Disinfection at Settled Water Conduits, and New Reservoir for Additional Storage Needs

Alternative 4.1 involves the implementation of ultra-violet (UV) disinfection between the clarification and filtration processes at the plant. In conjunction with the existing filtration process, this new UV disinfection process allows for *Giardia* disinfection requirements to be met. Virus inactivation requirements are met in the existing clear wells. In addition to the new UV reactors, Alternative 4.1 also consists of a new reservoir sized to meet the water demand-based needs (equalization and emergency supply).

UV Disinfection Design Concept

The design concept includes constructing two new UV facilities attached to the existing pre-treatment building, one for the north treatment train and one for the south treatment train. The new UV facilities will be retrofitted within and surrounding portions of the existing settled water conduits. For each treatment train, a pipe would be installed within the settled water conduit to convey the water to the UV reactors. The UV reactor effluent will then be directed back into the end of the settled water conduits (on the eastern end), prior to it flowing to the existing filter influent channels. The new piping and the UV reactors will be located on the lower level of the new UV facilities, with the electrical and control equipment associated with the UV reactors on the upper level of the facility. For the north treatment train, the existing electrical conduit to the chlorine buildings would need to be relocated in order to construct the new UV facility. Similarly, to install the new UV facility at the south treatment train a portion of the existing 300 mm diameter PVC clear well overflow pipe to the RMF will need to be relocated.

Considering a full redundancy on each treatment train, four 1,200 mm low-pressure high-output (LPHO) UV reactors (48 lamps per reactor) have been proposed to provide a dosage of 40 mJ/cm^2 for the peak design flow of 340 ML/d based on an UVT of 95%. On this basis, the proposed pipe to convey the water from the settled water conduit to the UV chamber will split into two parallel pipes, each with a UV reactor and associated flow meter. Refer to Figure 4-3 showing a conceptual layout for Alternative 4.1. The two reactor trains in the parallel configuration allows for redundancy for each train, should the duty reactor fail. Table 4-3 summarizes the design criteria for the UV design concept for Alternative 4.1. The equipment information that was used for developing the design concepts is included in Attachment E.

Table 4-3 Alternative 4.1 – UV Design Criteria

Parameter	Unit	Value
Total Design Flow	ML/d	340
Design UVT	%	95
Design Dose	mJ/cm^2	40
Design *Giardia* Log Inactivation	-	N/A
No. of Treatment Trains	-	2

Parameter	Unit	Value
Design Flow per Treatment Train (ML/d)	ML/d	170
No. of Units per Treatment Train	-	1 duty and 1 stand-by
No. of Lamps per UV Reactor	-	48
Type of UV Reactor	-	Low-Pressure, High-Output

Each reactor requires a power distribution center, local control panel, and hydraulic system center; all of which will be located on the upper floor of the new UV facilities. High voltage power to operate the UV systems may be provided from either the existing Motor Control Centre (MCC) within the Carbon Building and/or from the existing MCC in the electrical room of the Flocculation Building.

Reservoir Design Concept

A below-grade reservoir is proposed to meet the additional storage needs of the Lake Huron WTP. For Alternative 4.1, a reservoir with a total volume of 7 ML is proposed, which includes only the 7 ML volume required for water demand-based storage needs (refer to Section 3.1). The location for the proposed reservoir is south of the WTP (the same as for all short-listed alternatives), as shown in Figure 4-3.

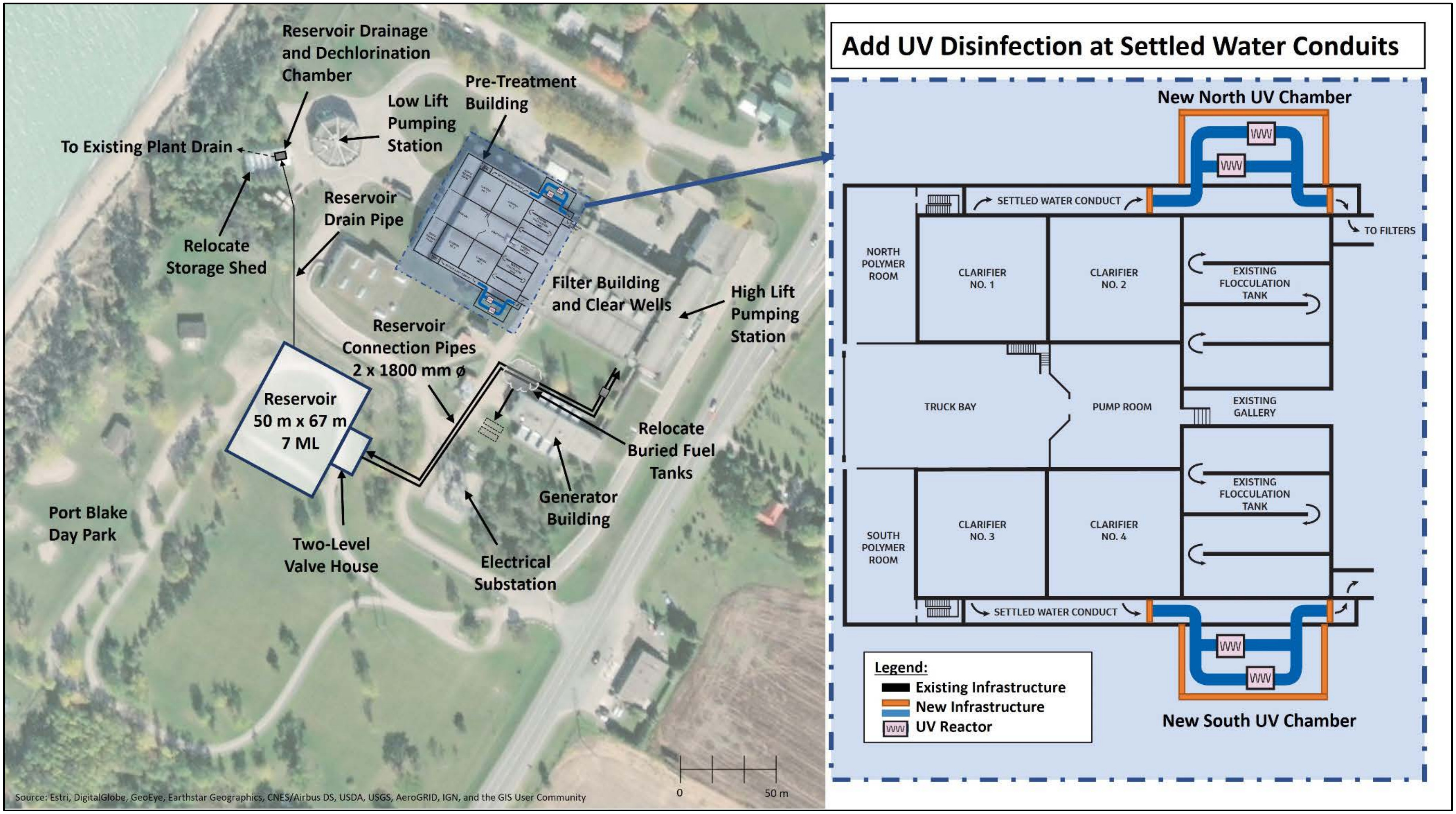

Figure 4-3 Alternative 4.1 Graphic

As for all the short-listed alternatives, the proposed reservoir concept for Alternative 4.1 includes:

- A below-grade, concrete, two rectangular cell reservoir.
- The reservoir will have a two-level, below-grade valve house adjacent on the east side which will house the influent piping from the existing clear wells and effluent piping back to the HLP suction conduit.
- A drainpipe from the reservoir will connect to the existing plant effluent drain, in the event of an emergency overflow event or scheduled reservoir maintenance. The drainpipe will connect from the new reservoir to a new reservoir drainage and dechlorination chamber to be located near the plant outlet maintenance hole.

Table 4-4 summarizes the design details of the reservoir for Alternative 4.1. Refer to Attachment D for a table of the critical elevations for the reservoir and associated piping. A conceptual diagram of the proposed inner configuration of the new reservoir and the adjacent valve-house is also included in Attachment D.

Table 4-4 Alternatives 4.1 and 4.2 – Design Criteria of Reservoir

Parameter	Unit	Value
Required Minimum Total Volume	ML	6.9
Proposed Total Volume	ML	6.9
Number of Cells	-	2
Reservoir Total Length	m	50
Reservoir Total Width	m	67
Total Footprint	m^2	3,350
Reservoir Height (including Freeboard)	m	3.2
Reservoir Depth (Below Ground Level) [1]	m	4.7
Reservoir Floor Elevation	m	182.30
Top Water Level	m	184.70
Reservoir Top Slab Elevation	m	185.50

Notes:

[1] Assuming an approximate average ground elevation of 187 m obtained via Google Earth®. Existing ground elevation to be confirmed during pre-design via a topographic survey.

4.5 Alternative 4.2: UV Disinfection at Each Filter Effluent, and New Reservoir for Additional Storage Needs

Alternative 4.2 involves the implementation of UV disinfection post filtration at the plant. This alternative will meet the 0.5-log *Giardia* inactivation requirements without the disinfection contribution from the raw water intake pipe and primary pipeline to B-Line Road. Virus inactivation requirements are met through chlorination in the existing clear wells. In addition to the new UV reactors, Alternative 4.2 also consists of a new reservoir sized to meet the water demand-based needs (equalization and emergency supply).

UV Disinfection Design Concept

One UV reactor will be installed on the effluent piping of each filter, for a total of 12 UV reactors. Refer to Figure 4-4 showing the conceptual layout for Alternative 4.2. Table 4-5 summarizes the design criteria.

Table 4-5 Alternative 4.2 – UV Design Criteria

Parameter	Unit	Value
Total Design Flow	ML/d	340
Design UVT	%	95
Design Dose	mJ/cm^2	40
Design *Giardia* Log Inactivation	-	N/A
No. of UV Units	-	12 (1 duty per filter)
Design Flow per Reactor (ML/d)	ML/d	28.3
No. of Lamps per Reactor	-	2
Type of UV Reactor	-	Medium Pressure

Locating the UV reactors post filtration would have the advantage of treating the water with minimal water quality variability and increased UVT. However, a significant disadvantage is that there is very limited spacing available within the existing filter piping gallery to retrofit the UV systems.

Only medium pressure (MP) systems would be practical for this alternative as the required length of LPHO reactors would not fit within the existing piping configuration and space constraints. It is noted that even with the use of MP UV reactors, rearrangement of the existing flow meters on the filter effluent pipes may be required and pipe expanders or reducers would be needed in order to accommodate the UV reactors. Based on discussion with some UV equipment vendors, only one of the three UV vendors contacted indicated they have a model that is sized to exactly fit the existing 450 mm (18”) filter effluent pipes. The equipment information from multiple UV equipment vendors is included in Attachment E.

Also, as a result of the limited spacing of the filter piping gallery, the local control panels for the 12 UV reactors will be located at the filter operating gallery level. High voltage power to operate the UV systems may be provided from the existing MCCs within the electrical room of the Flocculation Building or from the High Lift Pumping Station (HLPS) MCCs.

Reservoir Design Concept

A below-grade reservoir of the exact same design as for Alternative 4.1 is proposed to meet the additional storage needs of the Lake Huron WTP for Alternative 4.2, which consists of volume only for the water demand-based storage needs (i.e. 7 ML). Refer to the *Reservoir Design Concept* section of Section 4.4 for details.

Figure 4-4 demonstrates the overall design concept for Alternative 4.2.

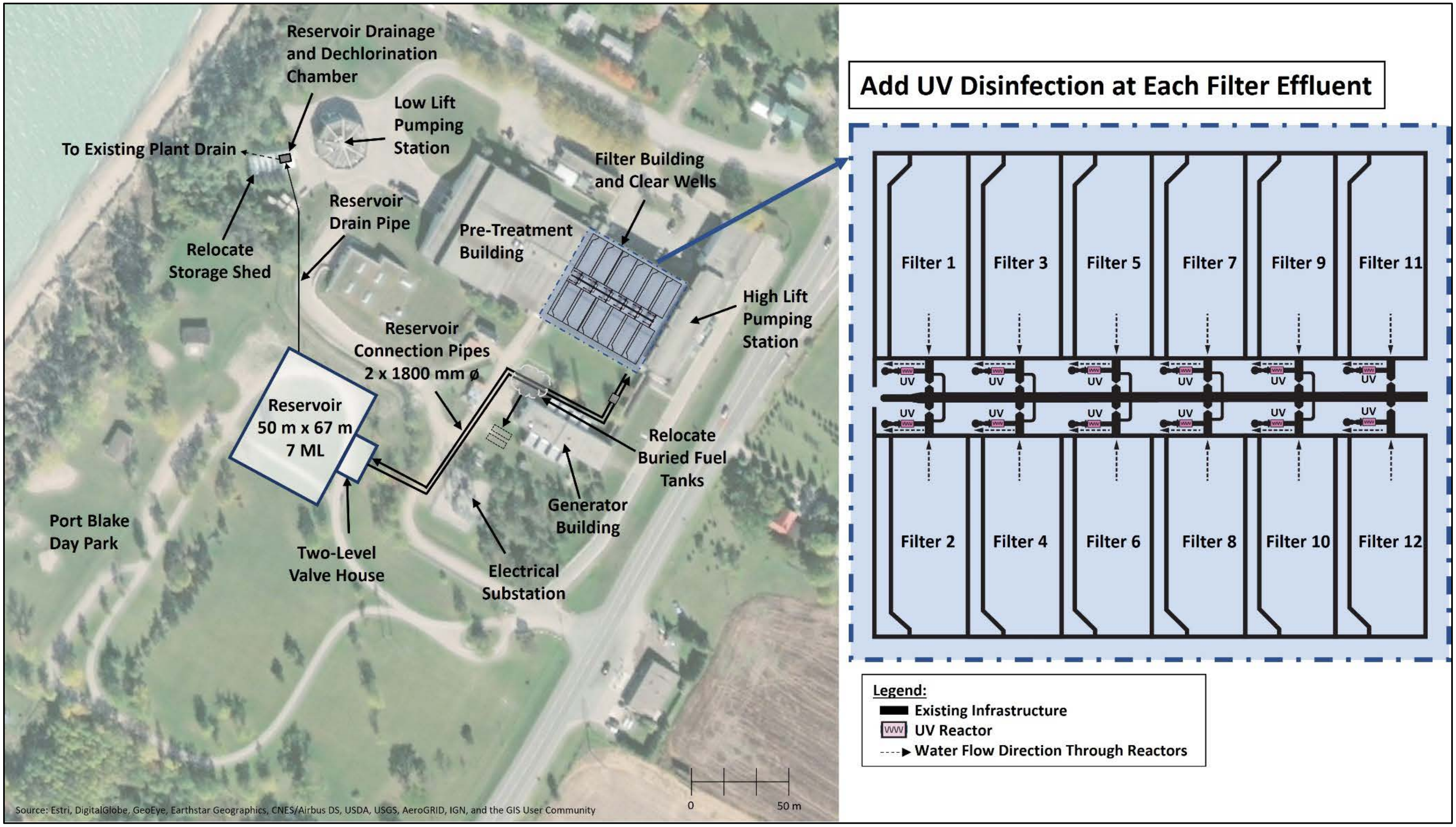

Figure 4-4 Alternative 4.2 Graphic

4.6 Alternative 4.3: UV Disinfection at New Reservoir

Alternative 4.3 involves the implementation of a new reservoir sized to meet the water demand-based needs (equalization and emergency supply), with UV disinfection prior to the water entering the new reservoir. The new UV disinfection process allows for minimum 0.5-log *Giardia* inactivation. Virus inactivation requirements are met by chlorination in the existing clear wells.

UV and Reservoir Design Concept

Similar to Alternatives 4.1 and 4.2, a below-grade reservoir of 7 ML is proposed in order to meet the water demand-based storage needs (refer to Section 3.1). The location for the proposed reservoir is still to south of the WTP (the same location and footprint as for Alternatives 4.1 and 4.2), as shown in Figure 4-5, however it has a slightly larger depth.

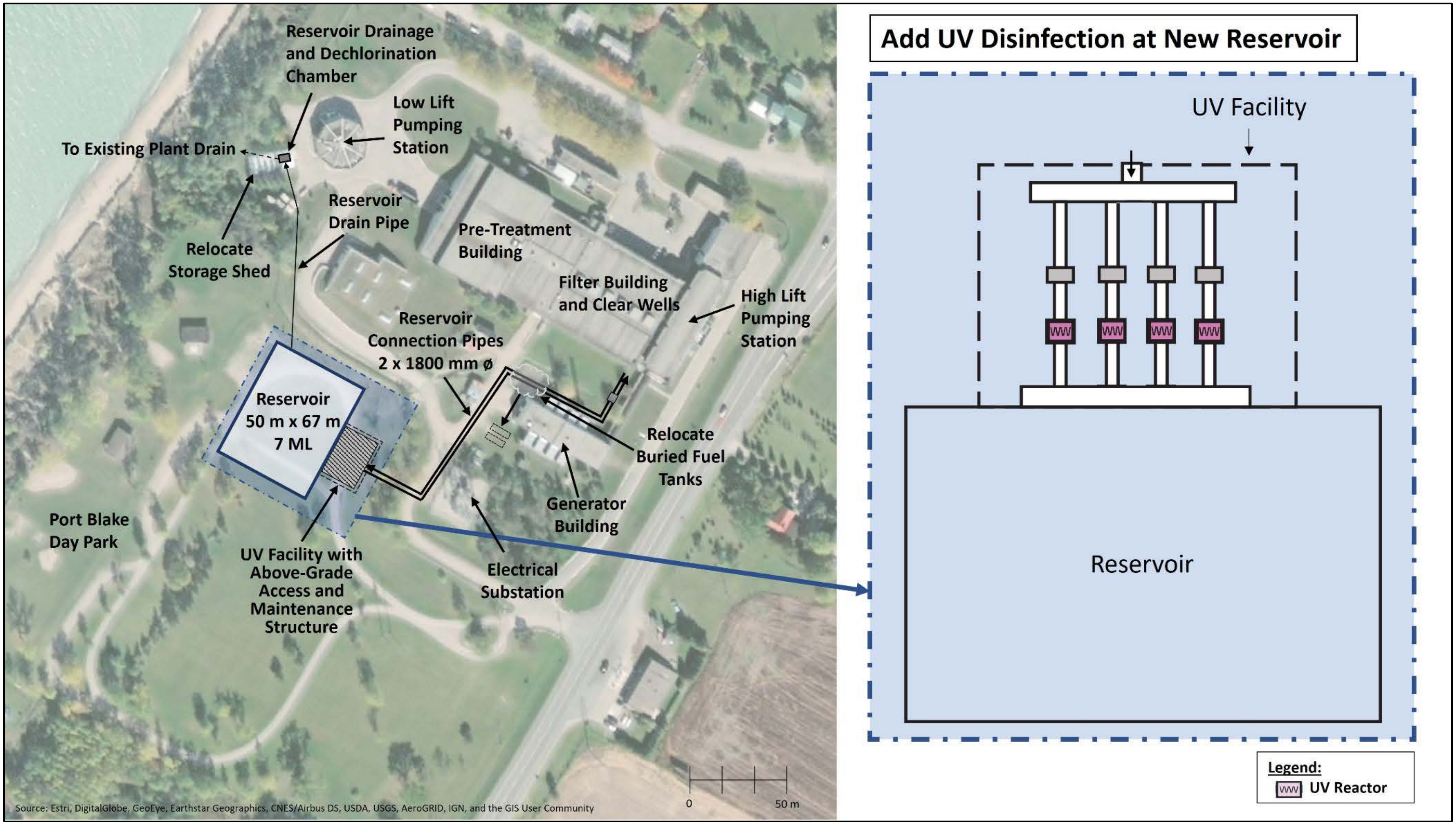

Figure 4-5 Alternative 4.3 Graphic

As for all the short-listed alternatives, the proposed reservoir concept for Alternative 4.3 includes:

- A below-grade, concrete, two rectangular cell reservoir.
- A drainpipe from the reservoir will connect to the existing plant effluent drain, in the event of an emergency overflow event or scheduled reservoir maintenance. The drainpipe will connect from the new reservoir to a new reservoir drainage and dechlorination chamber to be located near the plant outlet maintenance hole.

Refer to Table 4-6 for the summary of the design details of the reservoir for Alternative 4.3. Refer to Attachment D for a more detailed table of the critical elevations for the reservoir and associated piping.

Table 4-6 Alternative 4.3 – Design Criteria of Reservoir

Parameter	Unit	Value
Required Minimum Total Volume	ML	6.9
Proposed Total Volume	ML	6.9
Number of Cells	-	2
Reservoir Total Length	m	50
Reservoir Total Width	m	67
Total Footprint	m^2	3,350
Reservoir Height (including Freeboard)	m	3.5
Reservoir Depth (Below Ground Level) [1]	m	5.0
Reservoir Floor Elevation	m	182.00
Top Water Level	m	184.40
Reservoir Top Slab Elevation	m	185.50

Notes:

[1] Assuming an approximate average ground elevation of 187 m obtained via Google Earth®. Existing ground elevation to be confirmed during pre-design via a topographic survey.

Different from Alternative 4.1 and Alternative 4.2, Alternative 4.3 will have a combined facility to house the UV reactors and the reservoir influent and effluent piping. The new facility will be partially above-grade and partially below-grade, and will consist of the following levels:

- Upper Level (Above-Grade): The upper level will be an above-grade building that acts as an access point and service area to the facility, which houses the UV system power and control panels and a platform overlooking the UV reactor trains at the middle level of the facility.
- Middle Level (Below-Grade): The middle level will be the pipe gallery and will house the reservoir influent piping/valving with the UV reactors and associated equipment.

- Lower Level (Below-Grade): The lowest level of the facility is the effluent piping and valving for the treated water exiting the reservoir. This level will be below the floor slab of the UV pipe gallery and will be accessible by removing the grating over the pipe trench.

In addition to stairs, an elevator will be provided to allow access to the middle level of the UV facility for personnel and supplies.

Refer to Attachment F for conceptual drawings demonstrating the UV facility for Alternative 4.3.

Four LPHO reactors have been proposed for this alternative, comprising of 3 duty reactors and 1 redundant reactor. Table 4-7 summarizes the design criteria of the UV reactors for Alternative 4.3. The equipment information from multiple UV equipment vendors is included in Attachment E.

Table 4-7 Alternative 4.3 – UV Design Criteria

Parameter	Unit	Value
Total Design Flow	ML/d	340
Design UVT	%	95
Design Dose	mJ/cm^2	40
Design *Giardia* Log Inactivation	-	N/A
No. of UV Units	-	4 (3 duty and 1 stand-by)
No. of Lamps per Reactor	-	32
Type of UV Reactor	-	Low-Pressure, High-Output

Each reactor requires a power distribution center, local control panel, and hydraulic system center. High voltage power to operate the UV reactors and systems will require a new electrical duct bank to be installed to the new UV facility building location. A connection to a low voltage (LV) switchgear will be needed, likely from the existing Flocculation Building main LV switchgear.

4.7 Comparison of UV Reactors

Three of the five short-listed alternatives (excluding the Do Nothing option) involve the implementation of UV disinfection as a component of the solution. The introduction of UV disinfection at the Lake Huron WTP allows for the plant to have a multi-barrier approach to disinfection and will provide the ability to accommodate future more stringent primary disinfection regulatory requirements. It will also provide the plant with a better ability to mitigate changes in source water quality, such as increases in *Cryptosporidium* or *Giardia* levels in the source water.

Preliminary discussion with three UV vendors was completed throughout the development of the alternatives based on the existing plant configuration and constraints, as well as the UVT values and other design parameters as presented in the sections above. Both LPHO and MP UV reactor types have been proposed, depending on the nature of the alternative:

- LPHO reactors: Alternatives 4.1 and Alternative 4.3
- MP reactors: Alternative 4.2

MP reactors require smaller reactors and fewer lamps per reactors compared to a LPHO reactor. The lifetime of LPHO reactors however are longer, and typically have lower system operating temperatures and energy requirements to an equivalent MP system. Turndown capabilities are greater for LPHO systems (with lamp efficiency increasing at greater turndown) compared to MP systems. MP systems generally also include one sensor per lamp, whereas LPHO reactors may integrate one sensor per operating unit. The increased maintenance requirements imposed by the greater number of lamps in a LPHO reactor would be offset by the longer lamp life.

5. Conceptual Level Cost Estimates

Conceptual level capital and life cycle cost (LCC) estimates (including operating and maintenance costs) were developed for each of the short-listed alternatives.

5.1 Cost Estimate Basis and Assumptions

5.1.1 Capital Cost Estimate

Capital cost estimates were developed for each short-listed alternative. Capital costs for new infrastructure and assets were obtained via the following methods:

- Capital costs for new buildings and structures (e.g. reservoir, valve house, UV buildings) were estimated using Jacobs' Conceptual and Parametric Engineering System (CPES™). CPES™ uses a database of project data and quantity take-offs to develop conceptual estimates.
- The costs of major equipment (e.g. UV systems, weirs, baffle walls) were obtained from multiple vendors.
- Costs associated with the new connection from the existing clear wells to the new reservoir (as described in Section 3.4) were estimated based on the costing information from similar projects.

The capital costs developed are at the conceptual level (+50%/-30%) and a refined estimate will be developed for the preferred alternative solution during preliminary design. The cost estimates include the following mark-ups and adjustment factors:

- 10% for contractor overhead and profit
- 3% for project staff and home office overhead
- 5% for general conditions
- 5% for mobilization/demobilization, insurance, and bonds (3%, 1%, and 1% respectively)
- 10% for profit

- 30% contingency
- 12% for engineering services

Costs were escalated to the anticipated year of construction tendering, 2025, using the Engineering News-Record's (ENR) Construction Cost Index (CCI). To account for recent sharp increases in inflation due to the COVID-19 pandemic and other factors, the escalation percentage applied was computed based on the average annual increase of the CCIs from June 2020 to June 2022.

5.1.2 Operations and Maintenance Cost Estimate

The operations and maintenance (O&M) cost estimates were developed using a planning period of 20 years (2022 to 2042), consistent with the Master Plan planning duration. The O&M estimates were calculated using only additional costs resulting from new assets or processes resulting from the short-listed alternatives. Existing operational costs for the Lake Huron WTP are not included in the O&M cost estimates. The O&M cost estimates include the following components:

- Additional electricity costs
- Additional labour costs
- Additional material replacement (i.e. UV lamps; costs provided by vendors)
- Changes in chlorine use due to enhanced primary disinfection provided by the alternatives. For example, an expense was applied for anticipated increases in chlorine usage from the baseline in order to meet the Project Objectives. A credit was applied for anticipated decreases in chlorine usage from the baseline, such as for alternatives which include UV disinfection.

Unit costs that were applied for the O&M cost estimates are presented in Table 5-1.

Table 5-1 O&M Cost Estimate Basis

Item	Unit Cost	Source/Basis
Electricity	$0.13/kWh	Ontario 2021 Average Cost (Energy Hub, 2021)
Labour	$50/hour	Previous Jacobs Projects
Chlorine Gas	$1.10/kg	Previous Jacobs Projects

5.2 Life Cycle Cost Estimates

Based on the methodology for the capital and O&M cost estimates summarized in the previous section, Table 5-2 presents a summary of the total overall lifecycle cost estimates for the six short-listed alternatives (including Do Nothing).

Table 5-2 Short-Listed Alternatives Cost Estimate Summary

Alt No.	Alternative Description	O&M Costs[1], NPV	Capital Costs	Lifecycle Costs, NPV
1	Do Nothing	$ 844,000	-	**$ 844,000**
2	Clear Well Upgrades and New Reservoir (10.7 ML)	$ 303,000	$ 33,367,000	**$ 33,670,000**
3	New Reservoir (13.0 ML)	$ 294,000	$ 35,009,000	**$ 35,300,000**
4.1	UV Disinfection at Settled Water Conduits and New Reservoir (7 ML)	$ 346,000	$ 38,665,000	**$ 39,011,000**
4.2	UV Disinfection at Each Filter Effluent and New Reservoir (7 ML)	$ 420,000	$ 27,860,000	**$ 28,280,000**
4.3	UV Disinfection at New Reservoir (7 ML)	$ 182,000	$ 37,318,000	**$ 37,500,000**

Notes:

NPV = Net Present Value assuming a discount rate of 2.4% over a 20 year period.

[1] Additional costs resulting from new assets/processes only.

A breakdown of the overall lifecycle costs (including capital and O&M expenditures) for each of the alternatives is provided in the following sub-sections.

5.2.1 Alternative 1: Do Nothing

While the Do Nothing alternative does not require any capital investments as no new infrastructure will be implemented, it will require O&M costs as a result of operational changes as discussed in Section 4.1. An increase in chemical (chlorine) usage at the plant will be required at certain times of the year (winter) in order to meet the project disinfection objectives, including the assumption that the primary pipeline to B-Line Road and the raw water intake pipe are not contributing to the overall primary disinfection contact time.

Table 5-3 presents the breakdown of the lifecycle costs for Alternative 1.

Table 5-3 Alternative 1 Lifecycle Cost Estimate

Cost Category	Component	Cost
Capital Investment	N/A	-
	Total Capital Costs	**N/A**
O&M Expenditures	Additional Chemical (Chlorine) Usage (Annual)	$ 52,000
	Total O&M Costs Over 20 Years, NPV	**$ 844,000**
	Total Life Cycle Cost	***$ 844,000***

5.2.2 Alternative 2: Clear Well Upgrades, and New Reservoir

As described in Section 4, Alternative 2 involves the implementation of baffle walls and overflow weirs to improve disinfection contact time within the existing clear wells. It also involves the addition of a 10.7 ML reservoir to meet additional storage needs.

Table 5-4 presents the breakdown of the lifecycle costs for Alternative 2.

Table 5-4 Alternative 2 Lifecycle Cost Estimate

Cost Category	Component	Cost
Capital Investment	Overflow Weirs (x2)	$ 84,000
	Perforated Baffle Walls (x6)	$ 720,000
	Below-Grade Reservoir (10.7 ML)	$ 9,246,000
	Two Level Valve House	$ 2,627,000
	Clear Well Outlet Modifications	$ 576,000
	Conveyance Piping to/from Reservoir (1,800 mm dia. CPPs)	$ 2,475,000
	Sub-total Project Costs (excluding mark-ups)	$ 15,728,000
	Mark-ups (contractor OH, contingency, etc.)	$ 17,639,000
	Total Capital Costs	**$ 33,367,000**
O&M Expenditures	Additional Electricity (Annual)	$ 16,700
	Additional Labour: Inspection of Clear Wells and Reservoir (every 3 years)	$ 5,600
	Total O&M Costs Over 20 Years, NPV	**$ 303,000**
	Total Life Cycle Cost	***$33,670,000***

5.2.3 Alternative 3: New Reservoir

Alternative 3 involves the addition of a new reservoir with a total volume of 13 ML.

Table 5-5 presents the breakdown of the lifecycle costs for Alternative 3.

Table 5-5 Alternative 3 Lifecycle Cost Estimate

Cost Category	Component	Cost
Capital Investment	Below-Grade Reservoir (13.0 ML)	$ 10,588,000
	Two Level Valve House	$ 2,627,000
	Clear Well Outlet Modifications	$ 576,000
	Conveyance Piping to/from Reservoir (1,800 mm dia. CPPs)	$ 2,475,000
	Sub-total Project Costs (excluding mark-ups)	$ 16,266,000
	Mark-ups (contractor OH, contingency, etc.)	$ 18,740,000
	Total Capital Costs	**$ 35,006,000**
O&M Expenditures	Additional Electricity (Annual)	$ 16,700
	Additional Labour: Reservoir Inspection (Every 3 years)	$ 4,000
	Total O&M Costs Over 20 Years, NPV	**$ 294,000**
	Total Life Cycle Cost	***$35,300,000***

5.2.4 Alternative 4.1: UV Disinfection at Settled Water Conduits, and New Reservoir

Alternative 4.1 involves the addition of two UV buildings at the settled water conduits adjacent to the Sedimentation Building, as well as a new 7 ML reservoir.

Table 5-6 presents the breakdown of the lifecycle costs for Alternative 4.1.

Table 5-6 Alternative 4.1 Lifecycle Cost Estimate

Cost Category	Component	Cost
Capital Investment	UV Facilities (Adjacent to Sedimentation Building)	$ 8,032,000
	Below-Grade Reservoir (7 ML)	$ 5,027,000
	Two Level Valve House	$ 2,627,000
	Clear Well Outlet Modifications	$ 576,000

Cost Category	Component	Cost
	Conveyance Piping to/from Reservoir (1,800 mm dia. CPPs)	$ 2,475,000
	Sub-total Project Costs (excluding mark-ups)	$ 18,737,000
	Mark-ups (contractor OH, contingency, etc.)	$ 19,929,000
	Total Capital Costs	**$ 38,665,000**
O&M Expenditures	Additional Electricity (Annual)	$ 60,700
	Additional Labour: Reservoir Inspection (Every 3 years)	$ 4,000
	Additional Labour: UV System Maintenance (Annual)	$ 5,000
	UV Lamp Replacement (Annual)	$ 22,400
	Chemical (Chlorine) Usage Credit[1]	($ 68,300)
	Total O&M Costs Over 20 Years, NPV	**$ 346,000**
	Total Life Cycle Cost	***$ 39,011,000***

Notes:

[1] Calculated as a credit since the implementation of UV will provide an opportunity to eliminate pre-chlorination (pre-filters) at the plant year round.

5.2.5 Alternative 4.2: UV Disinfection at Each Filter Effluent, and New Reservoir

Alternative 4.2 involves the implementation of UV systems on each filter effluent pipe, as well as a new 7 ML reservoir.

Table 5-7 presents the breakdown of the lifecycle costs for Alternative 4.2.

Table 5-7 Alternative 4.2 Lifecycle Cost Estimate

Cost Category	Component	Cost
Capital Investment	UV Disinfection at Filter Effluents	$3,130,000
	Below-Grade Reservoir (7 ML)	$ 5,027,000
	Two Level Valve House	$ 2,627,000
	Clear Well Outlet Modifications	$ 576,000
	Conveyance Piping to/from Reservoir (1,800 mm dia. CPPs)	$ 2,475,000
	Sub-total Project Costs (excluding mark-ups)	$ 13,835,000

Cost Category	Component	Cost
	Mark-ups (contractor OH, contingency, etc.)	$ 14,025,000
	Total Capital Costs	**$ 27,860,000**
O&M Expenditures	Additional Electricity (Annual)	$ 83,400
	Additional Labour: Reservoir Inspection (Every 3 years)	$ 4,000
	Additional Labour: UV System Maintenance (Annual)	$ 5,000
	UV Lamp Replacement (Annual)	$ 4,300
	Chemical (Chlorine) Usage Credit[1]	($ 68,300)
	Total O&M Costs Over 20 Years, NPV	**$ 420,000**
	Total Life Cycle Cost	***$ 28,280,000***

Notes:

[1] Calculated as a credit since the implementation of UV will provide an opportunity to eliminate pre-chlorination (pre-filters) at the plant year round.

5.2.6 Alternative 4.3: UV Disinfection at New Reservoir

Alternative 4.3 involves the implementation of a new UV facility adjacent to a new 7 ML reservoir.

Table 5-8 presents the breakdown of the lifecycle costs for Alternative 4.3.

Table 5-8 Alternative 4.3 Lifecycle Cost Estimate

Cost Category	Component	Cost
Capital Investment	UV and Reservoir Valve Facility	$ 9,698,000
	Below-Grade Reservoir (7 ML)	$ 5,027,000
	Clear Well Outlet Modifications	$ 576,000
	Conveyance Piping to/from Reservoir (1,800 mm dia. CPPs)	$ 2,475,000
	Sub-total Project Costs (excluding mark-ups)	$ 17,776,600
	Mark-ups (contractor OH, contingency, etc.)	$ 19,543,000
	Total Capital Costs	**$ 37,318,000**

Cost Category	Component	Cost
O&M Expenditures	Additional Electricity (Annual)	$ 48,400
O&M Expenditures	Additional Labour: Reservoir Inspection (Every 3 years)	$ 4,000
O&M Expenditures	Additional Labour: UV System Maintenance (Annual)	$ 5,000
O&M Expenditures	UV Lamp Replacement (Annual)	$ 24,700
O&M Expenditures	Chemical (Chlorine) Usage Credit[1]	($ 68,300)
	Total O&M Costs Over 20 Years, NPV	**$ 182,000**
	Total Life Cycle Cost	***$ 37,500,000***

Notes:

[1] Calculated as a credit since the implementation of UV will provide an opportunity to eliminate pre-chlorination (pre-filters) at the plant year round.

6. Evaluation Framework and Criteria

The following section describes the evaluation framework and criteria that are used to compare the short-listed alternatives to determine a preferred solution for the Lake Huron WTP.

6.1 Development Guidelines

The following guidelines are used in the development of evaluation criteria to achieve a robust, representative evaluation of the short list of alternatives. Evaluation criteria should comprise of the following characteristics:

Mutually Exclusive and Collectively Exhaustive – to avoid double counting of possible consequence and to ensure that no important considerations are neglected

Concise – to focus the analysis only on those objectives necessary to make a decision

Operational – to ensure that the information necessary to measure objectives can be obtained with reasonable time and effort

Measurable – to define objectives precisely and to specify the degree to which objectives may be achieved

Understandable – to facilitate the communication of insights from the decision-making process

6.2 Evaluation Approach and Criteria

A set of evaluation criteria reflecting four overarching categories of the Natural, Socio-Cultural, Technical, and Economic Environments, were established as described in Table 6-1. These criteria are based on the triple-bottom-line approach described in the Class EA process and were established through consultation with LHPWSS, consideration of the existing conditions of the Study Area as outlined in the Problem/Opportunity Statement TM, the alternative solutions being considered, and the Problem/Opportunity Statement itself. LHPWSS Customer Level of Service (CLOS) objectives as defined in the LHPWSS Asset Management Plan were also considered and incorporated into the criteria where possible.

For each comparative criterion, the alternatives are assigned a high, medium or low score (equivalent of 10, 5, and 0 points respectively). The score is established based on the alternative solution's level of impacts and benefits, as described in Table 6-1.

The total score for each alternative is the sum of the scores from all 25 criteria, meaning that each criterion has an equal weighting. To confirm the robustness of the comparative evaluation, a sensitivity analysis using five scenarios was conducted. One sensitivity scenario involves each criteria category (i.e. Natural Environment, Socio-Cultural, Technical and Economic) being equally weighted, in other words 25% weighting each. The other four sensitivity scenarios were computed, in which the weighting is increased from 25% to 40% for each criteria category and the remaining weighting (60%) is evenly distributed across the other three categories (i.e. 20% weighing each category).

Table 6-1. Comparative Evaluation Criteria

Category	Criterion	Description	Measure: High (10)	Measure: Medium (5)	Measure: Low (0)
Natural Environment	Aquatic Vegetation and Wildlife	Potential impact on local aquatic species and habitats, aquatic species at risk and locally significant aquatic species	The alternative will have no permanent physical disturbance to aquatic features and no substantial long-term impact on the viability of aquatic habitats in terms of density and diversity of species.	The alternative has some potential for long term impact on the viability of aquatic habitats in terms of density and diversity of species. This alternative may have some temporary loss of aquatic features.	The alternative has high potential for long term impact on the viability of aquatic habitats in terms of density and diversity of species and will cause physical disturbance to aquatic features.
	Terrestrial Vegetation and Wildlife	Potential impact on local terrestrial species and habitats, designated areas, species at risk and locally significant species	The alternative will have low to no permanent substantial long-term impact on the viability of terrestrial habitats in terms of density and diversity of species. This alternative will require a small area of terrestrial land to be permanently lost.	The alternative has moderate potential for long term impact on the viability of terrestrial habitats in terms of density and diversity of species. This alternative will require a moderate area of terrestrial land to be permanently lost.	The alternative has high potential for long term impact on the viability of terrestrial habitats in terms of density and diversity of species. This alternative will require a large area of terrestrial land to be permanently lost.
	Surface Water	Potential impact on the quantity and quality of surface water	The alternative will have no substantial impact on surface water quantity/quality that would result in negative impacts to other users and/or the aquatic environment.	The alternative will have some potential impact on surface water quantity/quality that would result in negative impacts to other users and/or the aquatic environment.	The alternative will have a high potential impact on surface water quantity/quality that would result in negative impacts to other users and/or the aquatic environment.

Category	**Criterion**	**Description**	**Measure:** **High (10)**	**Measure:** **Medium (5)**	**Measure:** **Low (0)**
	Groundwater	Potential impact on the quantity and quality of groundwater	The alternative has a low to no potential for long term and temporary (during construction) impact on groundwater quality or quantity.	The alternative will have moderate long term and temporary impacts (during construction) on groundwater quality and quantity over long term.	The alternative will have significant long-term impacts and some temporary (during construction) on groundwater quality and quantity over long term.
	CLOS Sustainability - GHG from Energy Usage	Potential to increase energy usage and resulting GHG emissions from the current condition (based on 30 gm CO_2 per kW·h, 2020 National Inventory Report).	The alternative results in GHG emissions <5 tonnes CO_2 eq/year (above existing operations).	The alternative results in GHG emissions 5 - 15 tonnes CO_2 eq/year (above existing operations).	The alternative results in GHG emissions >15 tonnes CO_2 eq/year (above existing operations).
	CLOS Sustainability - Chemical Usage	Changes in chemical usage at the plant	This alternative results in a decrease in chemical usage from the current condition.	This alternative results in no change to the existing chemical usage.	This alternative results in an increase in chemical usage from the current condition.
	Soil and Geology	Geology, hydrogeology, contamination considerations	This alternative has low to no risk of encountering contaminated soil during excavation, and lowest potential to cause additional erosion to lake shoreline areas during construction.	This alternative has a moderate risk of encountering contaminated soil during excavation, and some potential to cause additional erosion to lake shoreline areas during construction.	This alternative has a high risk of encountering contaminated soil during excavation, and highest potential to cause additional erosion to lake shoreline areas during construction.

Category	Criterion	Description	Measure: High (10)	Measure: Medium (5)	Measure: Low (0)
Social/Cultural	Archaeological Sites	Impact to potential archaeological features during construction or ongoing operations	This alternative is located entirely within previously disturbed areas as identified in the Stage 1 Archeological Assessment which has low potential for archeological features.	This alternative is located in both previously disturbed and undisturbed areas as identified in the Stage 1 Archeological Assessment, thereby having a moderate potential for archeological features.	This alternative is located entirely within undisturbed areas as identified in the Stage 1 Archeological Assessment which have higher potential for archeological features.
	Cultural/Heritage Features	Potential impact on known cultural landscapes and built heritage features during construction or ongoing operations	This alternative will have no physical disturbance to known cultural or heritage features.	This alternative may have some non-physical disturbance (noise, vibrations) to known cultural or heritage features	This alternative will cause physical disturbance to known cultural or heritage features.
	Recreational Land Uses and Visual Landscape	Potential to permanently impact existing parks and open spaces, beach access, or impact the character of the existing community (e.g., interference with views)	This alternative results in the smallest permanent reduction in available park space and no permanent loss of beach access.	This alternative results in a moderate permanent reduction in available park space or some permanent reduction in beach access points.	This alternative results in the highest permanent reduction in available park space or a substantial permanent loss of beach access.

Category	Criterion	Description	Measure: High (10)	Measure: Medium (5)	Measure: Low (0)
	Impacts During Construction	Potential construction impacts due to traffic, access, noise, dust, and odour on existing residences and agricultural land within the vicinity	The alternative will result in no disruption to traffic and/or will have the shortest disruption to use of public areas during construction. This alternative has the lowest potential for dust, noise and/or vibration impacts to homeowners in proximity to the project site.	The alternative will result in some disruption to traffic and/or will cause a moderate duration of disruption to use of public areas during construction. This alternative has a moderate potential for dust, noise and/or vibration impacts to homeowners in proximity to the project site.	The alternative will result in significant disruption to traffic and/or will have the longest disruption to use of public areas during construction. This alternative has the highest potential for dust, noise and/or vibration impacts to homeowners in proximity to the project site.
	Long-Term Community Impact	Long-term impacts on traffic, noise, vibration and dust on existing residences and agricultural land within the vicinity, as well as potential changes in land use designations	This alternative will have no long-term impacts regarding traffic, noise, and vibration to local residents and requires no changes to existing land use designations.	This alternative will have long term impacts regarding traffic, noise, and vibration to local residents or requires changes to existing land use designations.	This alternative will have long term impacts regarding traffic, noise, and vibration to local residents and requires changes to existing land use designations.
	CLOS Reliability/Availability - Reduction in Service Interruptions	Ability to provide continuous, adequate quantity of water to customers	This alternative reduces the potential for the number and duration of planned or unplanned service interruptions	This alternative maintains the existing potential for the number and duration of planned or unplanned service interruptions	This alternative increases the potential for the number and duration of planned or unplanned service interruptions
	Planning Policy Compliance	Compliance with Local and Regional Planning Policies (e.g. South Huron Official Plan, Zoning)	This alternative is in compliance with local and regional planning policies with respect to zoning and land use permissions.	-	This alternative is not in compliance with local and regional planning policies with respect to zoning and land use permission.

Category	**Criterion**	**Description**	**Measure: High (10)**	**Measure: Medium (5)**	**Measure: Low (0)**
Technical	Improvements to Primary Disinfection	Ability to restore the plant's full rated capacity under all conditions (including winter conditions) within plant treatment processes, thus reducing reliance on primary pipeline to B Line Road for primary disinfection	This alternative can achieve primary disinfection under all conditions	-	This alternative does not achieve primary disinfection under all conditions
	Impact on DBP Formation	Potential for disinfection by-product (DBP) formation	This alternative achieves a portion of the required CT with a disinfection method that does not produce chlorinated DBPs, thereby providing the ability to reduce DBP formation	This alternative continues to rely on chlorination but provides some opportunity to eliminate pre-chlorination thereby reducing contact with DBP precursors	This alternative may increase DBP formation under certain operating conditions
	Ease of Implementation	Ease of implementation for new infrastructure in terms of available space and constructability.	This alternative has sufficient space available and minimal constructability issues.	This alternative has limited space available or imposes moderate constructability issues.	This alternative has minimal space available or imposes highest constructability issues.
	Future Proofing	Ability to increase water quality resilience by adding barrier(s) to the disinfection process, to provide robustness for meeting current and future regulatory requirements	This alternative has the best ability to increase water quality resilience by adding barrier(s) to the disinfection process, to provide robustness for meeting current and future regulatory requirements	This alternative has some ability to meet future regulatory requirements via improvements of the existing barrier	This alternative has no ability to meet future regulatory changes

Category	**Criterion**	**Description**	**Measure: High (10)**	**Measure: Medium (5)**	**Measure: Low (0)**
	Potential for System Expandability for Redundancy	Potential ability and space availability to include redundancy of equipment/infrastructure	This alternative has the greatest potential and space availability for redundancy of new infrastructure/ equipment implemented.	This alternative has a moderate space available to implement redundancy measures in relation to new infrastructure/equipment.	This alternative has little no ability to implement redundancy for new infrastructure/equipment.
	Compatibility with Plant HGL	Ability to accommodate new infrastructure/equipment into existing plant hydraulic grade line (HGL)	The alternative can be easily accommodated in the existing WTP HGL without additional equipment upgrades or operational changes.	This alternative can be accommodated in the existing WTP HGL with minor equipment upgrades or operational changes.	This alternative can be accommodated in the existing WTP HGL with major equipment upgrades or operational changes.
	Operation Flexibility	Ability to improve operational flexibility	This alternative will increase operational flexibility from both primary disinfection and storage perspective	This alternative will increase operational flexibility from either a primary disinfection or storage perspective	This alternative will maintain the existing level of operational flexibility
	Maintenance	The complexity and maintainability of new assets, as well as impacts to occupational health and safety required for new maintenance activities	This alternative is simple to maintain and requires low maintenance frequency, and poses little risk to occupational health and safety.	This alternative requires a moderate frequency of maintenance, or poses some risks to occupational health and safety.	This alternative requires frequent/complex maintenance requiring additional and extensive operator training, or poses high risks to occupational health and safety.

Category	Criterion	Description	Measure: High (10)	Measure: Medium (5)	Measure: Low (0)
	Permits and Approvals	Ease of receiving permits and approvals for implementation, as well as ease of maintaining compliance during operation	Obtaining or renewal of the permits/approvals for this alternative are anticipated to be easily achievable.	Obtaining or renewal of the permits/approvals for this alternative are anticipated to be achievable but may require additional mitigation measures or studies.	Obtaining or renewal of the permits/approvals for this alternative may require onerous negotiations with uncertain outcomes.
Economic	Capital Costs	Estimated capital cost (in 2022 dollars)	This alternative has a capital cost of <$20M	This alternative has a capital cost between $20M - $40M	This alternative has a capital cost >$40M
	Life Cycle Costs	Total annual capital and operational costs amortized over 20 years.	This alternative has a lifecycle cost of <$20M	This alternative has a lifecycle cost between $20M - $40M	This alternative has a lifecycle cost >$40M

Notes:

CLOS = Customer Level of Service objective

7. Comparative Evaluation of Short-Listed Alternatives

The short-listed alternatives were evaluated using the criteria and framework described in Section 6. Table 7-1 and Figure 7-1 provide summaries of the comparative evaluation of the alternatives. Detailed comparative evaluation with the scoring rationale as well as the breakdown of the sensitivity analysis are presented in Attachment G.

Table 7-1 Comparative Evaluation Summary

Alt No.	Alternative Description	Natural Environment Score	Socio-Cultural Score	Technical Score	Economic Score	Total Score	Ranking
1	Do Nothing	60	65	25	20	**170**	**6**
2	Clear Well Upgrades and New Reservoir (10.7 ML)	55	60	55	10	**180**	**4**
3	New Reservoir (13 ML)	55	60	60	10	**185**	**3**
4.1	UV Disinfection at Settled Water Conduits, and New Reservoir (7 ML)	60	55	70	10	**195**	**2**
4.2	UV Disinfection at Each Filter Effluent, and New Reservoir (7 ML)	55	60	50	10	**175**	**5**
4.3	UV Disinfection at New Reservoir (7 ML)	60	55	80	10	**205**	**1**

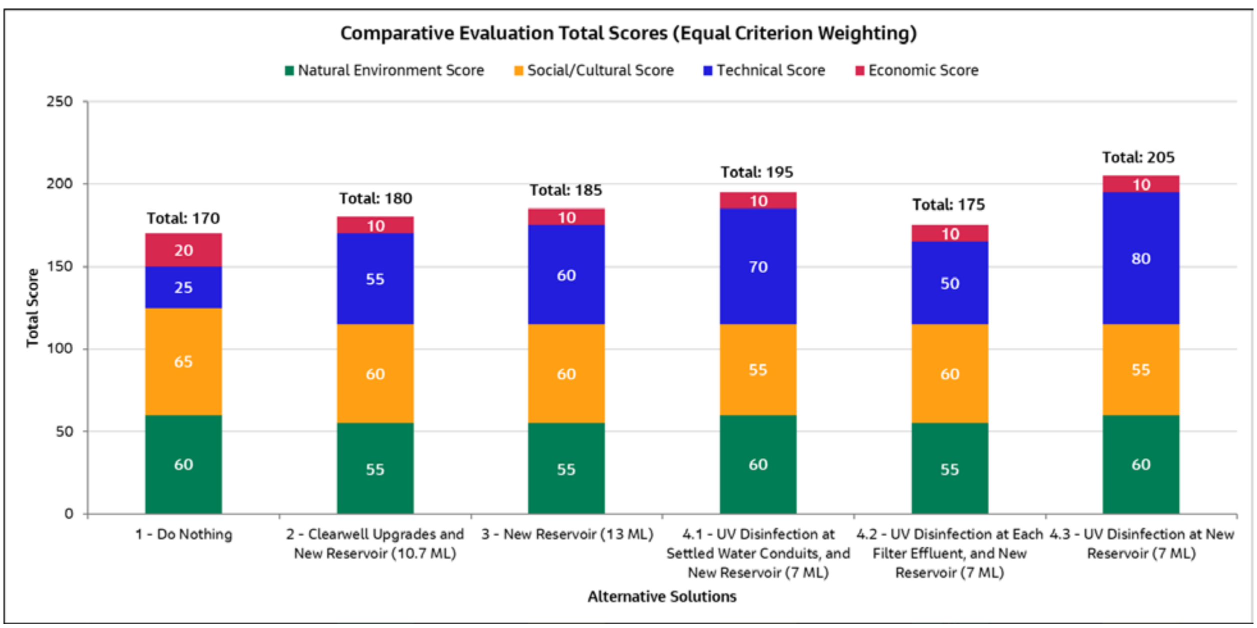

Figure 7-1 Comparative Evaluation Total Scores

8. Recommended Preferred Alternative

Based on the detailed comparative evaluation, Alternative 4.3 (UV Disinfection at New Reservoir) was selected preliminarily as the preferred alternative solution, with a total score of 205 points. This alternative as the preferred solution was also supported by one of the scenarios completed as part of the sensitivity analysis, as summarized in Table 8-1:

- Technical category weighted at 40%

Table 8-1 Evaluation Sensitivity Analysis Summary

Scenario	Alt. 1	Alt. 2	Alt. 3	Alt. 4.1	Alt. 4.2	Alt. 4.3
Main Evaluation (All Criteria Weighted Equally)	170	180	185	195	175	205*
Scenario 1: Each Category Weighting of 25%	76.6*	68.8	70.2	73.0	67.5	75.8
Scenario 2: 40% Natural Environment [1]	78.4*	70.8	71.9	75.6	69.7	77.8
Scenario 3: 40% Socio-Cultural [1]	79.8*	72.2	73.3	74.1	71.1	76.3
Scenario 4: 40% Technical [1]	66.8	67.3	69.5	74.0	65.1	78.4*
Scenario 5: 40% Economic [1]	81.3*	65.1	66.2	68.4	64.0	70.6

Notes:

[1] Other three categories are weighted at 20% each (for the remaining 60%).

* Indicates the highest score for the scenario.

The Do Nothing alternative was the preferred solution for the remaining scenarios completed as part of the sensitivity analysis, listed as follows:

- Each criteria category weighted equally (25% weighting each)
- Natural Environmental category weighted at 40%
- Socio-Cultural category weighted at 40%
- Economic category weighted at 40%

The Do Nothing, however, it is ruled out as a viable solution as it does not meet the overall Project Objectives. After the Do Nothing option, Alternative 4.3 was the next preferred solution under the four scenarios listed above.

In addition to meeting the Project Objectives, Alternative 4.3 will provide the Lake Huron WTP with enhanced primary disinfection capabilities through a multi-barrier disinfection process and therefore the ability to accommodate future more stringent primary disinfection regulatory requirements and changes in source water quality. It also provides the plant with more storage to reduce the potential for the number of planned or unplanned service interruptions to LHPWSS customers in the event of water production interruptions. Finally, Alternative 4.3 limits the construction to one area, reducing interference with plant operations when compared to other short-listed alternatives (except for Alternative 3).

9. Summary and Next Steps

Design concepts of the six short-listed alternatives (including the Do Nothing alternative) were developed in order to determine the potentially preferred solution to improve disinfection and water storage at the Lake Huron WTP. A detailed comparative evaluation was conducted to evaluate the alternatives, using information collected during the alternative development as well as from the following additional studies:

- Ecological Assessment (Jacobs)
- Cultural Heritage Assessment (Golder Associates)
- Stage 1 Archeological Assessment (Golder Associates)
- Replica™ Hydraulic Modelling (Jacobs)

Alternative 4.3 was identified as the preliminarily preferred alternative solution.

The next steps[1] of the Lake Huron WTP Disinfection and Storage Upgrades Schedule B EA is to present the short-listed alternative concepts and confirm the recommendation of the preferred solution with stakeholders and the public through a Public Information Centre (PIC). Following the PIC, a Project File Report will be prepared to document the Schedule B EA and made available to stakeholders and the public for review and comment.

[1] Document Revision Note: The next steps reflect the status of the project as of March 2022, which is when the first version of this document was developed. The original document was prepared prior to the Public Information Centre being held in May/June 2022. Minor text revisions were later made to the document, resulting in a final version date of July 25, 2022.

10. References

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Jacobs. (2021). *Technical Memorandum 1.* Lake Huron Water Treatment Plant Disinfection and Storage Upgrades Class EA.

Jacobs. (2022). *Desktop Natural Features Assessment*. Lake Huron Water Treatment Plant Disinfection and Storage Upgrades Class EA.

Jacobs. (2022). *Replica™ Modelling Technical Memorandum*. Lake Huron Water Treatment Plant Disinfection and Storage Upgrades Class EA.

MECP. (2008). *Design Guidelines for Drinking Water Systems.* Retrieved from https://www.ontario.ca/document/design-guidelines-drinking-water-systems-0

Municipality of South Huron. (2021). *Municipality of South Huron Zoning By-law.* Consolidated 2021.

US EPA. (1999). *Disinfection Profiling and Benchmarking Guidance Manual*.

US EPA. (2006). *Microbial Laboratory Guidance Manual for the Final Long Term 2 Enhanced Surface Water Treatment Rule.*

Attachment A. Water Demand-Based Storage Questionnaires

Alternative formats of the information in this attachment are available by contacting mmckillop@huronelginwater.ca.

Survey Purpose and Disclaimer

The Lake Huron Primary Water Supply System (LHPWSS) has initiated a Schedule B Municipal Class Environmental Assessment (EA) at the Lake Huron Water Treatment Plant to confirm the recommendation for additional storage at the plant site and refine requirements for enhanced disinfection to provide operational flexibility, as identified in the recently completed LHPWSS Master Water Plan Update (2020).

The purpose of this survey is to confirm and gain further information regarding existing municipal storage facilities and demands pertaining to your municipality as it relates to its supply from LHPWSS.

Information collected is for assessment purposes only and should not be considered a commitment to services outside of the existing water supply agreement with your municipality.

Part A: Contact Information

Municipality Name: Municipality of Bluewater

Completed by: Dave Kester

Title: Manager of Public Works

Email: publicworks@municipalityofbluewater.ca

Phone: 519-236-4351 ext. 221

Part B: General Information

Please review and confirm that the following information we have regarding the drinking water system associated with your municipality is correct and up to date:

Drinking Water System Name:	Bluewater Lakeshore Distribution System
Drinking Water System Number:	260006542
Other Drinking Water Systems that Receive All Drinking Water From This System:	N/A
Drinking Water System Receives Water from:	Lake Huron Primary Water Supply System

If any information noted above is incorrect or missing, please note and describe here:

Click or tap here to enter text.

Part C: Municipal Storage and Demand Information

1. Please review the following *municipally-owned* storage facilities that service your municipality and confirm that the information is accurate, or update as applicable. Please add extra rows for additional facilities that service your municipality that may not be listed.

Storage Facility Name	**Owner**	**Storage Facility Capacity (ML)**	**Storage Facility Useable Volume (ML)** *(based on operating levels)*
Bayfield Elevated Tank	Municipality of Bluewater	4 ML	Low level 50 psi High level – 57.5 psi
Hensall Elevated Tank	Municipality of Bluewater	*.455 ML*	Low - 39.5 psi High - 44 psi
Hensall Reservoir (York Street)	Municipality of Bluewater	.350 ML	Low - 42 psi High - 43.5psi

Please note any additional/relevant information related to the municipal storage facilities listed above:

Planning for water supply to Zurich planned for 2022 utilizing existing Zurich Well reservoir

2. While it is noted that the LHPWSS is not designed to meet municipal distribution system level requirements, please indicate your municipality's current reliance on this regional storage with municipal storage to meet the following demands:

Type of Demand	**Municipal Storage (ML)**	**Regional Storage (ML)**
Equalization to meet peak demands	0.514	0.899
Emergency storage	0.392	0.475
Fire flow	1.115	0.941

Please provide additional information as applicable, including whether current available storage meets your needs, in the space below:

Click or tap here to enter text.

3. Please review Figure 1 below and confirm that the portion of your municipality that is serviced directly from the Lake Huron Water Treatment Plant (i.e. customers upstream of LHPWSS Regional Storage Facilities) is represented by the respective nodes circled in red .

Yes, this is a correct representation.

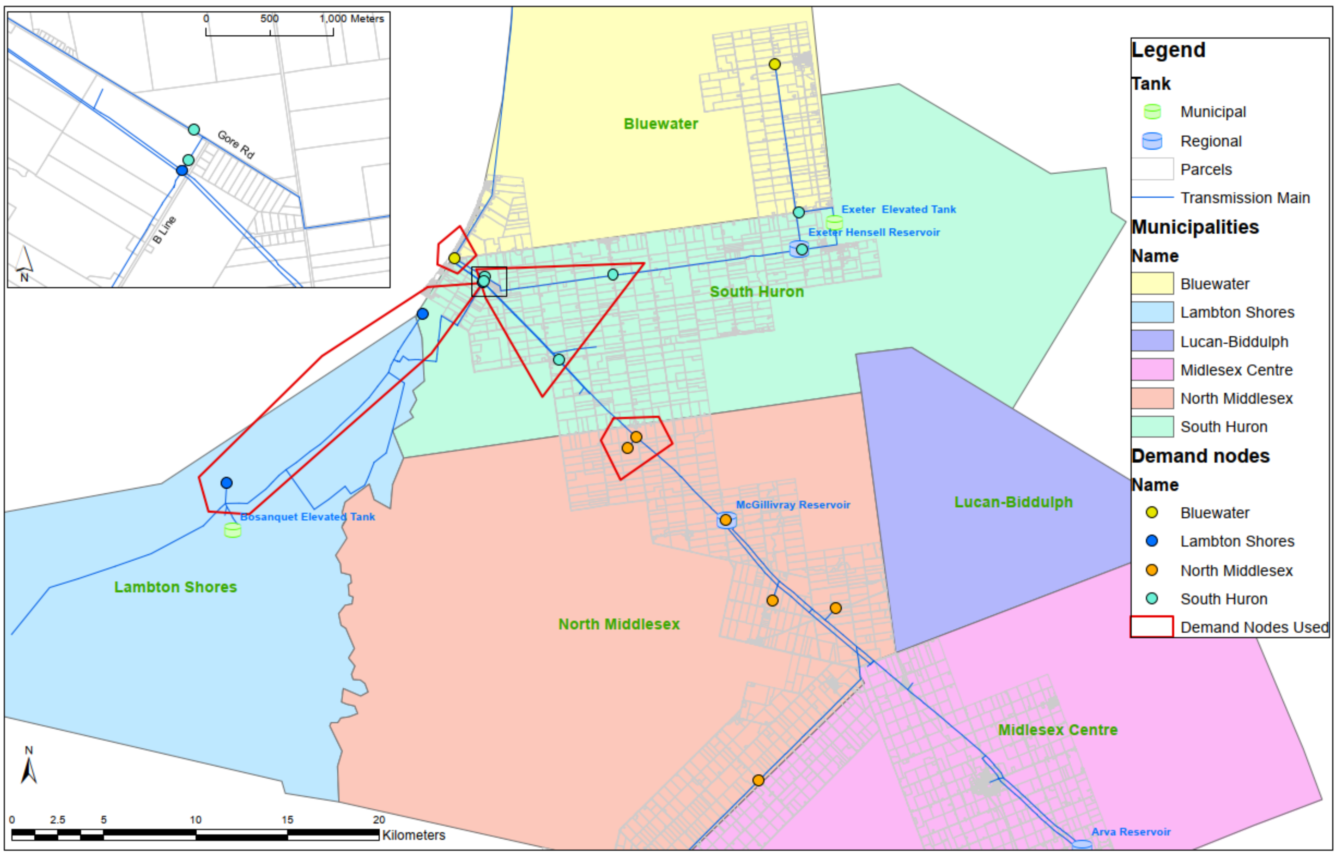


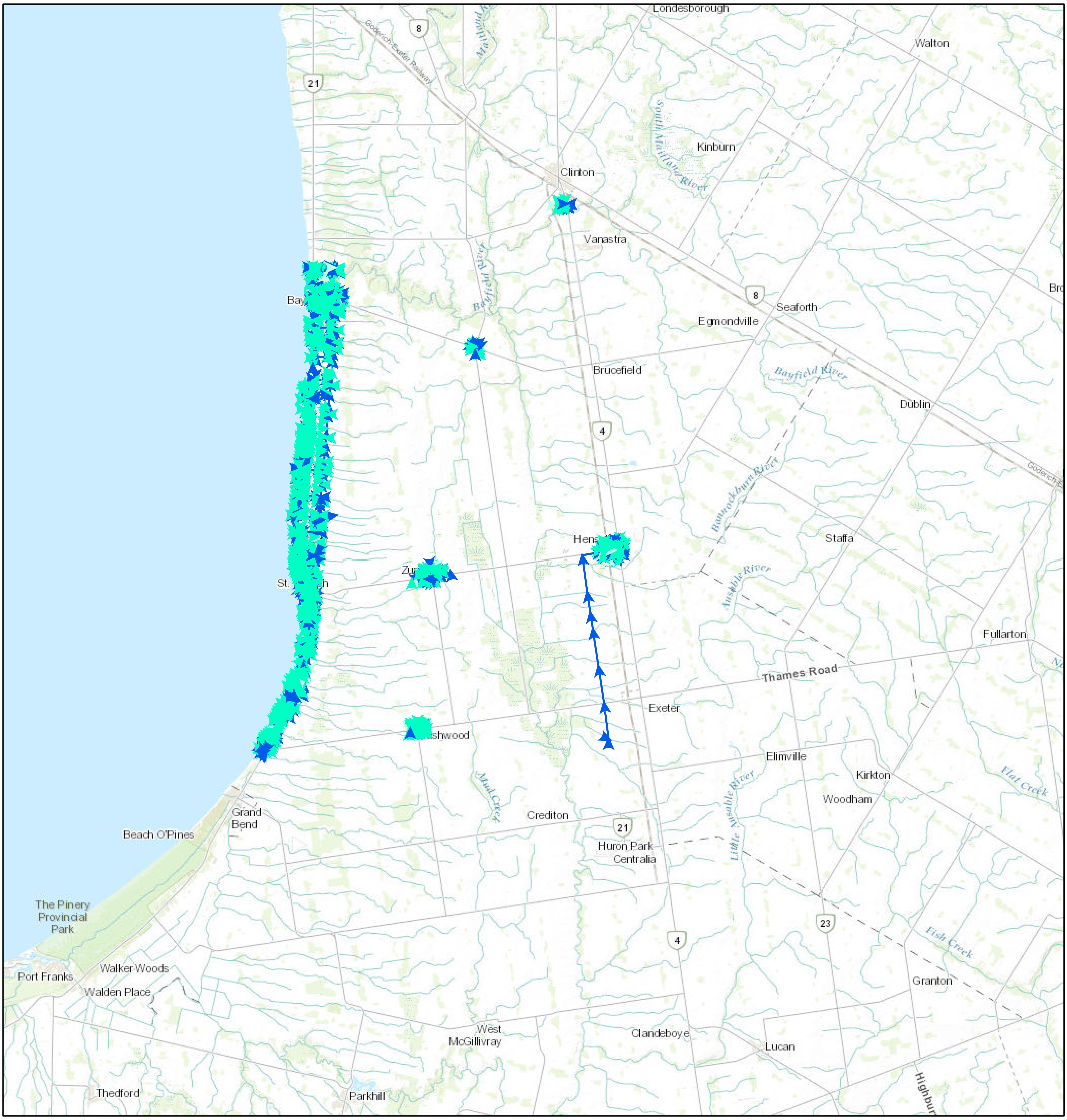
Figure 1. Lake Huron Primary Water Supply System Demand Nodes

4. An assessment undertaken through the recently completed Master Water Plan indicated that approximately 79% of the demand for the *Municipality of Bluewater* is not currently serviced by a LHPWSS regional storage facility. Please confirm whether this estimate is reasonable, and/or provide additional information to aid in our assessment.

Yes, this a reasonable assessment.

5. Please provide a current map of the distribution system for the *Municipality of Bluewater.*

Bluewater AM System



6/8/2021, 12:37:14 PM

WAT Line

- Hydrant Lead
- Service
- Watermain
- Other

1:288,895

0 | 2.25 | 4.5 | 9 mi
0 | 3.75 | 7.5 | 15 km

County of Huron, Ontario Base Map, Province of Ontario, Ontario MNR, Esri Canada, Esri, © OpenStreetMap contributors, HERE, Garmin, USGS, NGA, EPA, USDA, NPS, AAFC, NRCan

Survey Purpose and Disclaimer

The Lake Huron Primary Water Supply System (LHPWSS) has initiated a Schedule B Municipal Class Environmental Assessment (EA) at the Lake Huron Water Treatment Plant to confirm the recommendation for additional storage at the plant site and refine requirements for enhanced disinfection to provide operational flexibility, as identified in the recently completed LHPWSS Master Water Plan Update (2020).

The purpose of this survey is to confirm and gain further information regarding existing municipal storage facilities and demands pertaining to your municipality as it relates to its supply from LHPWSS.

Information collected is for assessment purposes only and should not be considered a commitment to services outside of the existing water supply agreement with your municipality.

Part A: Contact Information

Municipality Name: Municipality of South Huron

Completed by: Don Giberson

Title: Director of Infrastructure and Development

Email: dgiberson@southhuron.ca

Phone: 519-235-0310 (ext226)

Part B: General Information

Please review and confirm that the following information we have regarding the drinking water system associated with your municipality is correct and up to date:

Drinking Water System Name:	South Huron Water Distribution System
Drinking Water System Number:	220001520
Other Drinking Water Systems that Receive All Drinking Water From This System:	N/A
Drinking Water System Receives Water from:	Lake Huron Primary Water Supply System

If any information noted above is incorrect or missing, please note and describe here:

Click or tap here to enter text.

Part C: Municipal Storage and Demand Information

1. Please review the following *municipally-owned* storage facilities that service your municipality and confirm that the information is accurate, or update as applicable. Please add extra rows for additional facilities that service your municipality that may not be listed.

Storage Facility Name	**Owner**	**Storage Facility Capacity (ML)**	**Storage Facility Useable Volume (ML)** *(based on operating levels)*
Exeter Water Tower	Municipality of South Huron	1.5 ML	Click or tap here to enter text.
Huron Park Water Tower	Municipality of South Huron	2.7 ML	Click or tap here to enter text.
MacNaughton Drive Reservoirs	Municipality of South Huron	3.6 ML	Click or tap here to enter text.
Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.

Please note any additional/relevant information related to the municipal storage facilities listed above:

The LHPWSS Exeter-Hensall Reservoir and Booster Pumping Station located at Airport Line and Huron Street has 8,000m3 of storage, of which 69.81% is allocated to South Huron.

2. While it is noted that the LHPWSS is not designed to meet municipal distribution system level requirements, please indicate your municipality's current reliance on this regional storage with municipal storage to meet the following demands:

Type of Demand	**Municipal Storage (ML)**	**Regional Storage (ML)**
Equalization to meet peak demands	Can meet with municipal storage.	Not required
Emergency storage	Have approximately 5 days of emergency supply from existing municipal storage if LHPWSS supply disrupted.	Only required from Exeter-Hensall BPS & Reservoir
Fire flow	Can meet with existing municipal storage.	Only required from Exeter-Hensall BPS & Reservoir

Please provide additional information as applicable, including whether current available storage meets your needs, in the space below:

Current available storage meets our requirements. It would be beneficial if the Exeter-Hensall Reservoir could be re-configured to back feed the LHPWSS connection to the village of Dashwood.

3. Please review Figure 1 below and confirm that the portion of your municipality that is serviced directly from the Lake Huron Water Treatment Plant (i.e. customers upstream of LHPWSS Regional Storage Facilities) is represented by the respective nodes circled in red .

The areas of South Huron supplied directly from the LHPWSS Water Treatment Plant are shown correctly on Figure 1.

Please note that in an emergency, all areas of South Huron can be backfed and kept in service from municipal storage facilities. Also note that in an emergency, the lakeshore areas of South Huron can be backfed from Lambton Shores (LAWSS).

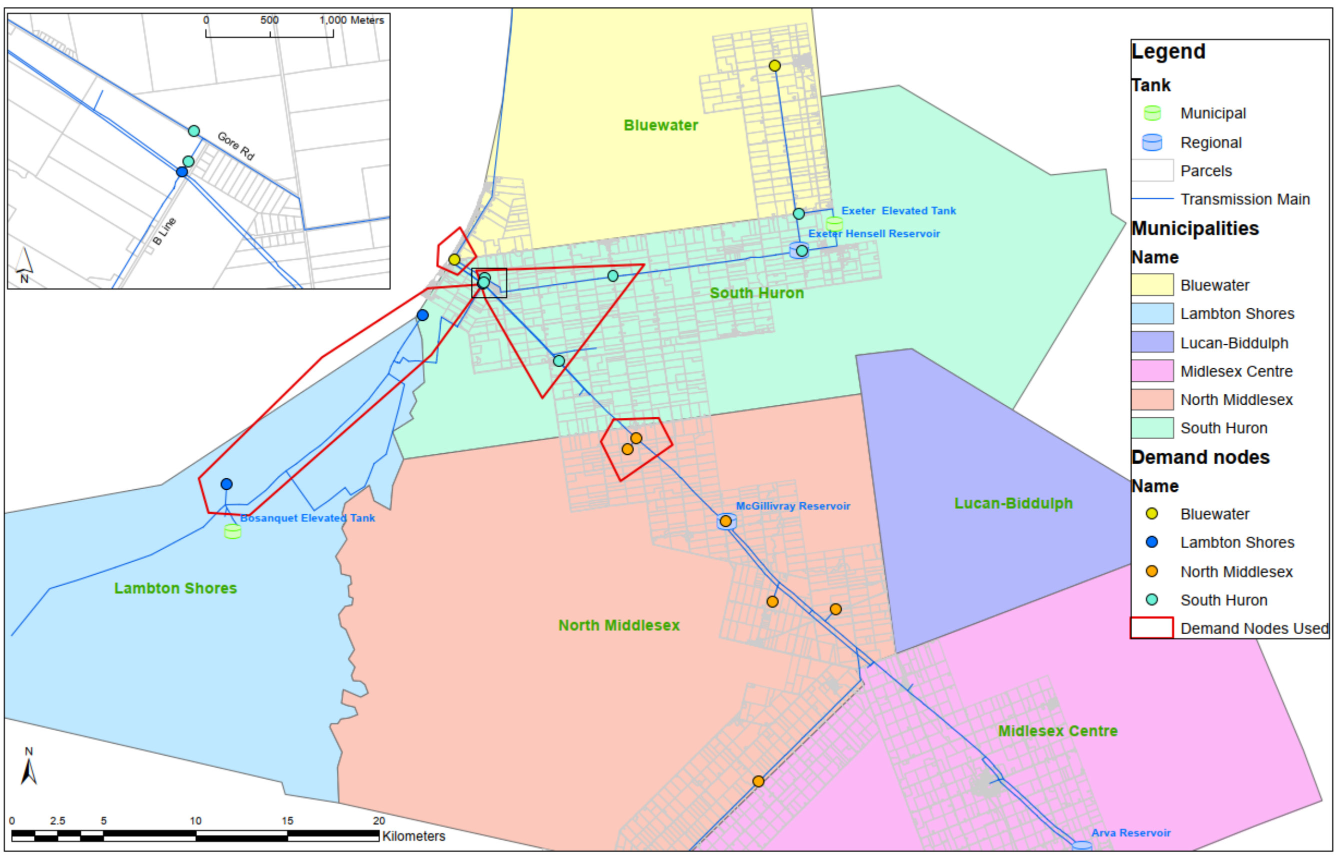
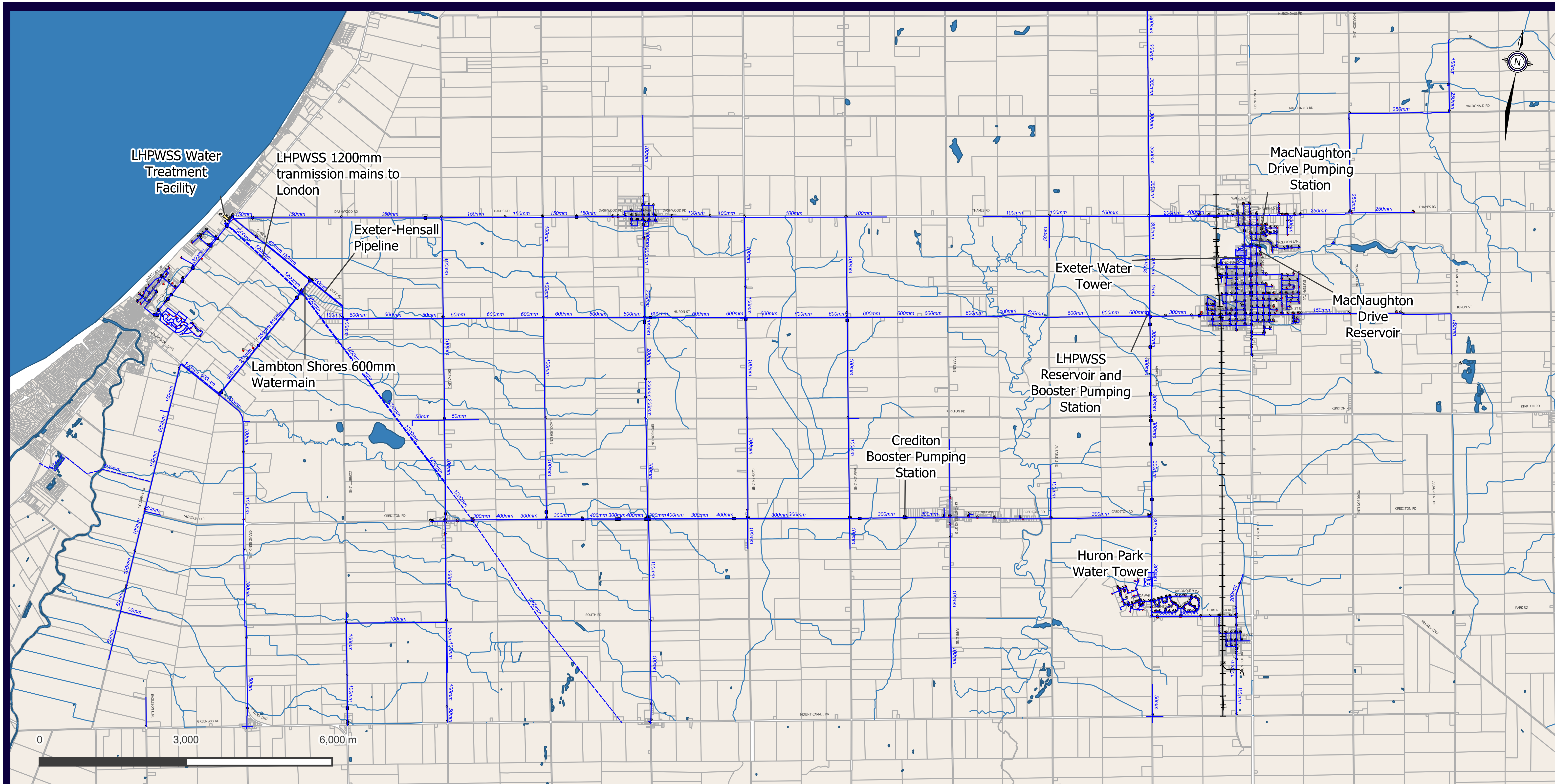


Figure 1. Lake Huron Primary Water Supply System Demand Nodes

4. An assessment undertaken through the recently completed Master Water Plan indicated that approximately 77% of the demand for the *Municipality of South Huron* is not currently serviced by a LHPWSS regional storage facility. Please confirm whether this estimate is reasonable, and/or provide additional information to aid in our assessment.

This estimate is reasonable if the LHPWSS Exeter-Hensall Reservoir is included. Based on South Huron historical consumption data we have estimated that approximately 80% of our demand is from municipal storage facilities.

5. Please provide a current map of the distribution system for the *Municipality of South Huron.*



Municipality of South Huron Stephen Ward Water Distribution System

No.	Revision Date	Revision Description	In-Service Date	Revised By
1	10/15/2015	Issued for MOECC Drinking Water Works Permit #054-201	N/A	D. Giberson
2	1/31/2017	Shipka Line (South Rd to Mount Carmel Dr) - 100mm	10/17/2016	D. Giberson
3	7/12/2018	Dashwood Rd (Hwy #21 to Shipka Line) - 150mm	5/18/2018	D. Giberson
	7/12/2018	Shipka Line (Crediton Rd to Kirkton Line) - 100mm	5/18/2018	D. Giberson
	7/12/2018	Dashwood Rd (Shipka Line to Dashwood Village) - 150mm	5/18/2018	D. Giberson
4	12/31/2019	Mollard Line (between South Rd and Crediton Rd) - 100mm	2/15/2019	D. Giberson
	12/31/2019	Huron St (Corbett Line to west end) - 100mm	4/15/2019	D. Giberson
	12/31/2019	Parr Line (Crediton Rd to Kirkton Rd) - 100mm	4/26/2019	D. Giberson
	12/31/2019	Parr Line (Crediton Rd to South Rd) - 100mm	5/10/2019	D. Giberson
	12/31/2019	Shipka Line (Kirkton Rd to Dashwood Rd) - 100mm	5/31/2019	D. Giberson

Water Hydrant
Water Valve
Water Chamber
Watermain
LHPWSS Watermain
Railway
Watercourse
Water Body

Facilities
Water Tower
Other Building

Project 518062
Issued February 2020
EPSG: 26917

Survey Purpose and Disclaimer

The Lake Huron Primary Water Supply System (LHPWSS) has initiated a Schedule B Municipal Class Environmental Assessment (EA) at the Lake Huron Water Treatment Plant to confirm the recommendation for additional storage at the plant site and refine requirements for enhanced disinfection to provide operational flexibility, as identified in the recently completed LHPWSS Master Water Plan Update (2020).

The purpose of this survey is to confirm and gain further information regarding existing municipal storage facilities and demands pertaining to your municipality as it relates to its supply from LHPWSS.

Information collected is for assessment purposes only and should not be considered a commitment to services outside of the existing water supply agreement with your municipality.

Part A: Contact Information

Municipality Name: Municipality of Lambton Shores

Completed by: Nick Verhoeven

Title: Engineering Specialist

Email: nverhoeven@lambtonshores.ca

Phone: 519.243.1400 ext 8213

Part B: General Information

Please review and confirm that the following information we have regarding the drinking water system associated with your municipality is correct and up to date:

Drinking Water System Name:	East Lambton Shores Water Distribution System
Drinking Water System Number:	260006568
Other Drinking Water Systems that Receive All Drinking Water From This System:	N/A
Drinking Water System Receives Water from:	Lake Huron Primary Water Supply System

If any information noted above is incorrect or missing, please note and describe here:

Click or tap here to enter text.

Part C: Municipal Storage and Demand Information

1. Please review the following *municipally-owned* storage facilities that service your municipality and confirm that the information is accurate, or update as applicable. Please add extra rows for additional facilities that service your municipality that may not be listed.

Storage Facility Name	**Owner**	**Storage Facility Capacity (ML)**	**Storage Facility Useable Volume (ML)** *(based on operating levels)*
Northville (Bosanquet) Elevated Tank	Municipality of Lambton Shores	3.7 ML	Click or tap here to enter text.
Thedford Reservoir	Municipality of Lambton Shores	0.9 ML	Click or tap here to enter text.
Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.

Please note any additional/relevant information related to the municipal storage facilities listed above:

Click or tap here to enter text.

2. While it is noted that the LHPWSS is not designed to meet municipal distribution system level requirements, please indicate your municipality's current reliance on this regional storage with municipal storage to meet the following demands:

Type of Demand	**Municipal Storage (ML)**	**Regional Storage (ML)**
Equalization to meet peak demands	Click or tap here to enter text.	Click or tap here to enter text.
Emergency storage	Click or tap here to enter text.	Click or tap here to enter text.
Fire flow	Click or tap here to enter text.	Click or tap here to enter text.

Please provide additional information as applicable, including whether current available storage meets your needs, in the space below:

Click or tap here to enter text.

3. Please review Figure 1 below and confirm that the portion of your municipality that is serviced directly from the Lake Huron Water Treatment Plant (i.e. customers upstream of LHPWSS Regional Storage Facilities) is represented by the respective nodes circled in red .

Correct below

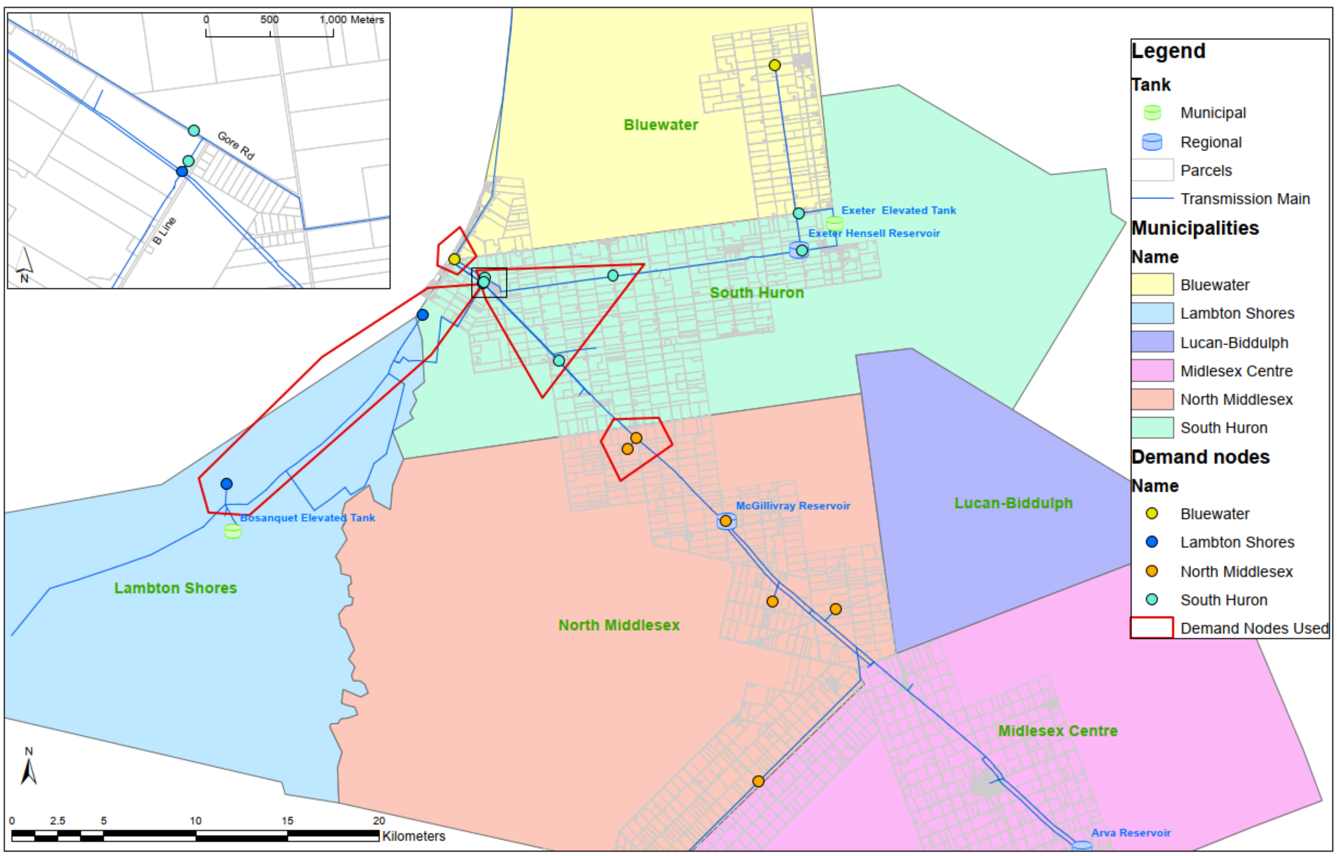
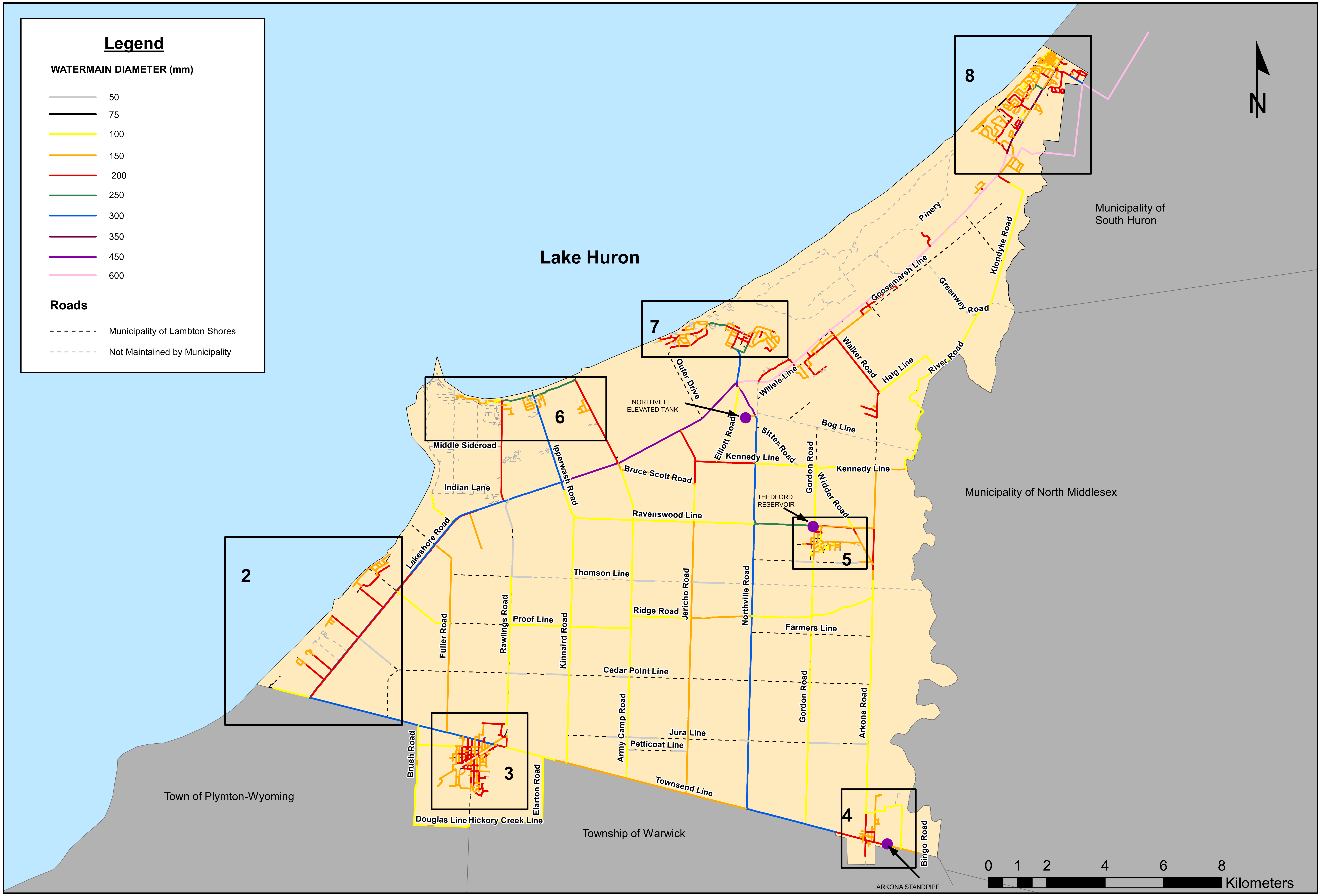


Figure 1. Lake Huron Primary Water Supply System Demand Nodes

4. An assessment undertaken through the recently completed Master Water Plan indicated that approximately 100% of the demand for the *Municipality of Lambton Shores (East Lambton Shores Distribution System)* is not currently serviced by a LHPWSS regional storage facility. Please confirm whether this estimate is reasonable, and/or provide additional information to aid in our assessment.

Yes this is reasonable

5. Please provide a current map of the distribution system for the *Municipality of Lambton Shores.*

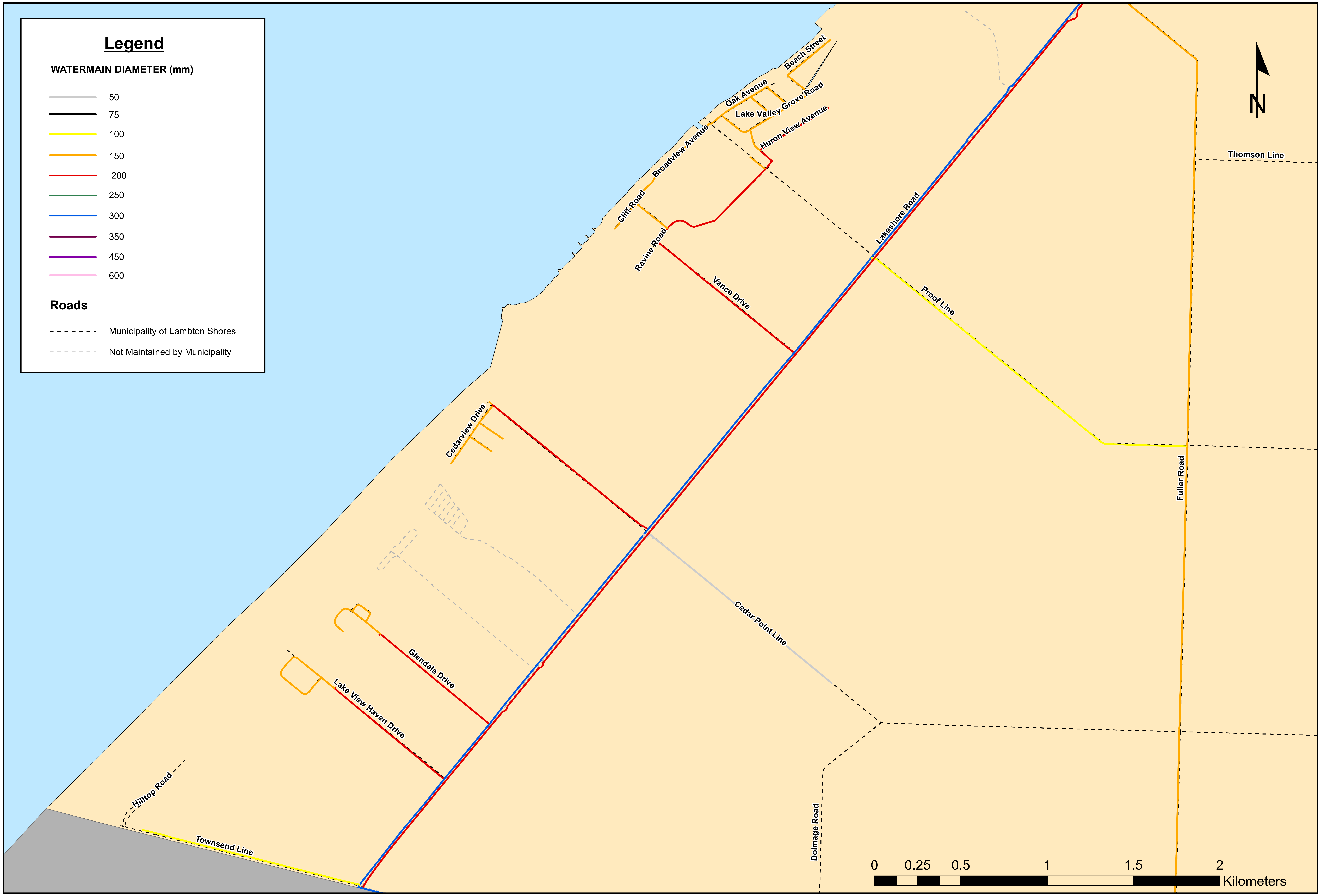


THE MUNICIPALITY OF
LAMBTON SHORES

MUNICIPALITY OF LAMBTON SHORES

WATER DISTRIBUTION SYSTEM

FIGURE No. 1	
DATE CREATED Jan. 2020	CREATED BY RM



THE MUNICIPALITY OF
LAMBTON SHORES

MUNICIPALITY OF LAMBTON SHORES

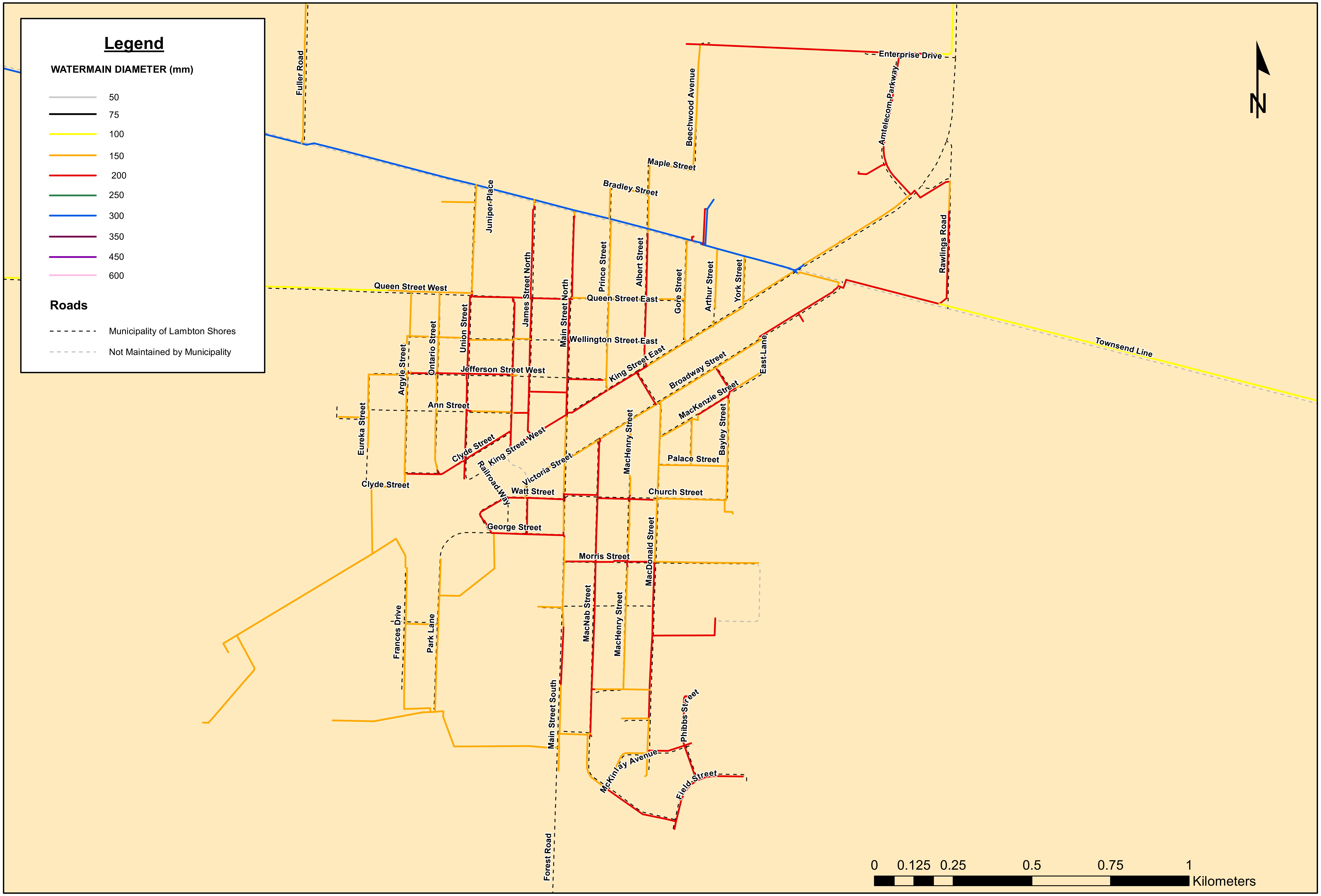
WATER DISTRIBUTION SYSTEM

LAKESHORE

FIGURE No.
2

DATE CREATED
Jan. 2020

CREATED BY
RM



THE MUNICIPALITY OF
LAMBTON SHORES

MUNICIPALITY OF LAMBTON SHORES

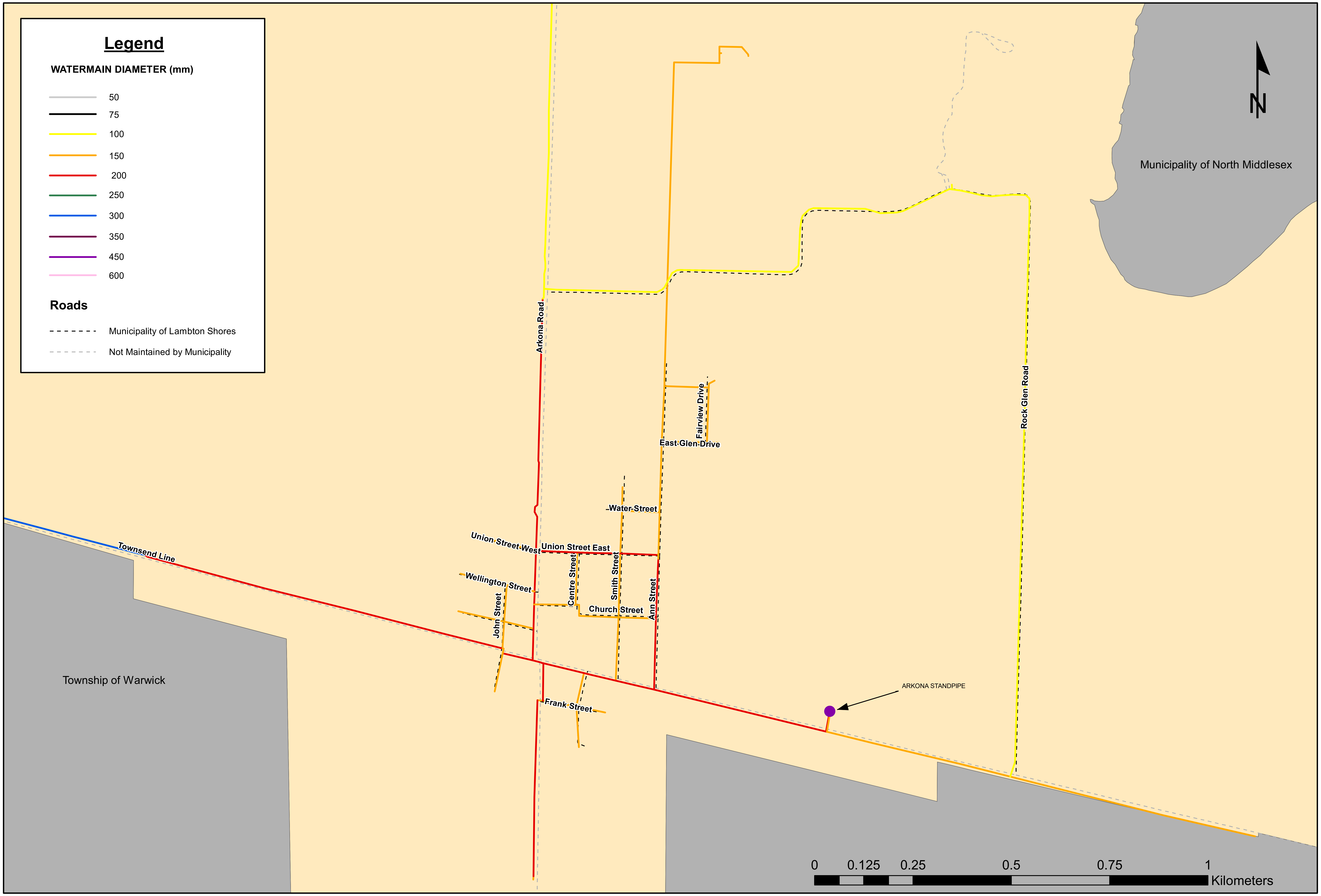
WATER DISTRIBUTION SYSTEM

FOREST

FIGURE No.
3

DATE CREATED
Jan. 2020

CREATED BY
RM



THE MUNICIPALITY OF LAMBTON SHORES

MUNICIPALITY OF LAMBTON SHORES

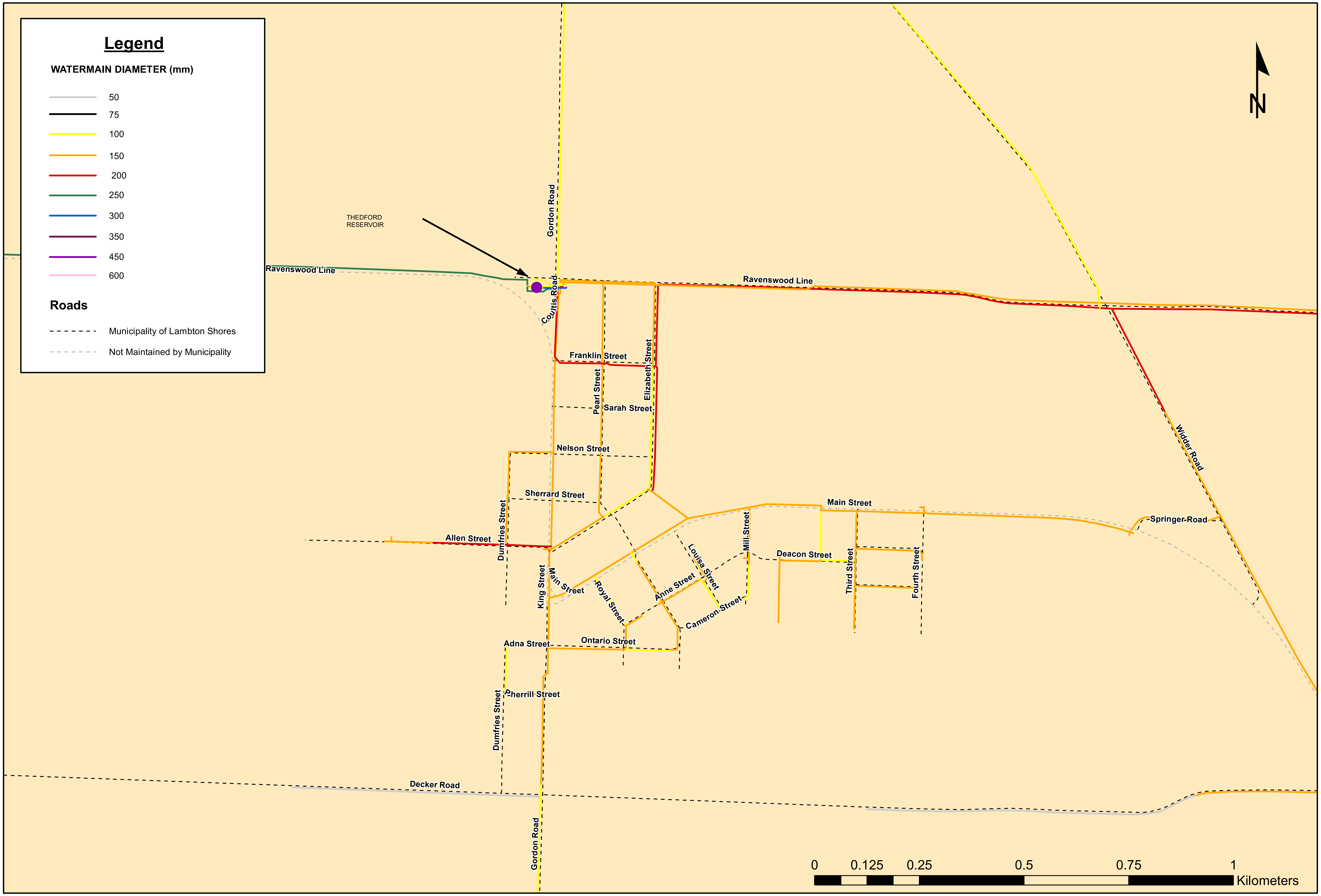
WATER DISTRIBUTION SYSTEM

ARKONA

FIGURE No. 4

DATE CREATED Jan. 2020

CREATED BY RM



THE MUNICIPALITY OF LAMBTON SHORES

MUNICIPALITY OF LAMBTON SHORES

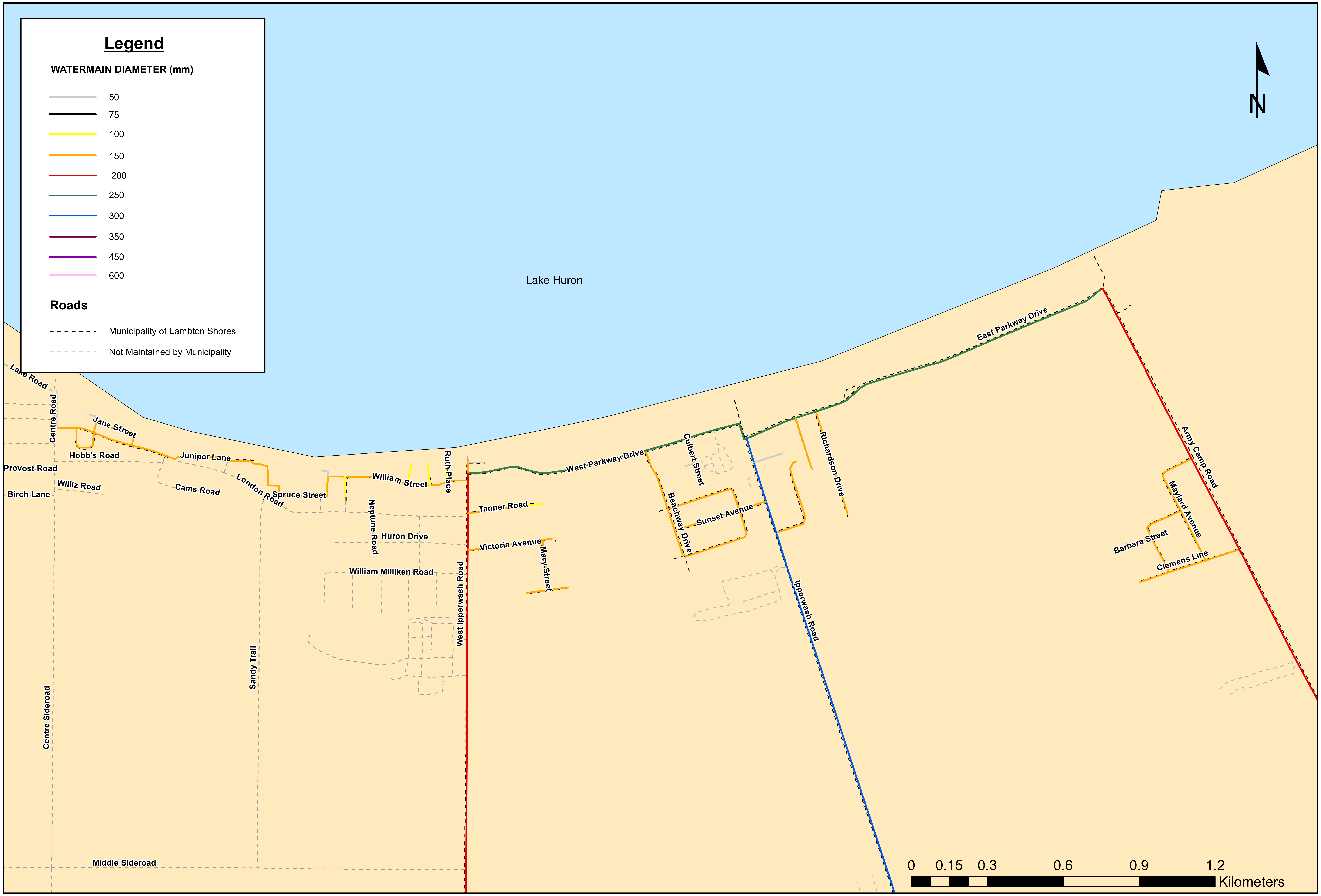
WATER DISTRIBUTION SYSTEM

THEDFORD

FIGURE No. 5

DATE CREATED Jan. 2020

CREATED BY RM



THE MUNICIPALITY OF
LAMBTON SHORES

MUNICIPALITY OF LAMBTON SHORES

WATER DISTRIBUTION SYSTEM

IPPERWASH

FIGURE No.
6

DATE CREATED
Jan. 2020

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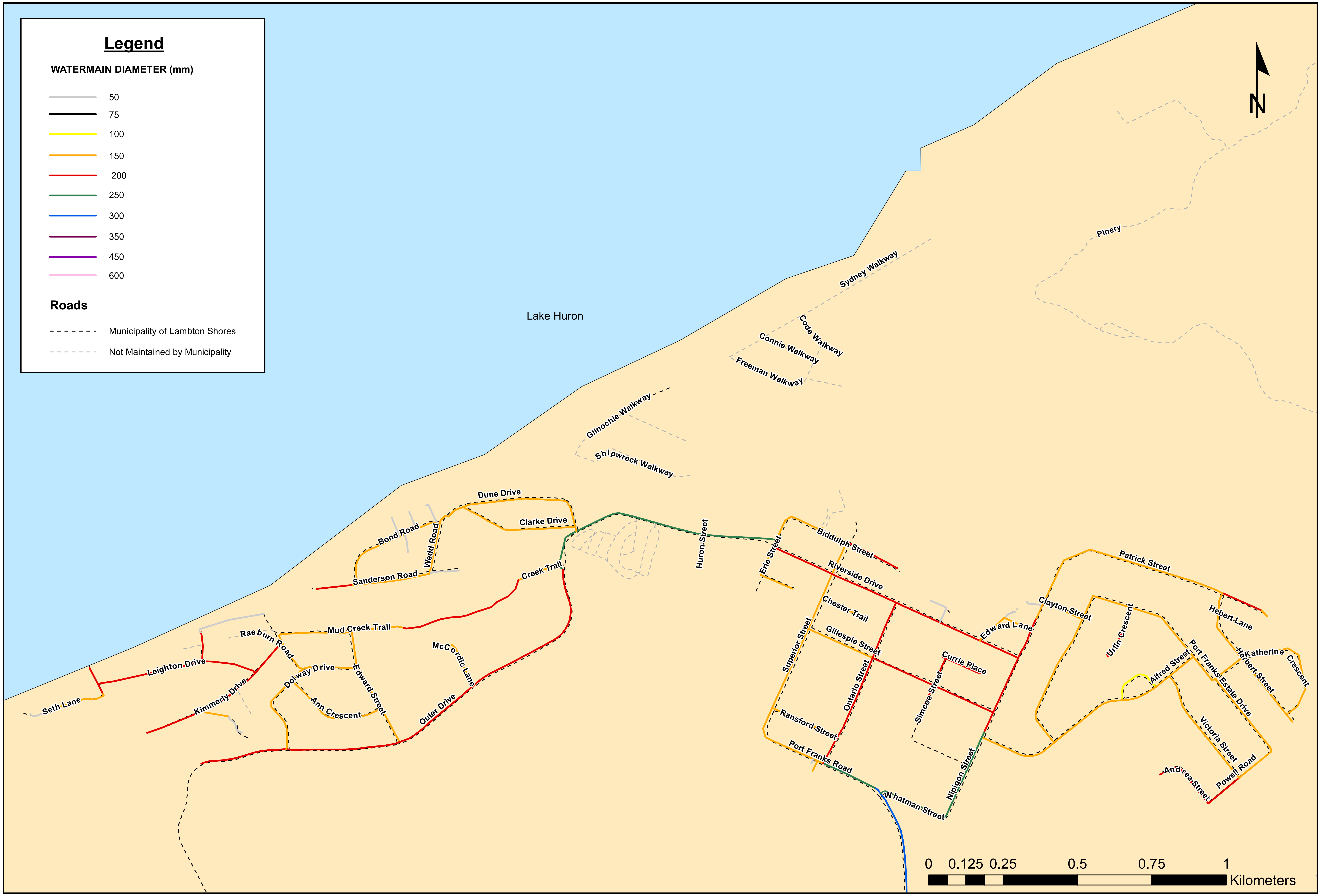
RM



THE MUNICIPALITY OF LAMBTON SHORES

MUNICIPALITY OF LAMBTON SHORES

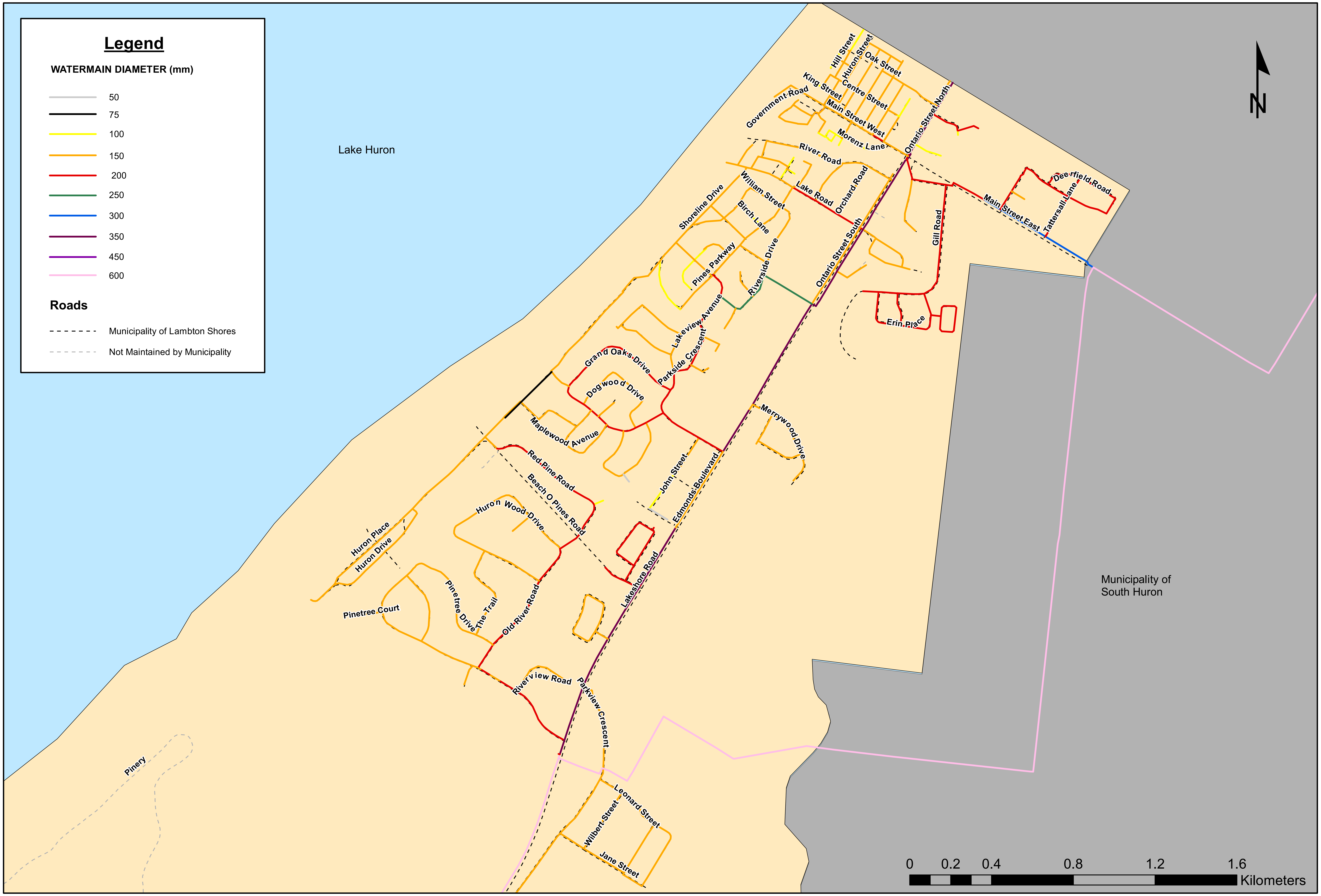
WATER DISTRIBUTION SYSTEM

PORT FRANKS

FIGURE No.
7

DATE CREATED
Jan. 2020

CREATED BY
RM



THE MUNICIPALITY OF
LAMBTON SHORES

MUNICIPALITY OF LAMBTON SHORES

WATER DISTRIBUTION SYSTEM

GRAND BEND

FIGURE No.
8

DATE CREATED
Jan. 2020

CREATED BY
RM

Survey Purpose and Disclaimer

The Lake Huron Primary Water Supply System (LHPWSS) has initiated a Schedule B Municipal Class Environmental Assessment (EA) at the Lake Huron Water Treatment Plant to confirm the recommendation for additional storage at the plant site and refine requirements for enhanced disinfection to provide operational flexibility, as identified in the recently completed LHPWSS Master Water Plan Update (2020).

The purpose of this survey is to confirm and gain further information regarding existing municipal storage facilities and demands pertaining to your municipality as it relates to its supply from LHPWSS.

Information collected is for assessment purposes only and should not be considered a commitment to services outside of the existing water supply agreement with your municipality.

Part A: Contact Information

Municipality Name: North Middlesex

Completed by: Jonathan Lampman

Title: Infrastructure Manager

Email: jonathanl@northmidlesex.on.ca

Phone: 519-520-3515

Part B: General Information

Please review and confirm that the following information we have regarding the drinking water system associated with your municipality is correct and up to date:

Drinking Water System Name:	North Middlesex Distribution System
Drinking Water System Number:	260006529
Other Drinking Water Systems that Receive All Drinking Water From This System:	N/A
Drinking Water System Receives Water from:	Lake Huron Primary Water Supply System

If any information noted above is incorrect or missing, please note and describe here:

North Middlesex feeds residents of Lucan Biddulph, Adelaide Metcalfe, Lambton Shores, South Huron & Middlesex Centre along boundary Roads.

Part C: Municipal Storage and Demand Information

1. Please review the following *municipally-owned* storage facilities that service your municipality and confirm that the information is accurate, or update as applicable. Please add extra rows for additional facilities that service your municipality that may not be listed.

Storage Facility Name	**Owner**	**Storage Facility Capacity (ML)**	**Storage Facility Useable Volume (ML)** *(based on operating levels)*
Parkhill Reservoir	Municipality of North Middlesex	1.1 ML	Click or tap here to enter text.
Mount Carmel Reservoir	Municipality of North Middlesex	0.45 ML	Click or tap here to enter text.
Ailsa Craig Elevated Tank (To be constructed)	Municipality of North Middlesex	2.5 ML	Click or tap here to enter text.
McGillivaray Reservoir	LHPWSS	Click or tap here to enter text.	Click or tap here to enter text.

Please note any additional/relevant information related to the municipal storage facilities listed above:

AC Water Tower should be online by October 2022, NM has 2 x 30hp pumps that feed the north central portion of the Municipality from the McGillivaray reservoir

2. While it is noted that the LHPWSS is not designed to meet municipal distribution system level requirements, please indicate your municipality's current reliance on this regional storage with municipal storage to meet the following demands:

Type of Demand	Municipal Storage (ML)	Regional Storage (ML)
Equalization to meet peak demands	1.55ML	Click or tap here to enter text.
Emergency storage	N/A	Click or tap here to enter text.
Fire flow	N/A	Click or tap here to enter text.

Please provide additional information as applicable, including whether current available storage meets your needs, in the space below:

The Parkhill reservoir provides approximately 8 hours (ADD) of storage when LPHWSS line is down. At which point the reservoir would be empty and we would lose pressure and flow to half of the municipality. We completely rely upon LPHWSS for all storage and supply needs.

3. Please review Figure 1 below and confirm that the portion of your municipality that is serviced directly from the Lake Huron Water Treatment Plant (i.e. customers upstream of LHPWSS Regional Storage Facilities) is represented by the respective nodes circled in red .

Click or tap here to enter text.

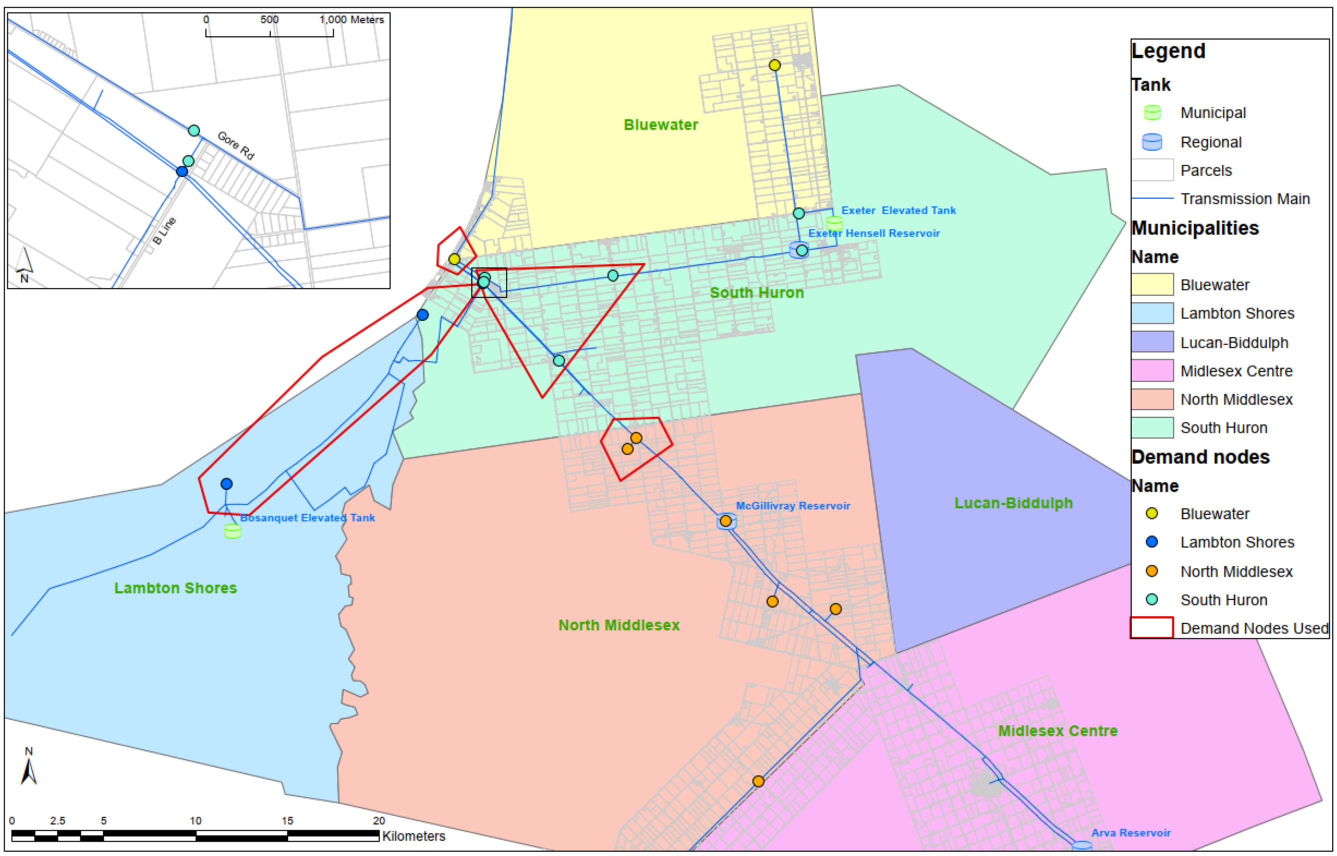


Figure 1. Lake Huron Primary Water Supply System Demand Nodes

4. An assessment undertaken through the recently completed Master Water Plan indicated that approximately 36% of the demand for the *Municipality of North Middlesex* is not currently serviced by a LHPWSS regional storage facility. Please confirm whether this estimate is reasonable, and/or provide additional information to aid in our assessment.

100% of the piped water serving North Middlesex comes from LHPWSS Grand Bend Facility. We have 2631 Residences in the municipality 2350 of them are fed via the NM distribution network.

5. Please provide a current map of the distribution system for the *Municipality of North Middlesex.*

Stea, Cassie

From: Jonathan Lampman <jonathanl@northmiddlesex.on.ca>
Sent: Friday, July 16, 2021 9:23 AM
To: Stea, Cassie
Cc: Waller, Monique/KWO; Yu, Ray
Subject: [EXTERNAL] RE: Lake Huron WTP Environmental Assessment - Water Storage Questionnaire

Follow Up Flag: Follow up
Flag Status: Flagged

Hello Cassie,

Ahead of the water tower installation, which we have broken ground on, 50% would be more accurate. Once the tower is installed and commissioned (December 2022) 36% Would be reasonable.

Regards,

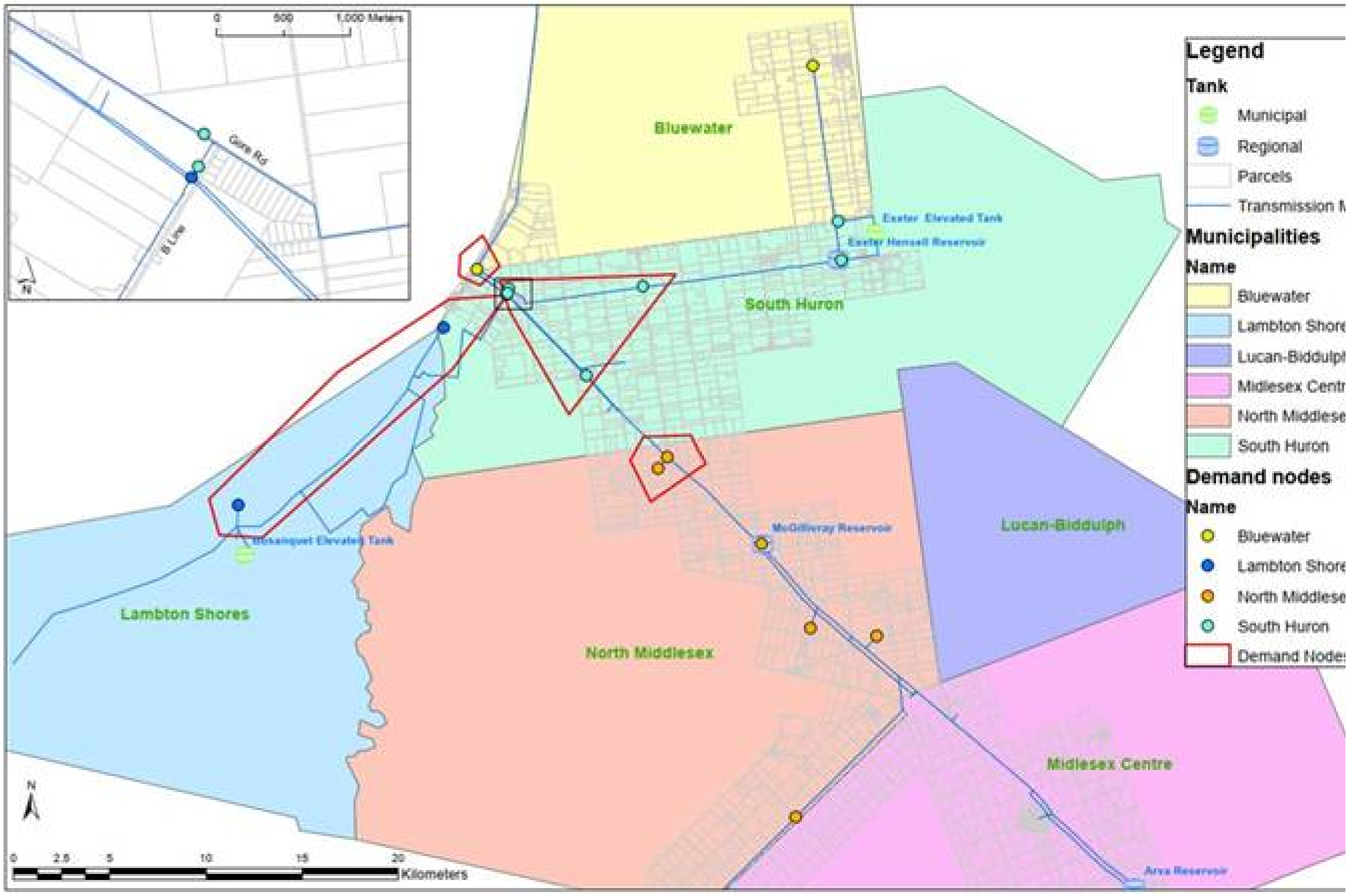
Jonathan Lampman
Infrastructure Manager
The Municpality of North Middlesex
jonathanl@northmiddlesex.on.ca
519-294-6244 ext. 223

From: Stea, Cassie [mailto:Cassie.Stea@jacobs.com]
Sent: Thursday, July 15, 2021 6:20 PM
To: Jonathan Lampman <jonathanl@northmiddlesex.on.ca>
Cc: Waller, Monique/KWO <Monique.Waller@jacobs.com>; Yu, Ray <Ray.Yu@jacobs.com>
Subject: RE: Lake Huron WTP Environmental Assessment - Water Storage Questionnaire

Hello Jonathan,

Thank you again for taking the time to complete the storage questionnaire. Upon review of your submitted responses, we would like to clarify responses with regards to Questions 3 and 4 in Part C of the survey. For convenience, Questions 3 and 4 are copied below:

Question 3: Please review Figure 1 below and confirm that the portion of your municipality that is serviced directly from the Lake Huron Water Treatment Plant (i.e. customers upstream of LHPWSS Regional Storage Facilities) is represented by the respective nodes circled in red .



Question 4: An assessment undertaken through the recently completed Master Water Plan indicated that approximately 36% of the demand for the Municipality of North Middlesex is not currently serviced by a LHPWSS regional storage facility. Please confirm whether this estimate is reasonable, and/or provide additional information to aid in our assessment.

We are aware that North Middlesex receives 100% of their water from the Lake Huron Water Treatment Plant in Grand Bend. However the intent of Questions 3 and 4 were to confirm that 36% is a reasonable estimate for the portion of the demand in the Municipality of North Middlesex that is serviced directly from the Lake Huron WTP without any other LHPWSS regional storage facilities in between (i.e. customers upstream of the McGillivray Reservoir). The two orange nodes circled in red on the Figure above are a physical representation of this, showing that only these two demand nodes are considered as being directly supplied by the Lake Huron WTP without a LHPWSS regional storage facility in between. Based on these clarifications, can you advise on whether you agree or not that ~36% is a reasonable estimate?

If you would like any further clarifications, would be happy to schedule a call to discuss.

Kind regards,
Cassie

Cassie Stea | Jacobs | Water/Wastewater Engineer-in-Training
People, Places & Solutions | Toronto, Canada
M: 604-724-3601 | cassie.stea@jacobs.com

From: Jonathan Lampman <jonathanl@northmiddlesex.on.ca>
Sent: Thursday, June 17, 2021 2:16 PM
To: Stea, Cassie <Cassie.Stea@jacobs.com>

Cc: Waller, Monique/KWO <Monique.Waller@jacobs.com>; Yu, Ray <Ray.Yu@jacobs.com>; Brittany Bryans <bbryans@huronelginwater.ca>
Subject: [EXTERNAL] RE: Lake Huron WTP Environmental Assessment - Water Storage Questionnaire

Cassie,

Please see the attached completed Storage document for you use as well as our latest and greatest distribution map.

Regards,

North Middlesex

Jonathan Lampman
Infrastructure Manager
Municipality of North Middlesex
jonathanl@northmiddlesex.on.ca
P: 519-294-6244 ext.223
C: 519-520-3515

From: Stea, Cassie [mailto:Cassie.Stea@jacobs.com]
Sent: Monday, June 14, 2021 10:29 AM
To: Jonathan Lampman <jonathanl@northmiddlesex.on.ca>
Cc: Waller, Monique/KWO <Monique.Waller@jacobs.com>; Yu, Ray <Ray.Yu@jacobs.com>; Brittany Bryans <bbryans@huronelginwater.ca>
Subject: Lake Huron WTP Environmental Assessment - Water Storage Questionnaire

Hello Mr. Lampman,

As of February 1, 2021, the Lake Huron Primary Water Supply System (LHPWSS) has commenced a Class Environmental Assessment (EA) for Disinfection and Storage Upgrades at the Lake Huron Water Treatment Plant.

As part of the EA, Jacobs has prepared a Water Storage Questionnaire to confirm and gain further information regarding existing municipal storage facilities and demands pertaining to your municipality as it relates to its supply from LHPWSS, to inform the development of alternatives for the EA. The intent of the survey is to expand the information that was provided by your municipality as part of the LHPWSS Master Water Plan Update (2020). It should be noted that the information collected via the questionnaire is for assessment purposes only and should not be considered a commitment to services outside of the existing water supply agreement with your municipality and LHPWSS.

An email was sent with the survey request to the contact below, Jonathon Graham, on May 5, 2021.

Jonathon Graham
Director of Operations
JonathonDG@northmiddlesex.on.ca

No response has been received since the initial request and after two follow up emails were issued. Would you or another qualified person at your municipality be willing to complete the attached survey?

If you have any questions, please contact myself or a member of the project team: Monique Waller – Assistant Project Manager (Jacobs), or Brittany Bryans – Research and Process Optimization Engineer (Lake Huron and Elgin Area Water Systems). We look forward to hearing from you.

Kind regards,
Cassie Stea

Cassie Stea | Jacobs | Water/Wastewater Engineer-in-Training
People, Places & Solutions | Toronto, Canada
M: 604-724-3601 | cassie.stea@jacobs.com

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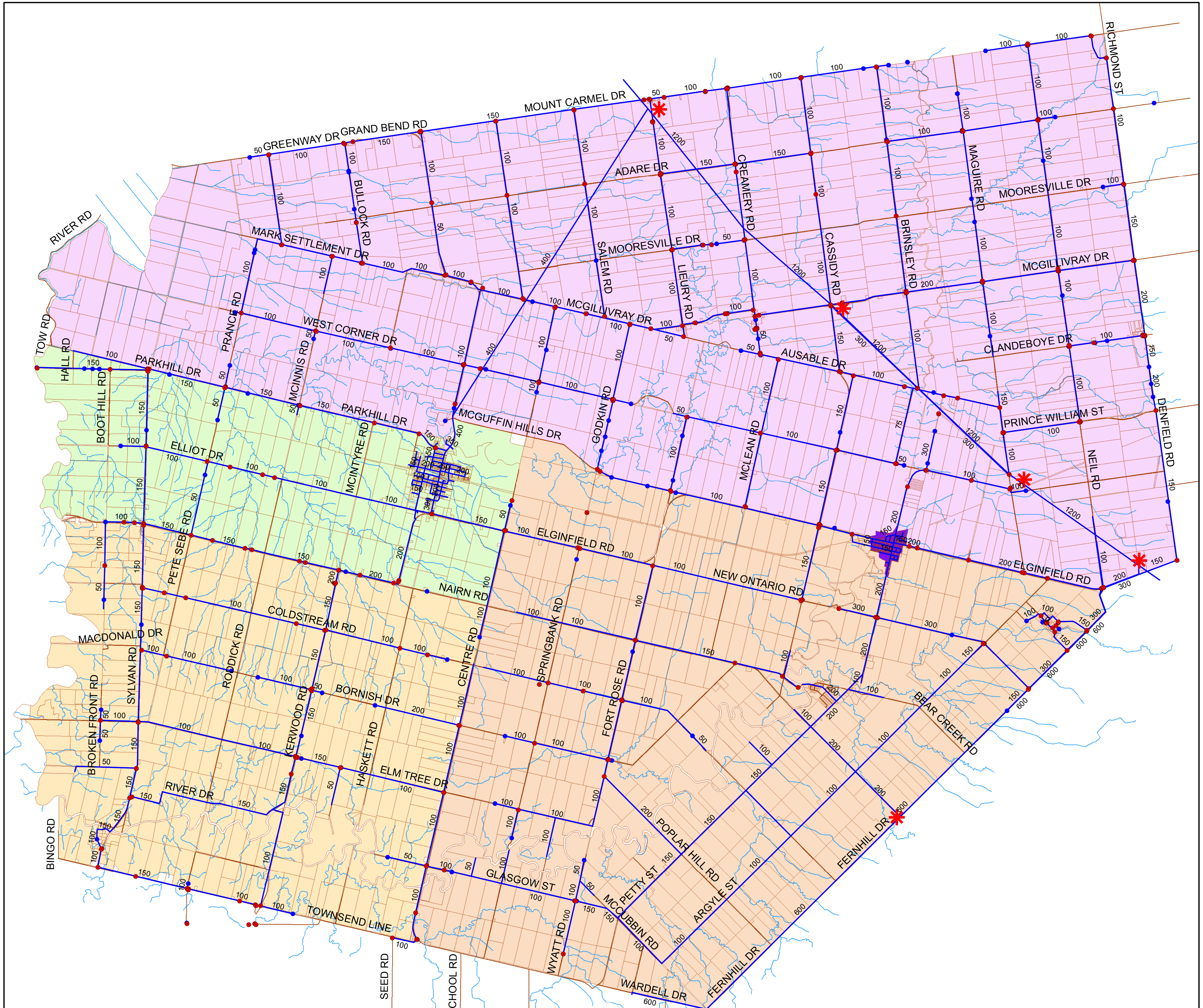


MUNICIPALITY OF NORTH MIDDLESEX

WATER SERVICE DISTRICTS

Legend

- Secondary System Connection to Primary System
- WaterValve (CW)
- Watervalve (CCW)
- WaterBlowoffs
- Watermains
- Property
- Streams
- Roads
- McGillvray District
- East Williams District
- Parkhill District
- Ailsa Craig District
- West Williams District

0 700 1,400 2,800 4,200 5,600 Meters

Date: March 2009
Scale: 1:100,000
Coodinate System: UTM Nad83 Zone17
Source Date:

N W E S

OVERALL SYSTEM

DILLON CONSULTING

Attachment B. CT Calculations

Alternative formats of the information in this attachment are available by contacting mmckillop@huronelginwater.ca.

Alternative 2 - Clearwell Upgrades (Install Overflow Weirs and Increase BF to 0.7 with Baffle Walls), and New Reservoir

Disinfection Segment No.	Process	No. of Trains	Units per Train	Unit Dimensions	Monitoring Station	Baffling Factor (t_{10}/T)	Worst Scenario Conditions					Process Volume / Train (m^3)	Retention time (T, min)	t10 (min)	CT (mg/L-min)	CT Req'd for 3-log Giardia Inactivation	CT Req'd for 4-log Viruses Inactivation	Achieved Giardia Inactivation	Achieved Viruses Inactivation
						BF	Q: Flow (m^3/d)	FCR (mg/L)	pH	Temp. (°C)	Operation Depth (m)	V: Operating Volume	T = V/Q	t10 = BF*T	CT = FCR*t10	CT3	CT4	CT/CT3*3	CT/CT4*4
Potential Segment	Raw water intake pipe	1	1	2,530 m × ø1,800 mm	MS1	1	340,000	0.00	8.70	2.30	n/a	6,438	27.27	27.27	0.00			0	0
Segment I	Raw water pipe to treatment plant	1	1	1,800 mm dia. 80 m	MS1.5	1	340,000	0.50	7.50	2.30	n/a	200	0.85	0.85	0.42	210	10	0.006	0.166
	Flocculation	2	4	17.8 m (L) × 5.03 m (W) × 7.42 m (WD)	MS2	0.5	340,000	0.50	7.50	2.30	n/a	2,656	22.50	11.25	5.62	210	10	0.080	2.206
	Sedimentation	2	2	15.6 m (L) × 15.6 m (W) × 6.96 m (WD)	MS2	0.3	340,000	0.50	7.50	2.30	n/a	3,396	28.77	8.63	4.31	210	10	0.062	1.692
Segment II	Filtration	2	6	16.76 m (L) × 6.1 m (W) × 1.52 m (above media)	MS3	0.7	340,000	0.50	7.50	2.30	n/a	777	6.58	4.61	2.30	210	10	0.033	0.903
Segment III	Clearwell	2	1 / 2#	North: 20.12 m (L) × 45.75 m (W)	MS4	0.7	170,000	1.10	7.50	2.30	2.00	1,841	15.59	10.92	12.01	226	10	0.159	4.709
				South: 20.12 m (L) × 45.75 m (W) + 20.15 m (L) × 46 m (W) #	MS4	0.7	170,000	1.10	7.50	2.30	2.00	3,695	31.30	21.91	24.10	226	10	0.319	9.450
Segment IV	New Reservoir (Disinfection Component)	1	1	65 m (L) x 70 m (W)	MS4	0.7	340,000	1.10	7.50	2.30	0.81	3,650	15.46	10.82	11.90	226	10	0.158	4.668
	Suction Conduits	1	1	52.43 m (L) × 3.05 m (W) *	MS5	0.1	485,000	1.10	7.50	2.30	4.90	798	2.37	0.24	0.26	226	10	0.003	0.102
	~~B-line loop~~	~~1~~	~~1~~	~~2 × 2,035 m × ø 1,200 mm~~	~~MS5.5~~	~~1~~	~~340,000~~	~~1.00~~	~~9.50~~	~~2.30~~	~~n/a~~	~~4,603~~	~~19.50~~	~~19.50~~	~~19.50~~	~~462~~	~~43~~	-	-
Credits																		**0.501**	**14.446**
Required																		**0.500**	**2.000**

<--Requires a volume component in the new reservoir for disinfection

Credits Excluding Reservoir Disinfection Volume:	0.344
Deficit (Excluding Reservoir):	0.156

Alternative 3 - New Large Reservoir to Meet All Storage Needs

Disinfection Segment No.	Process	No. of Trains	Units per Train	Unit Dimensions	Monitoring Station	Baffling Factor (t_{10}/T)	Worst Scenario Conditions					Process Volume / Train (m^3)	Retention time (T, min)	t10 (min)	CT (mg/L-min)	CT Req'd for 3-log Giardia Inactivation	CT Req'd for 4-log Viruses Inactivation	Achieved Giardia Inactivation	Achieved Viruses Inactivation
						BF	Q: Flow (m^3/d)	FCR (mg/L)	pH	Temp. (°C)	Operation Depth (m)	V: Operating Volume	T = V/Q	t10 = BF*T	CT = FCR*t10	CT3	CT4	CT/CT3*3	CT/CT4*4
Potential Segment	Raw water intake pipe	1	1	2,530 m × ø1,800 mm	MS1	1	340,000	0.00	8.70	2.30	n/a	6,438	27.27	27.27	0.00			0	0
Segment I	Raw water pipe to treatment plant	1	1	1,800 mm dia. 80 m	MS1.5	1	340,000	0.50	7.50	2.30	n/a	200	0.85	0.85	0.42	210	10	0.006	0.166
	Flocculation	2	4	17.8 m (L) × 5.03 m (W) × 7.42 m (WD)	MS2	0.5	340,000	0.50	7.50	2.30	n/a	2,656	22.50	11.25	5.62	210	10	0.080	2.206
	Sedimentation	2	2	15.6 m (L) × 15.6 m (W) × 6.96 m (WD)	MS2	0.3	340,000	0.50	7.50	2.30	n/a	3,396	28.77	8.63	4.31	210	10	0.062	1.692
Segment II	Filtration	2	6	16.76 m (L) × 6.1 m (W) × 1.52 m (above media)	MS3	0.7	340,000	0.50	7.50	2.30	n/a	777	6.58	4.61	2.30	210	10	0.033	0.903
Segment III	Clearwell	2	1 / 2#	North: 20.12 m (L) × 45.75 m (W)	MS4	0.4	170,000	1.10	7.50	2.30	2.00	1,841	15.59	6.24	6.86	226	10	0.091	2.691
				South: 20.12 m (L) × 45.75 m (W) + 20.15 m (L) × 46 m (W) #	MS4	0.4	170,000	1.10	7.50	2.30	2.00	3,695	31.30	12.52	13.77	226	10	0.183	5.400
Segment IV	New Reservoir (Disinfection Component)	1	1	65 m (L) x 70 m (W)	MS4	0.7	340,000	1.10	7.50	2.30	1.16	5,225	22.13	15.49	17.04	226	10	0.226	6.682
	Suction Conduits	1	1	52.43 m (L) × 3.05 m (W) *	MS5	0.1	485,000	1.10	7.50	2.30	4.90	798	2.37	0.24	0.26	226	10	0.003	0.102
	~~B-line loop~~	~~1~~	~~1~~	~~2 × 2,035 m × ø 1,200 mm~~	~~MS5.5~~	~~1~~	~~340,000~~	~~1.00~~	~~9.50~~	~~2.30~~	~~n/a~~	~~4,603~~	~~19.50~~	~~19.50~~	~~19.50~~	~~462~~	~~43~~	-	-
Credits																		**0.501**	**14.442**
Required																		**0.500**	**2.000**

<--Requires a volume component in the new reservoir for disinfection

Credits Excluding Reservoir Disinfection Volume:	0.275
Deficit (Excluding Reservoir):	0.225

Alternative 4.1 - UV Disinfection at Settled Water Conduits (and New Reservoir for Water Demand-Based Needs Only)

Disinfection Segment No.	Process	No. of Trains	Units per Train	Unit Dimensions	Monitoring Station	Baffling Factor (t_{10}/T)	Worst Scenario Conditions					Process Volume / Train (m^3)	Retention time (T, min)	t10 (min)	CT (mg/L-min)	CT Req'd for 3-log Giardia Inactivation	CT Req'd for 4-log Viruses Inactivation	Achieved Giardia Inactivation	Achieved Viruses Inactivation
						BF	Q: Flow (m^3/d)	FCR (mg/L)	pH	Temp. (°C)	Operation Depth (m)	V: Operating Volume	T = V/Q	t10 = BF*T	CT = FCR*t10	CT3	CT4	CT/CT3*3	CT/CT4*4
Potential Segment	Raw water intake pipe	1	1	2,530 m × ø1,800 mm	MS1	1	340,000	0.00	8.70	2.30	n/a	6,438	27.27	27.27	0.00			0	0
Segment I	Raw water pipe to treatment plant	1	1	1,800 mm dia. 80 m	MS1.5	1	340,000	0.00	7.50	2.30	n/a	200	0.85	0.85	0.00	197	10	0.000	0.000
	Flocculation	2	4	17.8 m (L) × 5.03 m (W) × 7.42 m (WD)	MS2	0.5	340,000	0.00	7.50	2.30	n/a	2,656	22.50	11.25	0.00	197	10	0.000	0.000
	Sedimentation	2	2	15.6 m (L) × 15.6 m (W) × 6.96 m (WD)	MS2	0.3	340,000	0.00	7.50	2.30	n/a	3,396	28.77	8.63	0.00	197	10	0.000	0.000
UV	UV Disinfection																	0.500	
Segment II	Filtration	2	6	16.76 m (L) × 6.1 m (W) × 1.52 m (above media)	MS3	0.7	340,000	0.50	7.50	2.30	n/a	777	6.58	4.61	2.30	210	10	0.033	0.903
Segment III	Clearwell	2	1 / 2*	North: 20.12 m (L) × 45.75 m (W)	MS4	0.4	242,500	1.10	7.50	2.30	2.00	1,841	10.93	4.37	4.81	226	10	0.064	1.886
				South: 20.12 m (L) × 45.75 m (W) + 20.15 m (L) × 46 m (W) *	MS4	0.4	242,500	1.10	7.50	2.30	2.00	3,695	21.94	8.78	9.65	226	10	0.128	3.786
Segment IV	Suction Conduits	1	1	52.43 m (L) × 3.05 m (W) *	MS5	0.1	485,000	1.10	7.50	2.30	4.90	798	2.37	0.24	0.26	226	10	0.003	0.102
	~~B-line loop~~	~~1~~	~~1~~	~~2 × 2,035 m × ø 1,200 mm~~	~~MS5.5~~	~~1~~	~~340,000~~	~~1.00~~	~~9.50~~	~~2.30~~	~~n/a~~	~~4,603~~	~~19.50~~	~~19.50~~	~~19.50~~	~~462~~	~~43~~	-	-
Credits																		0.600	2.892
Required																		0.500	2.000

Notes: Pre-chlorination (from LLPS to Filters) dosing reduced from 0.5 mg/L to 0 mg/L)

Alternative 4.2 - UV Disinfection at Each Filter Effluent (and New Reservoir for Water Demand-Based Needs Only)

Disinfection Segment No.	Process	No. of Trains	Units per Train	Unit Dimensions	Monitoring Station	Baffling Factor (t_{10}/T)	Worst Scenario Conditions					Process Volume / Train (m^3)	Retention time (T, min)	t10 (min)	CT (mg/L-min)	CT Req'd for 3-log Giardia Inactivation	CT Req'd for 4-log Viruses Inactivation	Achieved Giardia Inactivation	Achieved Viruses Inactivation
						BF	Q: Flow (m^3/d)	FCR (mg/L)	pH	Temp. (^oC)	Operation Depth (m)	V: Operating Volume	T = V/Q	t10 = BF*T	CT = FCR*t10	CT3	CT4	CT/CT3*3	CT/CT4*4
Potential Segment	Raw water intake pipe	1	1	2,530 m × ø1,800 mm	MS1	1	340,000	0.00	8.70	2.30	n/a	6,438	27.27	27.27	0.00			0	0
Segment I	Raw water pipe to treatment plant	1	1	1,800 mm dia. 80 m	MS1.5	1	340,000	0.00	7.50	2.30	n/a	200	0.85	0.85	0.00	197	10	0.000	0.000
	Flocculation	2	4	17.8 m (L) × 5.03 m (W) × 7.42 m (WD)	MS2	0.5	340,000	0.00	7.50	2.30	n/a	2,656	22.50	11.25	0.00	197	10	0.000	0.000
	Sedimentation	2	2	15.6 m (L) × 15.6 m (W) × 6.96 m (WD)	MS2	0.3	340,000	0.00	7.50	2.30	n/a	3,396	28.77	8.63	0.00	197	10	0.000	0.000
Segment II	Filtration	2	6	16.76 m (L) × 6.1 m (W) × 1.52 m (above media)	MS3	0.7	340,000	0.50	7.50	2.30	n/a	777	6.58	4.61	2.30	210	10	0.033	0.903
UV	UV Disinfection																	0.500	
Segment III	Clearwell	2	1 / 2*	North: 20.12 m (L) × 45.75 m (W)	MS4	0.4	242,500	1.10	7.50	2.30	2.00	1,841	10.93	4.37	4.81	226	10	0.064	1.886
				South: 20.12 m (L) × 45.75 m (W) + 20.15 m (L) × 46 m (W) *	MS4	0.4	242,500	1.10	7.50	2.30	2.00	3,695	21.94	8.78	9.65	226	10	0.128	3.786
Segment IV	Suction Conduits	1	1	52.43 m (L) × 3.05 m (W) *	MS5	0.1	485,000	1.10	7.50	2.30	4.90	798	2.37	0.24	0.26	226	10	0.003	0.102
	~~B-line loop~~	~~1~~	~~1~~	~~2 × 2,035 m × ø 1,200 mm~~	~~MS5.5~~	~~1~~	~~340,000~~	~~1.00~~	~~9.50~~	~~2.30~~	~~n/a~~	~~4,603~~	~~19.50~~	~~19.50~~	~~19.50~~	~~462~~	~~43~~	-	-
Credits																		**0.600**	**2.892**
Required																		**0.500**	**2.000**

Notes: Pre-chlorination (from LLPS to Filters) dosing reduced from 0.5 mg/L to 0 mg/L)

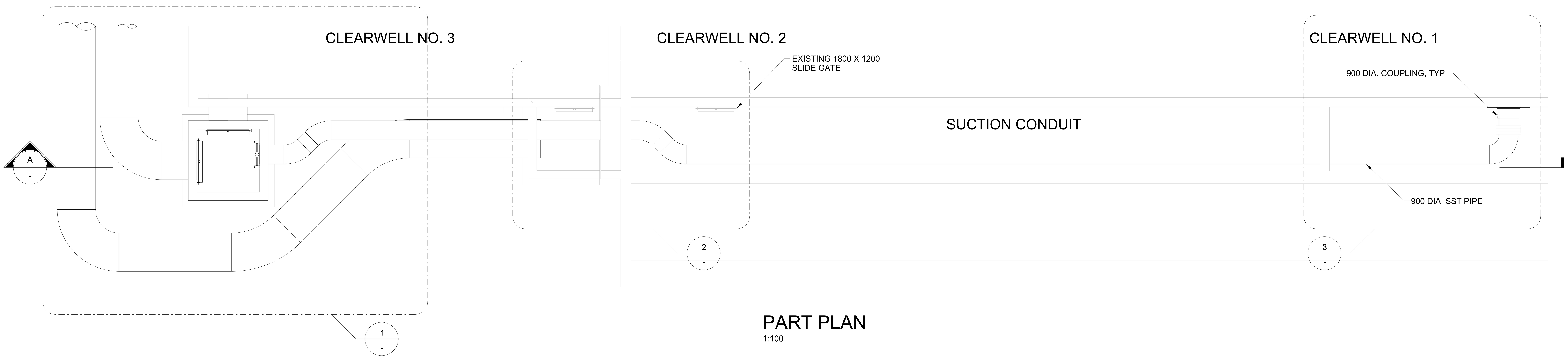
Alternative 4.3 - UV Disinfection at New Reservoir (New Reservoir for Water Demand-Based Needs Only)

Disinfection Segment No.	Process	No. of Trains	Units per Train	Unit Dimensions	Monitoring Station	Baffling Factor (t_{10}/T)	Worst Scenario Conditions					Process Volume / Train (m^3)	Retention time (T, min)	t10 (min)	CT (mg/L-min)	CT Req'd for 3-log Giardia Inactivation	CT Req'd for 4-log Viruses Inactivation	Achieved Giardia Inactivation	Achieved Viruses Inactivation
						BF	Q: Flow (m^3/d)	FCR (mg/L)	pH	Temp. (°C)	Operation Depth (m)	V: Operating Volume	T = V/Q	t10 = BF*T	CT = FCR*t10	CT3	CT4	CT/CT3*3	CT/CT4*4
Potential Segment	Raw water intake pipe	1	1	2,530 m × ø1,800 mm	MS1	1	340,000	0.00	8.70	2.30	n/a	6,438	27.27	27.27	0.00			0	0
Segment I	Raw water pipe to treatment plant	1	1	1,800 mm dia. 80 m	MS1.5	1	340,000	0.00	7.50	2.30	n/a	200	0.85	0.85	0.00	197	10	0.000	0.000
	Flocculation	2	4	17.8 m (L) × 5.03 m (W) × 7.42 m (WD)	MS2	0.5	340,000	0.00	7.50	2.30	n/a	2,656	22.50	11.25	0.00	197	10	0.000	0.000
	Sedimentation	2	2	15.6 m (L) × 15.6 m (W) × 6.96 m (WD)	MS2	0.3	340,000	0.00	7.50	2.30	n/a	3,396	28.77	8.63	0.00	197	10	0.000	0.000
Segment II	Filtration	2	6	16.76 m (L) × 6.1 m (W) × 1.52 m (above media)	MS3	0.7	340,000	0.50	7.50	2.30	n/a	777	6.58	4.61	2.30	210	10	0.033	0.903
Segment III	Clearwell	2	1 / 2*	North: 20.12 m (L) × 45.75 m (W)	MS4	0.4	242,500	1.10	7.50	2.30	2.00	1,841	10.93	4.37	4.81	226	10	0.064	1.886
				South: 20.12 m (L) × 45.75 m (W) + 20.15 m (L) × 46 m (W) *	MS4	0.4	242,500	1.10	7.50	2.30	2.00	3,695	21.94	8.78	9.65	226	10	0.128	3.786
UV	UV Disinfection																	0.500	
Segment IV	Suction Conduits	1	1	52.43 m (L) × 3.05 m (W) *	MS5	0.1	485,000	1.10	7.50	2.30	4.90	798	2.37	0.24	0.26	226	10	0.003	0.102
	~~B-line loop~~	~~1~~	~~1~~	~~2 × 2,035 m × ø 1,200 mm~~	~~MS5.5~~	~~1~~	~~340,000~~	~~1.00~~	~~9.50~~	~~2.30~~	~~n/a~~	~~4,603~~	~~19.50~~	~~19.50~~	~~19.50~~	~~462~~	~~43~~	-	-
Credits																		**0.600**	**2.892**
Required																		**0.500**	**2.000**

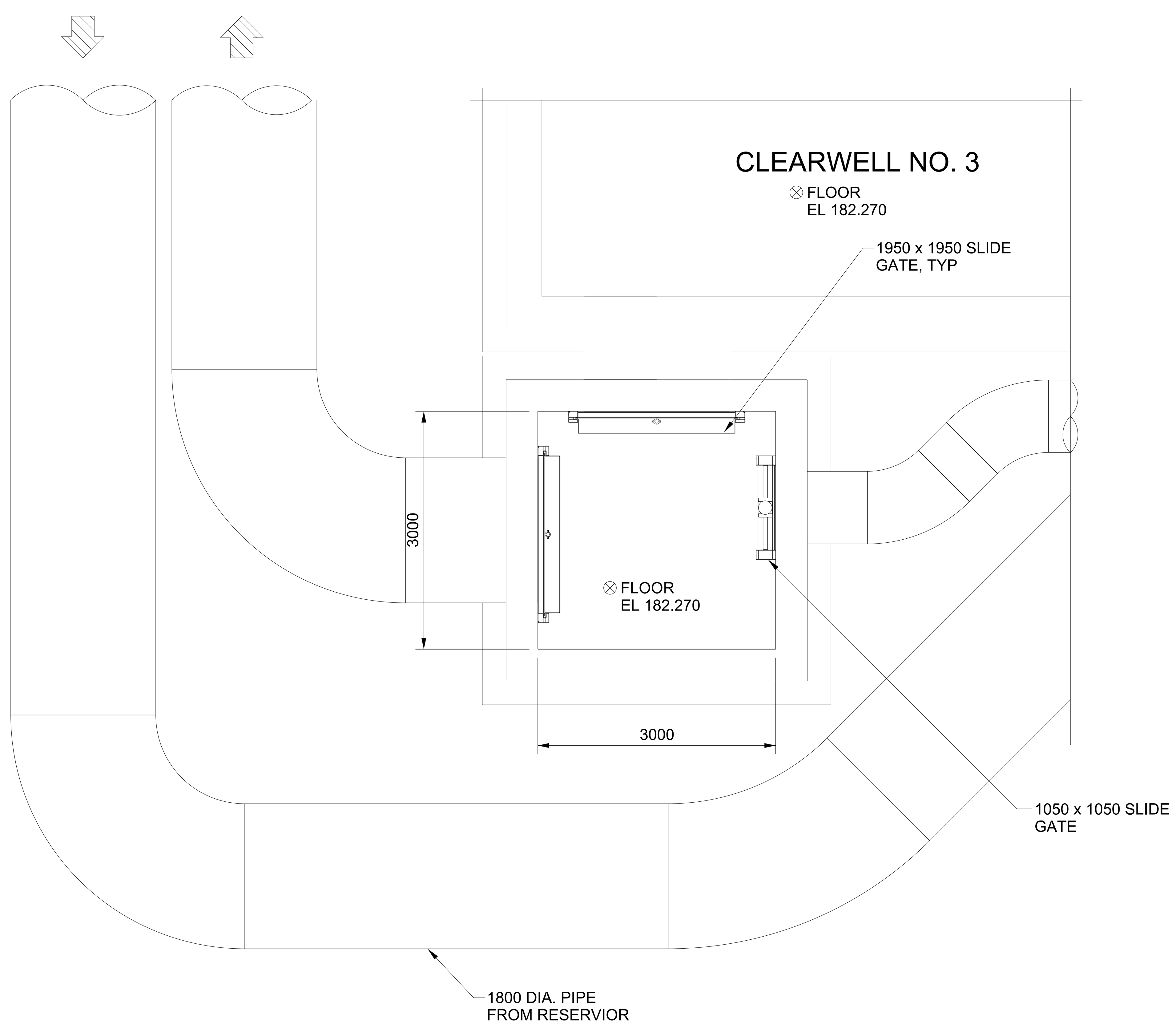
Notes: Pre-chlorination (from LLPS to Filters) dosing reduced from 0.5 mg/L to 0 mg/L)

Attachment C. Reservoir Connection Drawings

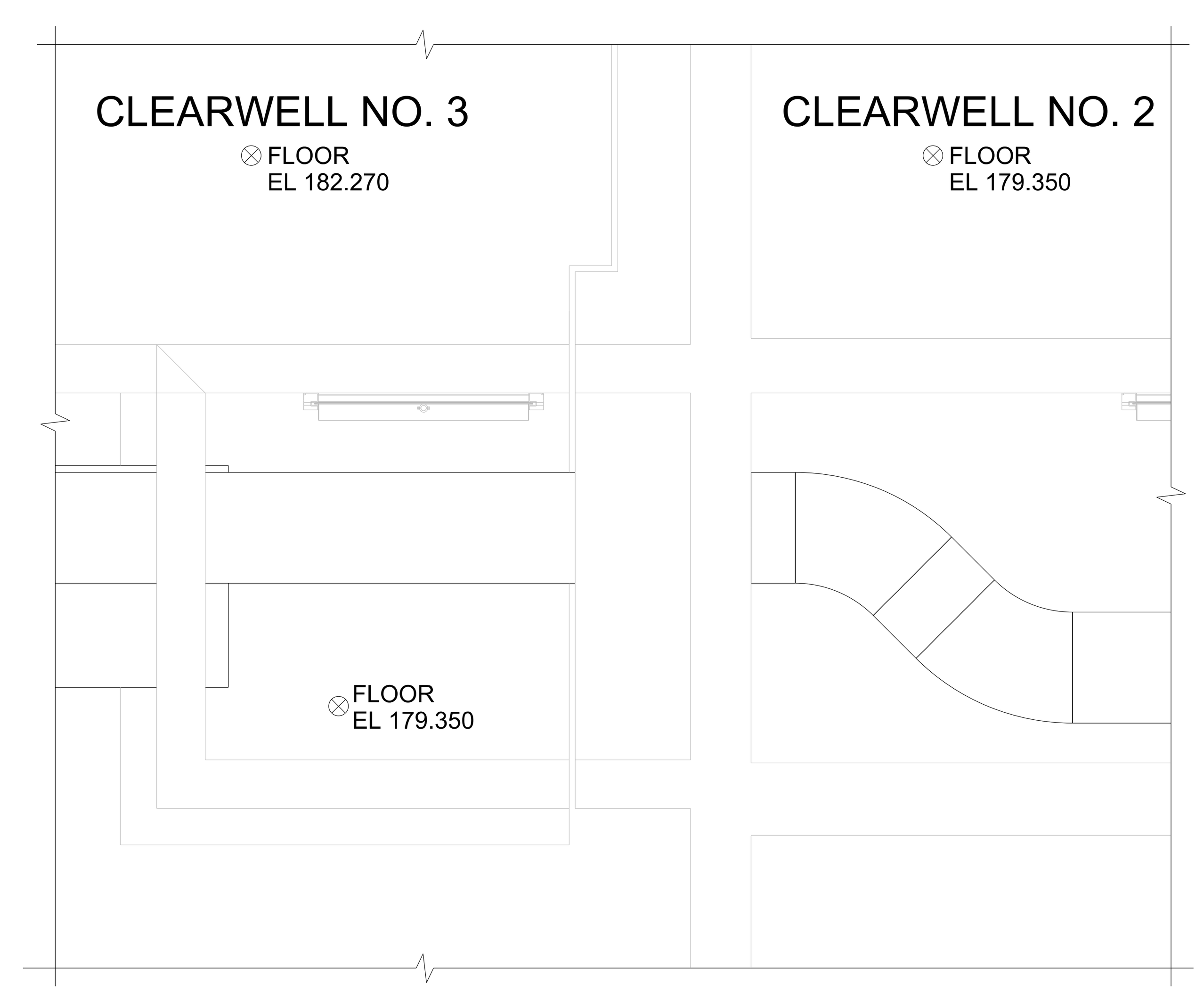
Alternative formats of the information in this attachment are available by contacting mmckillop@huronelginwater.ca.



PART PLAN
1:100



1 PART PLAN
1:50
-



2 PART PLAN
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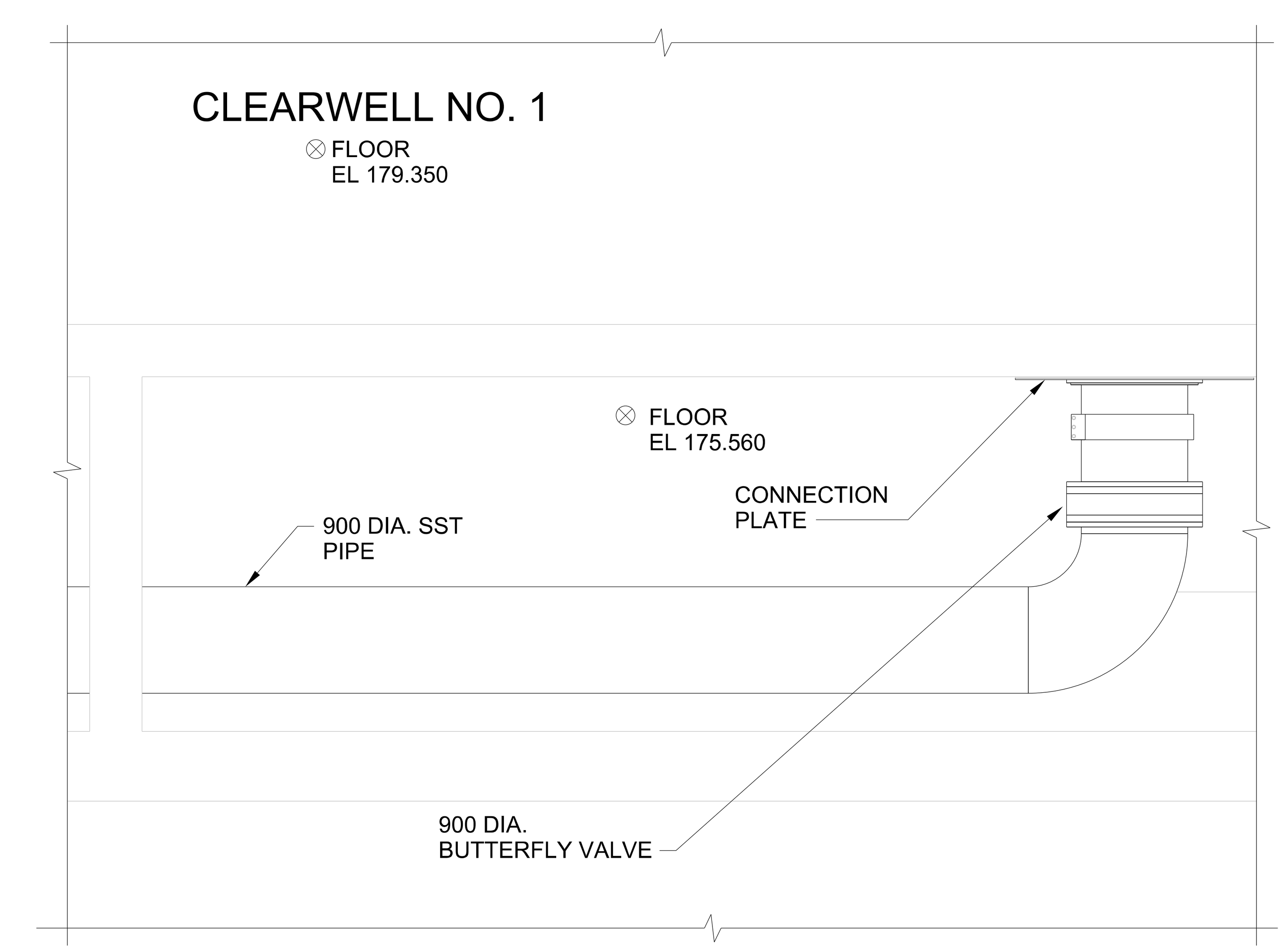
-



3 PART PLAN
1:50
-

NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	APVD
A				

DSGN | DR C. PURNEY | CHK | APVD

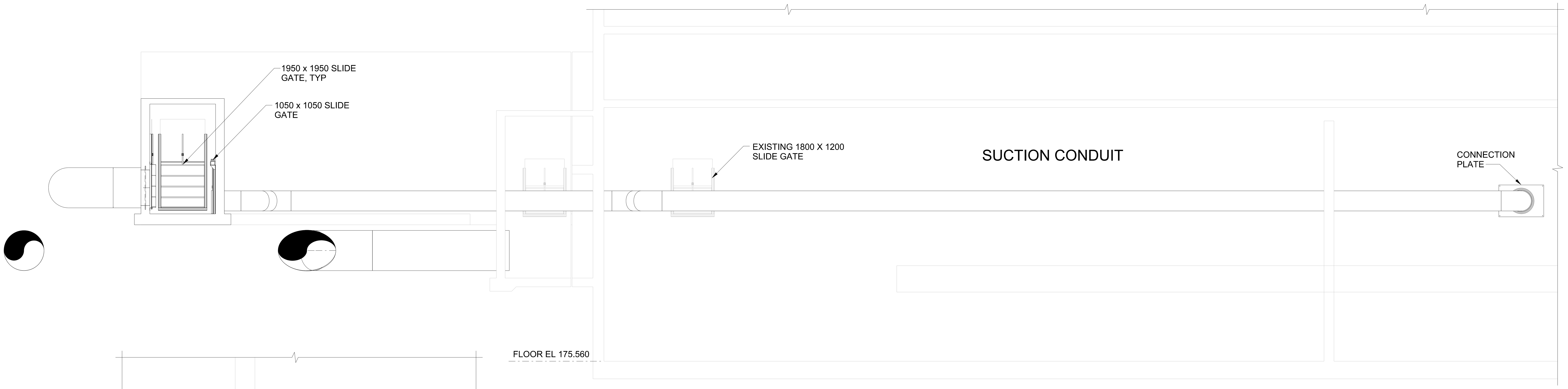
LAKE HURRON WATER TREATMENT PLANT
DISINFECTION AND STORAGE
Ontario

JACOBS

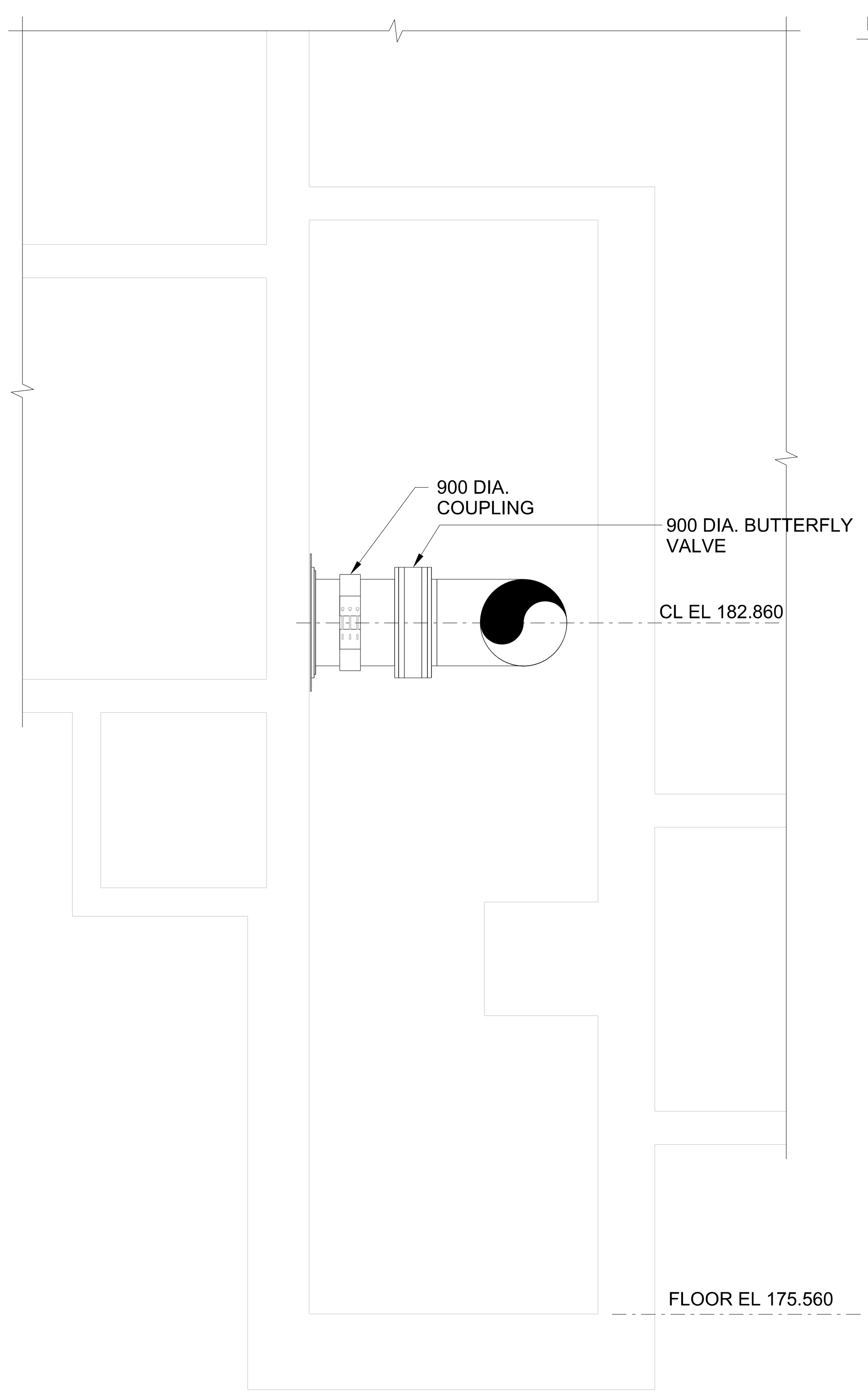
Process Mechanical
Plans and Sections

VERIFY SCALE
BAR IS 25 mmON ORIGINAL DRAWING.
0 25.4 mm

DATE
PROJ CE801200
DWG D101
SHEET of



A SECTION
1:100
-



B SECTION
1:50
-

NOT FOR CONSTRUCTION

NO.	DATE	REVISION	DSGN	DR	CHK	APVD	BY	APVD

LAKE HURRON WATER TREATMENT PLANT
DISINFECTION AND STORAGE
Ontario

JACOBS

VERIFY SCALE
BAR IS 25 mmON ORIGINAL DRAWING.
0 25.4 mm

DATE
PROJ CE801200
DWG
SHEET of

Attachment D. Reservoir Design Concept

Alternative formats of the information in this attachment are available by contacting mmckillop@huronelginwater.ca.

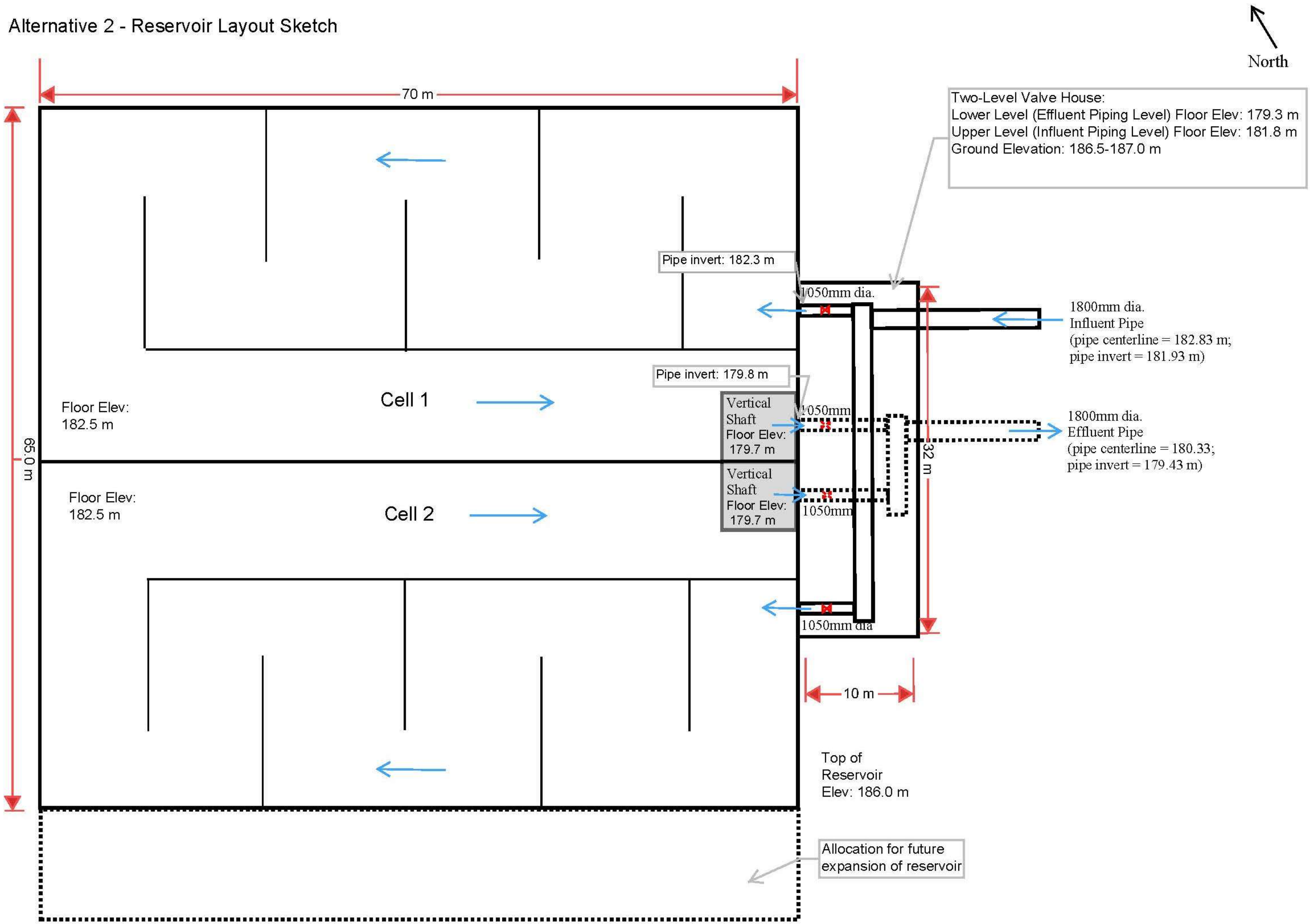
Note: Only difference between Alternatives 2 and 3 are that the bottom level of the reservoir for Alt 2 is set slightly higher (at 182.5 m rather than 182.0 m).

Summary Table

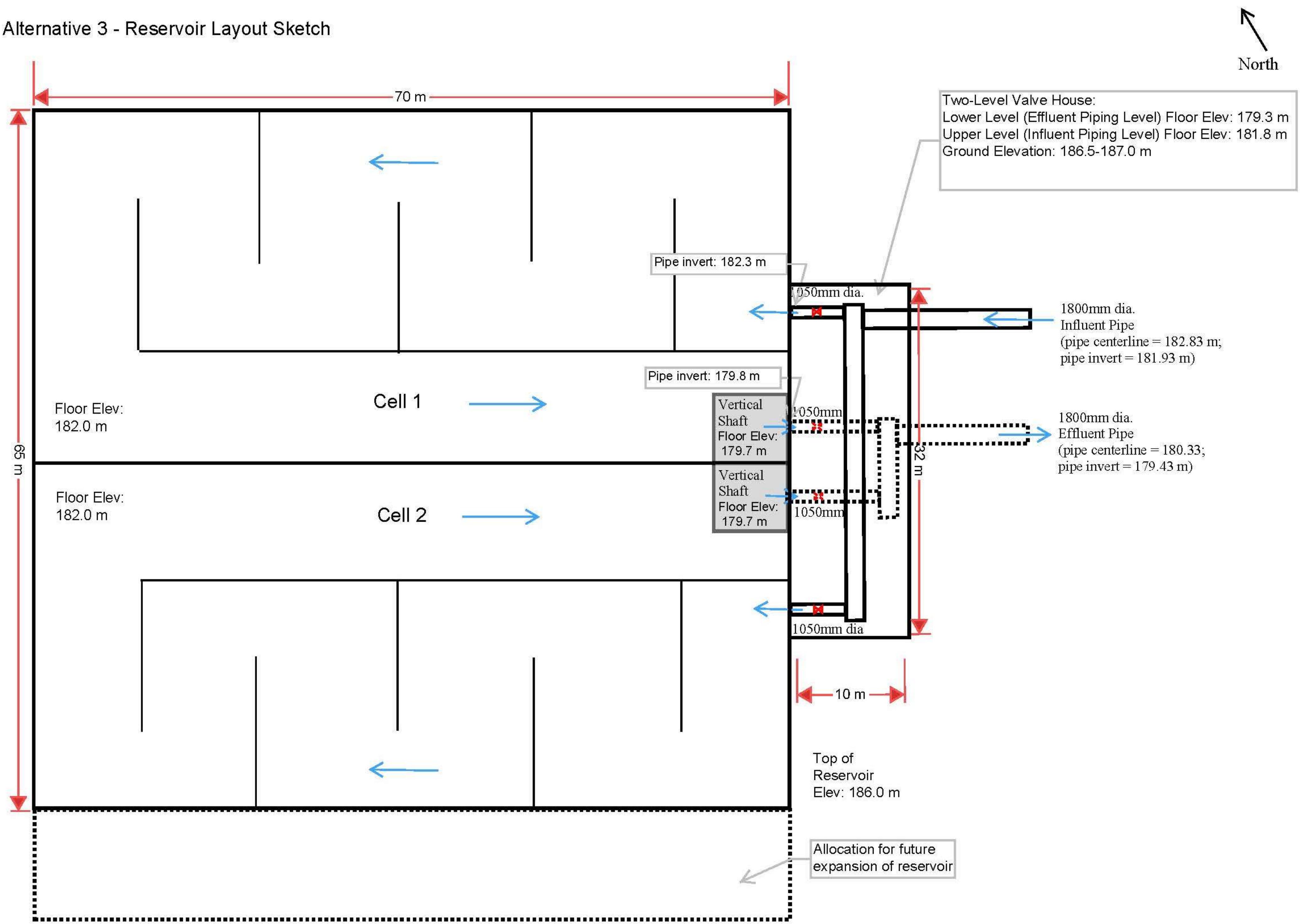
Conceptual Reservoir Design of Alternatives - Critical Elevations

Component	Alternative 2	Alternative 3	Alternative 4.1 and Alternative 4.2	Alternative 4.3	Notes
Clearwells					
High Water Line Elevation (m)	185.79	185.79	185.60	185.93	Back-calculated based on HWL of Reservoir. Maximum = 185.93 m (Source: Record Drawings)
Low Water Line Elevation (m)	184.27	184.27	183.85	183.86	Back- calculated based on LWL of Reservoir. Minimum based on Scada "Lo Lo" Settings (1.5 m) = 183.77 m
Floor Elevation (m)	182.27	182.27	182.27	182.27	Source: Record drawings
Pipe to Reservoir Valve Chamber (1800mm)					
Pipe Invert Elevation at Exit from New Clearwell Outlet Chamber (m)	182.27	182.27	182.05	182.05	Alternatives 4.1, 4.2, and 4.3 require the bottom elevation of the new clearwell outlet chamber to be at a lower elevation (182.05) than Alternatives 2 and 3.
Pipe Obvert Elevation at Exit from New Clearwell Outlet Chamber (m)	184.07	184.07	183.85	183.85	
Pipe Invert Elevation at Connection to Header in Reservoir Valve Chamber (m)	181.93	181.93	182.03	181.93	
Pipe Obvert Elevation at Connection to Header in Reservoir Valve Chamber (m)	182.98	183.73	183.83	183.73	
Decrease in Elevation of Pipe (m)	0.34	0.34	0.03	0.13	Minimum = 0
Influent Pipes into Reservoir Cells (1050mm x 2)					
Pipe Invert Elevation at Connection to Reservoir Cell (m)	182.30	182.30	182.40	182.30	
Pipe Obvert Elevation at Connection to Reservoir Cell (m)	183.35	183.35	183.45	183.35	
New Reservoir					
High Water Line Elevation (m)	184.86	184.86	184.70	184.41	
Low Water Line Elevation (m)	183.34	183.34	182.63	182.34	
Floor Elevation (m)	182.50	182.00	182.30	182.00	
Reservoir Vertical Outlet Shaft Floor Elevation (m)	179.70	179.70	179.95	179.65	
Pipes from Reservoir (1050mm x2)					
Pipe Invert Elevation at Exit from Reservoir Cells (m)	179.80	179.80	180.05	179.75	
Pipe Obvert Elevation at Exit from Reservoir Cells (m)	180.85	180.85	181.10	180.80	
Pipe from Reservoir Valve Chamber to Suction Conduit (1800mm)					
Pipe Invert Elevation at Connection from Header in Reservoir Valve Chamber (m)	179.43	179.43	179.68	179.38	
Pipe Obvert Elevation at Connection from Header in Reservoir Valve Chamber (m)	181.23	181.23	181.48	181.18	
Pipe Invert Elevation at Suction Conduit Connection (m)	179.35	179.35	179.45	179.35	Minimum = 179.35 (Source: Record Drawings)
Pipe Obvert Elevation at Suction Conduit Connection (m)	181.15	181.15	181.25	181.15	
Decrease in Elevation of Pipe (m)	0.45	0.45	0.22	0.03	Minimum = 0
Suction Conduit Adjacent Chamber					
Floor Elevation (m)	179.35	179.35	179.35	179.35	Source: Record Drawings
Suction Conduit					
High Water Line Elevation (m)	184.49	184.49	184.33	184.03	Calculated based on HWL of Reservoir. Maximum = 185.93 m (Source: Record Drawings)
Low Water Line Elevation (m)	182.97	182.97	182.25	181.97	Calculated based on LWL of Reservoir. Minimum = 181.97 m (Source: Replica Baseline Modelling Required Depth = 6.4 m)
Floor Elevation (m)	175.57	175.57	175.57	175.57	Source: Record drawings

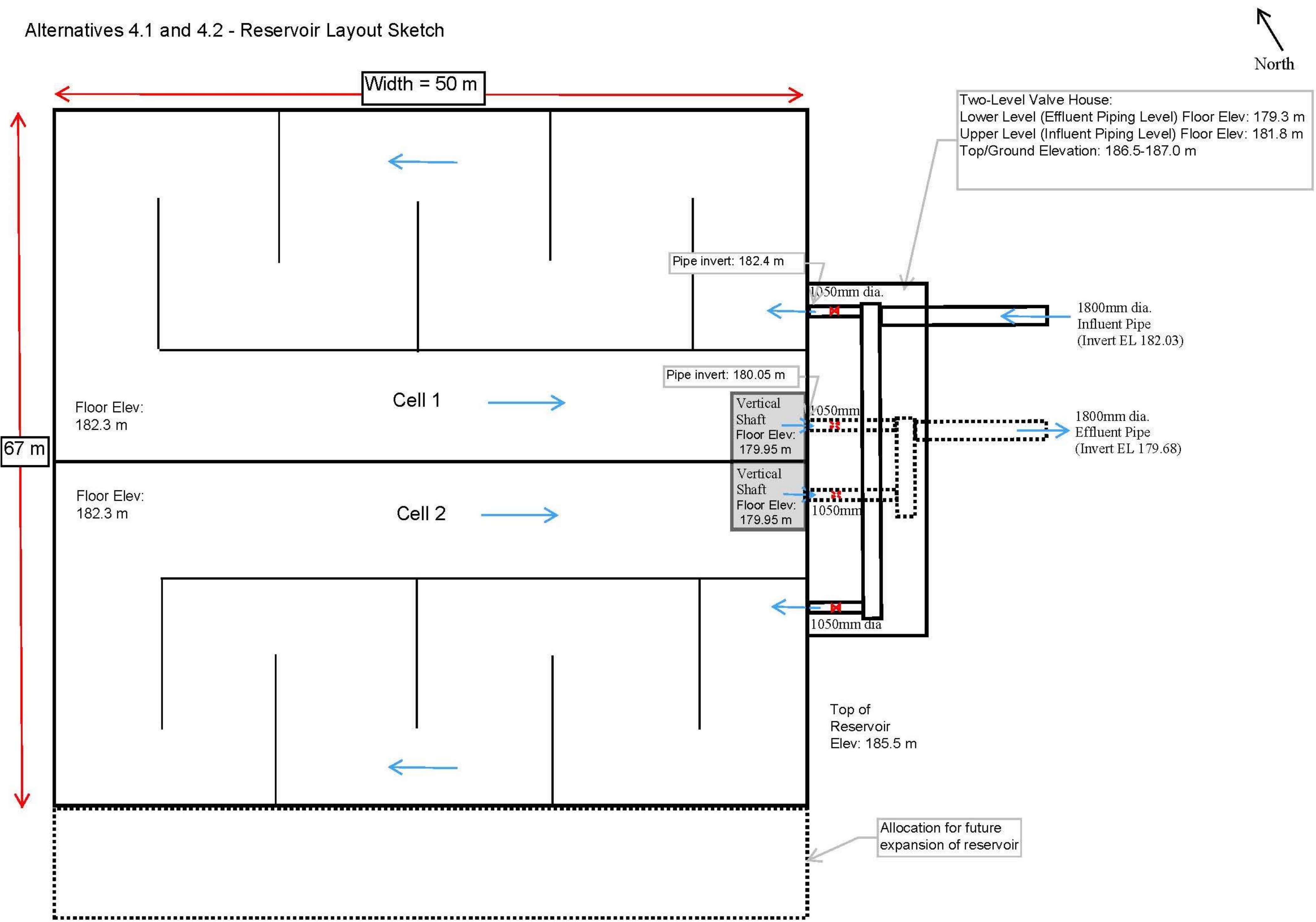
Alternative 2 - Reservoir Layout Sketch



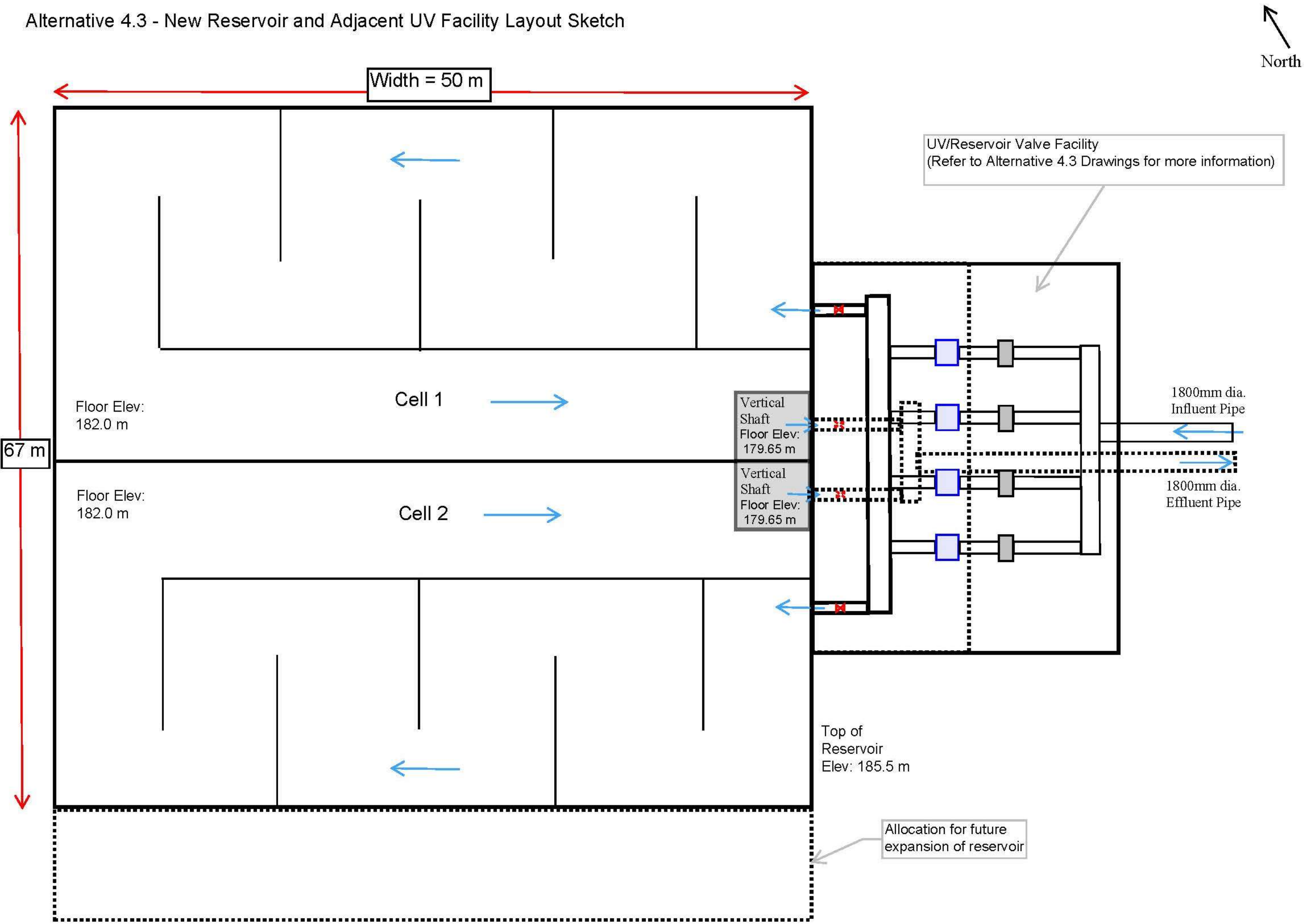
Alternative 3 - Reservoir Layout Sketch



Alternatives 4.1 and 4.2 - Reservoir Layout Sketch



Alternative 4.3 - New Reservoir and Adjacent UV Facility Layout Sketch



Attachment E. UV Equipment Information

This information can be made available on request.

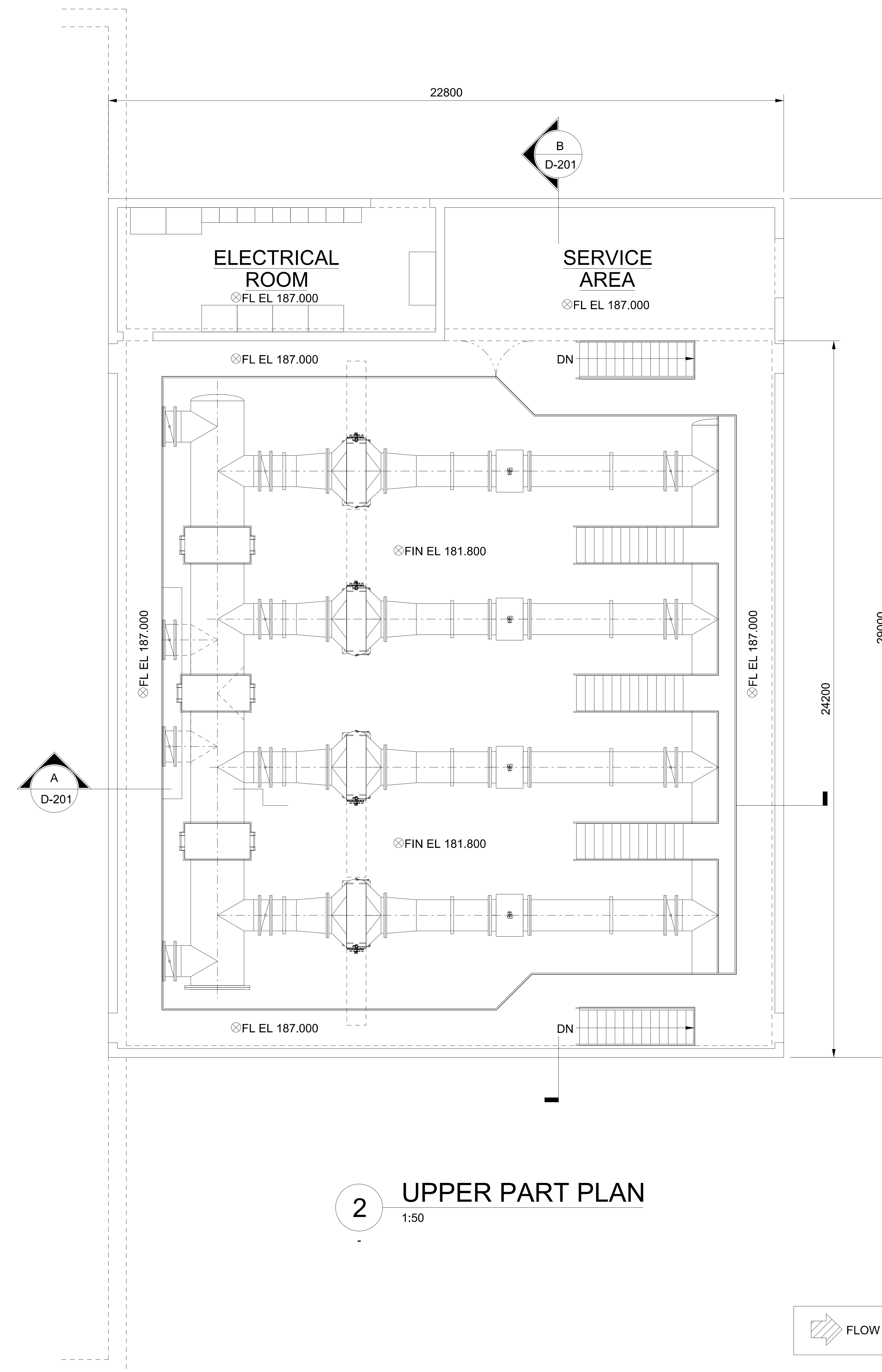
Attachment F. Alternative 4.3 UV Facility Concept Drawings

Alternative formats of the information in this attachment are available by contacting mmckillop@huronelginwater.ca.

1 2 3 4 5 6

A B C D

1 LOWER PART PLAN
1:50



2 UPPER PART PLAN
1:50

FLOW DIRECTION

NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	APVD
A				

DSGN | DR C. PURNEY | CHK | APVD

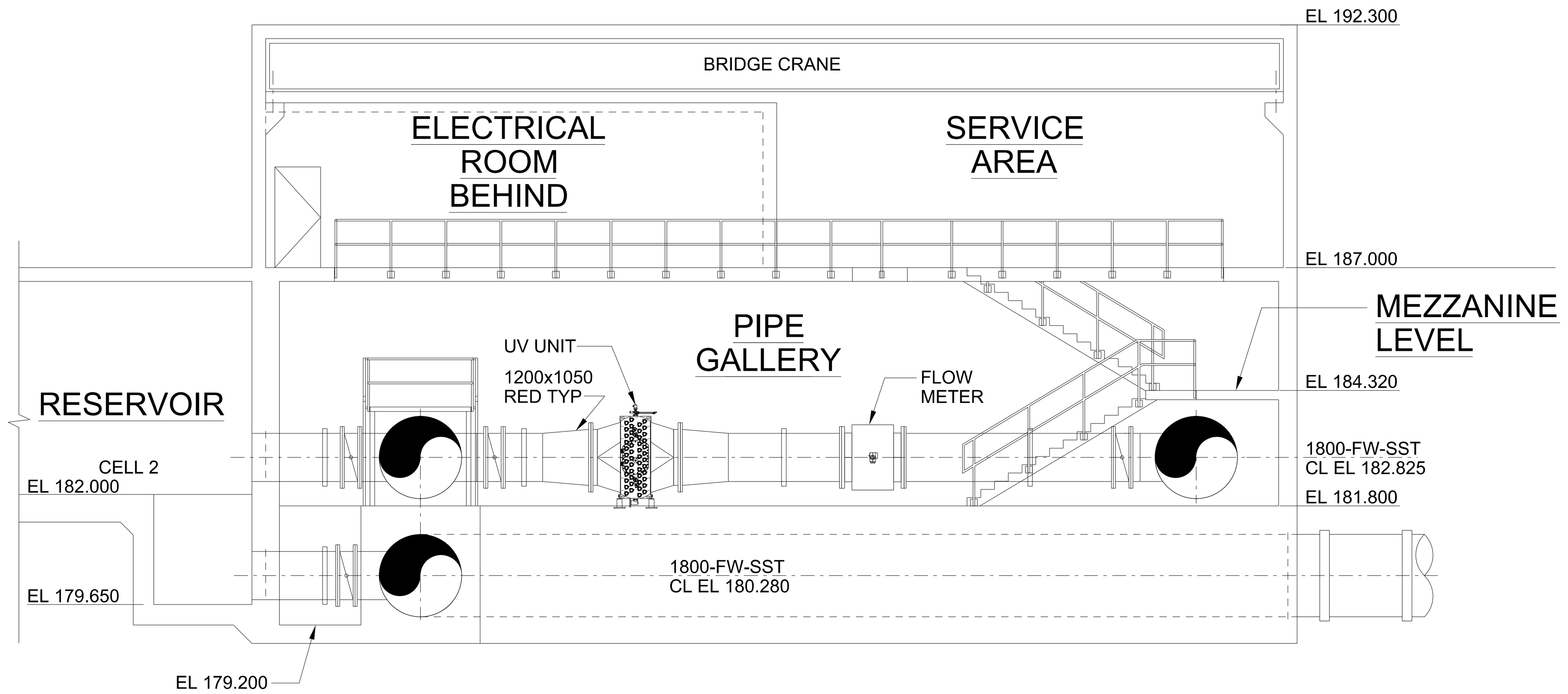
LAKE HURRON WATER TREATMENT PLANT
DISINFECTION AND STORAGE
Ontario

JACOBS

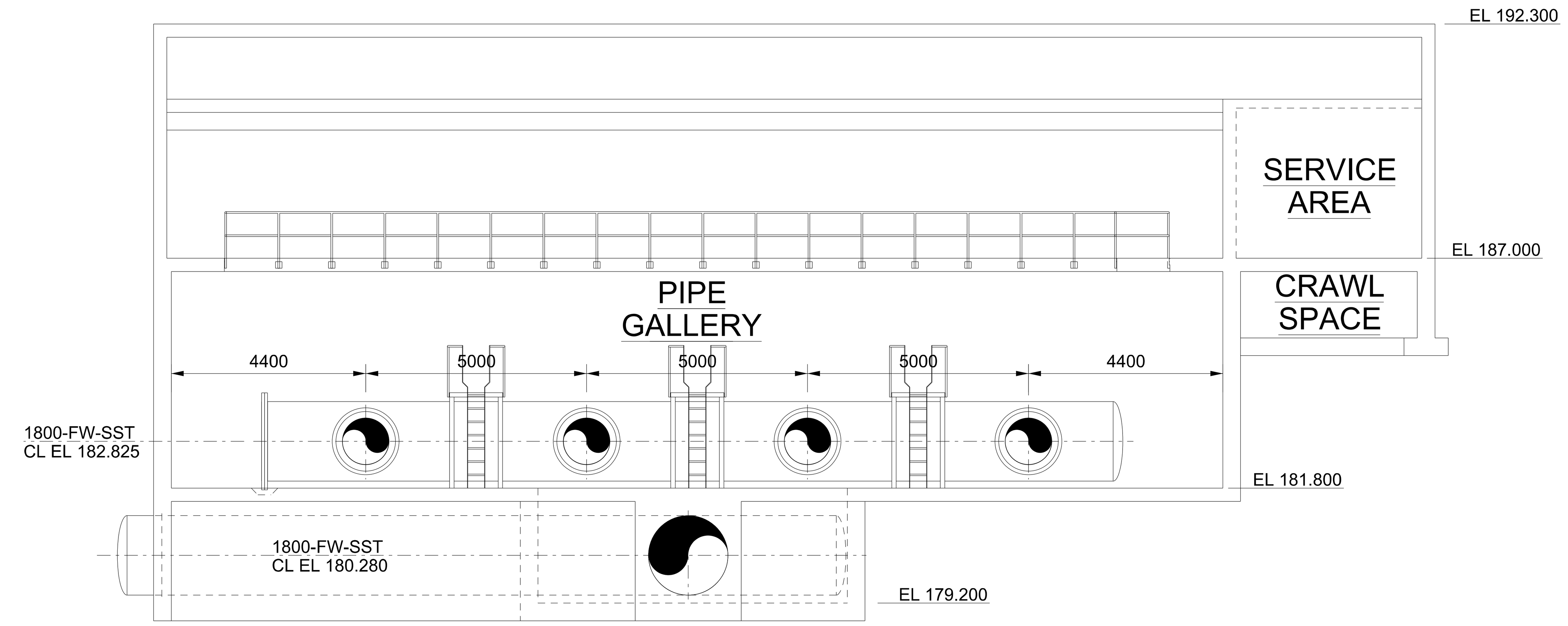
Process Mechanical
Plans

VERIFY SCALE
BAR IS 25 mmON ORIGINAL DRAWING.
0 25.4 mm

DATE	
PROJ	CE801200
DWG	D101
SHEET	of



A SECTION
1:50



B SECTION
1:50

NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	APVD
A				

DSGN | DR | B. COOPER | CHK | APVD

LAKE HURRON WATER TREATMENT PLANT
DISINFECTION AND STORAGE
Ontario

JACOBS

Process Mechanical
Sections A and B

VERIFY SCALE
BAR IS 25 mmON ORIGINAL DRAWING.
0 25.4 mm

DATE	
PROJ	CE801200
DWG	D201
SHEET	of

Attachment G. Detailed Comparative Evaluation

Alternative formats of the information in this attachment are available by contacting mmckillop@huronelginwater.ca.

Lake Huron WTP EA - Evaluation Criteria

Category	Criterion	Description	Measure High (10)	 Medium (5)	 Low (0)
Natural Environment	Aquatic Vegetation and Wildlife	Potential impact on local aquatic species and habitats, aquatic species at risk and locally significant aquatic species	The alternative will have no permanent physical disturbance to aquatic features and no substantial long term impact on the viability of aquatic habitats in terms of density and diversity of species.	The alternative has some potential for long term impact on the viability of aquatic habitats in terms of density and diversity of species. This alternative may have some temporary loss of aquatic features.	The alternative has high potential for long term impact on the viability of aquatic habitats in terms of density and diversity of species and will cause physical disturbance to aquatic features.
	Terrestrial Vegetation and Wildlife	Potential impact on local terrestrial species and habitats, designated areas, species at risk and locally significant species	The alternative will have low to no permanent substantial long term impact on the viability of terrestrial habitats in terms of density and diversity of species. This alternative will require a small area of terrestrial land to be permanantly lost.	The alternative has moderate potential for long term impact on the viability of terrestrial habitats in terms of density and diversity of species. This alternative will require a moderate area of terrestrial land to be permanantly lost.	The alternative has high potential for long term impact on the viability of terrestrial habitats in terms of density and diversity of species. This alternative will require a large area of terrestrial land to be permanantly lost.
	Surface Water	Potential impact on the quantity and quality of surface water	The alternative will have no substantial impact on surface water quantity/quality that would result in negative impacts to other users and/or the aquatic environment.	The alternative will have some potential impact on surface water quantity/quality that would result in negative impacts to other users and/or the aquatic environment.	The alternative will have a high potential impact on surface water quantity/quality that would result in negative impacts to other users and/or the aquatic environment.
	Groundwater	Potential impact on the quantity and quality of groundwater	The alternative has a low to no potential for long term and temporary (during construction) impact on groundwater quality or quantity.	The alternative will have moderate long term and temporary impacts (during construction) on groundwater quality and quantity over long term.	The alternative will have significant long term impacts and some temporary (during construction) on groundwater quality and quantity over long term.
	CLOS Sustainability - GHG from Energy Usage	Potential to increase energy usage and resulting GHG emissions from the current condition (based on 30 gm CO2 per Kwhr, 2020 National Inventory Report).	The alternative results in GHG emissions <5 tonnes CO2 eq/year (in addition to existing operations).	The alternative results in GHG emissions 5 - 15 tonnes CO2 eq/year (in addition to existing operations).	The alternative results in GHG emissions >15 tonnes CO2 eq/year (in addition to existing operations).
	CLOS Sustainability - Chemical Usage	Changes in chemical usage at the plant	This alternative results in a decrease in chemical usage from the current condition.	This alternative results in no change to the existing chemical usage.	This alternative results in an increase in chemical usage from the current condition.
	Soil and Geology	Geology, hydrogeology, contamination considerations	This alternative has low to no risk of encountering contaminated soil during excavation, and lowest potential to cause additional erosion to lake shoreline areas during construction.	This alternative has a moderate risk of encountering contaminated soil during excavation, and some potential to cause additional erosion to lake shoreline areas during construction.	This alternative has a high risk of encountering contaminated soil during excavation, and highest potential to cause additional erosion to lake shoreline areas during construction.
Social/Cultural	Archaeological Sites	Impact to potential archaeological features during construction or ongoing operations	This alternative is located entirely within previously disturbed areas as identified in the Stage 1 Archelogical Assessment which has low potential for archeological features.	This alternative is located in both previously disturbed and undisturbed areas as identified in the Stage 1 Archelogical Assessment, thereby having a moderate potential for archeological features.	This alternative is located entirely within undisturbed areas as identified in the Stage 1 Archelogical Assessment which have higher potential for archeological features.
	Cultural/Heritage Features	Potential impact on known cultural landscapes and built heritage features during construction or ongoing operations	This alternative will have no physical disturbance to known cultural or heritage features.	This alternative may have some non-physical disturbance (noise, vibrations) to known cultural or heritage features	This alternative will cause physical disturbance to known cultural or heritage features.
	Recreational Land Uses and Visual Landscape	Potential to permanently impact existing parks and open spaces, beach access, or impact the character of the existing community (i.e., interference with views)	This alternative results in the smallest permanent reduction in available park space and no permanent loss of beach access.	This alternative results in a moderate permanent reduction in available park space or some permanent reduction in beach access points.	This alternative results in the highest permanent reduction in available park space or a substantial permanent loss of beach access.
	Impacts During Construction	Potential construction impacts due to traffic, access, noise, dust, and odour on existing residences and agricultural land within the vicinity	The alternative will result in no distruption to traffic and/or will have the shortest distruption to use of public areas during construction. This alternative has the lowest potential for dust,noise and/or vibration impacts to homeowners in proximity to the project site.	The alternative will result in some disruption to traffic and/or will cause a moderate duration of distruption to use of public areas during construction. This alternative has a moderate potential for dust,noise and/or vibration impacts to homeowners in proximity to the project site.	The alternative will result in significant disruption to traffic and/or will have the longest distruption to use of public areas during construction. This alternative has the highest potential for dust,noise and/or vibration impacts to homeowners in proximity to the project site.
	Long-Term Community Impact	Long-term impacts on traffic, noise, vibration and dust on existing residences and agricultural land within the vicinity, as well as potential changes in land use designations	This alternative will have no long term impacts regarding traffic, noise, and vibration to local residents and requires no changes to existing land use designations.	This alternative will have long term impacts regarding traffic, noise, and vibration to local residents or requires changes to existing land use designations.	This alternative will have long term impacts regarding traffic, noise, and vibration to local residents and requires changes to existing land use designations.
	CLOS Reliability/Availability - Reduction in Service Interruptions	Ability to provide continous, adequate quantity of water to customers	This alternative reduces the potential for the number and duration of planned or unplanned service interruptions	This alternative maintains the existing potential for the number and duration of planned or unplanned service interruptions	This alternative increases the potential for the number and duration of planned or unplanned service interruptions
	Planning Policy Compliance	Compliance with Local and Regional Planning Policies (e.g. South Huron Official Plan, Zoning)	This alternative is in compliance with local and regional planning policies with respect to zoning and land use permissions.	-	This alternative is not in compliance with local and regional planning policies with respect to zoning and land use permission.
Technical	Improvements to Primary Disinfection	Ability to restore the plant's full rated capacity under all conditions (including winter conditions) within plant treatment processes, thus reducing reliance on primary pipeline to B Line Road for primary disinfection	This alternative can achieve primary disinfection under all conditions	-	This alternative does not achieve primary disinfection under all conditions
	Impact on DBP Formation	Potential for disinfection byproduct formation	This alternative achieves a portion of the required CT with a disinfection method that does not produce chlorinated DBPs, thereby providing the ability to reduce DBP formation	This alternative continues to rely on chlorination but provides some opportunity to eliminate pre-chlorination thereby reducing contact with DBP precursors	This alternative may increase DBP formation under certain operating conditions
	Ease of Implementatation	Ease of implementation for new instrastructure in terms of available space and constructability.	This alternative has sufficient space available and minimal constructability issues.	This alternative has limited space available or imposes moderate constructability issues.	This alternative has minimal space available or imposes highest constructability issues.
	Future Proofing	Ability to increase water quality resilience by adding barrier(s) to the disinfection process, to provide more robustness for meeting current and future regulatory requirements	This alternative has the best ability to increase water quality resilience by adding barrier(s) to the disinfection process, to provide more robustness for meeting current and future regulatory requirements	This alternative has some ability to meet future regulatory requirements via improvements of the existing barrier	This alternative has no ability to meet future regulatory changes
	Potential for System Expandability for Redundancy	Potential ability and space availability to include redundancy of equipment/infrastruture	This alternative has the greatest potential and space availability for redundancy of new infrastructure/equipment implemented.	This alternative has a moderate space available to implement redudancy measures in relation to new infrastructure/equipment.	This alternative has little no ability to implement redundancy for new infrastructure/equipment.
	Compatibility with Plant HGL	Ability to accommodate new infrastructure/equipment into existing plant hydraulic grade line (HGL)	The alternative can be easily accomodated in the existing WTP HGL. No additional equipment upgrades or operational changes required.	This alternative can be accomodated in the existing WTP HGL with minor equipment upgrades or operational changes.	This alternative can be accomodated in the existing WTP HGL with major equipment upgrades or operational changes.
	Operation Flexibility	Ability to improve operational flexibility	This alternative will increase operational flexibility from both primary disinfection and storage perspective	This alternative will increase operational flexibility from either a primary disinfection or storage perspective	This alternative will maintain the existing level of operational flexibility
	Maintenance	The complexity and maintainability of new assets, as well as impacts to occupational health and safety required for new maintenance activities	This alternative is simple to maintain and requires low maintenace frequency, as well as posing little risk to occupational health and safety.	This alternative requires a moderate frequency of maintenance, or poses some risks to occupational health and safety.	This alternative requires frequent/complex maintenance requiring additional and extensive operator training, or poses high risks to occupational health and safety.
	Permits and Approvals	Ease of receiving permits and approvals for implementation, as well as ease of maintaining compliance during operation	Obtaining or renewal of the permits/approvals for this alternative are anticipated to be easily achievable.	Obtaining or renewal of the permits/approvals for this alternative are anticipated to be achievable but may require additional mitigation measures or studies.	Obtaining or renewal of the permits/approvals for this alternative may require onerous negotiations with uncertain outcomes.
Economic	Capital Costs	Estimated capital cost (in 2022 dollars)	This alternative has a capital cost of <$20M	This alternative has a capital cost between $20M - $40M	This alternative has a capital cost >$40M
	Life Cycle Costs	Total annual capital and operational costs amortized over 20 years.	This alternative has a lifecycle cost of <$20M	This alternative has a lifecycle cost between $20M - $40M	This alternative has a lifecycle cost >$40M

Number of Criterion 25

Lake Huron WTP EA - Detailed Evaluation - ALL CRITERION HAVE EQUAL WEIGHTING

Category	Weighting	Criterion	Alternative 1 - Do Nothing No additions/changes to existing WTP		Alternative 2 Clearwell Upgrades and New Reservoir (10.7 ML)		Alternative 3 New Reservoir (13 ML)		Alternative 4.1 UV Disinfection at Settled Water Conduits, and New Reservoir (6.9 ML)		Alternative 4.2 UV Disinfection at Each Filter Effluent, and New Reservoir (6.9 ML)		Alternative 4.3 UV Disinfection at New Reservoir (6.9 ML)	
Natural Environment	4%	Aquatic Vegetation and Wildlife	10	The alternative will have no substantial long term impact on the viability of aquatic habitats in terms of density and diversity of species, as there will be no changes made.	10	The alternative will have no permanent physical disturbance to aquatic features and no substantial long term impact on the viability of aquatic habitats in terms of density and diversity of species, as residuals discharge will not change .	10	The alternative will have no permanent physical disturbance to aquatic features and no substantial long term impact on the viability of aquatic habitats in terms of density and diversity of species, as residuals discharge will not change .	10	The alternative will have no permanent physical disturbance to aquatic features and no substantial long term impact on the viability of aquatic habitats in terms of density and diversity of species, as residuals discharge will not change .	10	The alternative will have no permanent physical disturbance to aquatic features and no substantial long term impact on the viability of aquatic habitats in terms of density and diversity of species, as residuals discharge will not change .	10	The alternative will have no permanent physical disturbance to aquatic features and no substantial long term impact on the viability of aquatic habitats in terms of density and diversity of species, as residuals discharge will not change .
	4%	Terrestrial Vegetation and Wildlife	10	The alternative will have no substantial long term impact on the viability of terrestrial habitats in terms of density and diversity of species, as there will be no changes made.	10	The alternative will require no terrestrial land to be permanantly lost, as the new reservoir will be completely below grade and the topsoil and grass will be replaced. The permanant removal of a small number of trees may be required for the new reservoir. Other works (i.e. clearwell upgrades) associated with this alternative occur within the existing WTP buildings.	10	The alternative will require no terrestrial land to be permanantly lost, as the new reservoir will be completely below grade and the topsoil and grass will be replaced. The permanant removal of a small number of trees may be required for the new reservoir.	10	The alternative will require no terrestrial land to be permanantly lost, as the new reservoir will be completely below grade and the topsoil and grass will be replaced. The permanant removal of a small number of trees may be required for the new reservoir. Other works (new UV building attachments to existing sedimentation building) associated with this alternative occur within the extents of the existing WTP property.	10	The alternative will require no terrestrial land to be permanantly lost, as the new reservoir will be completely below grade and the topsoil and grass will be replaced. The permanant removal of a small number of trees may be required for the new reservoir. Other works (i.e. UV implementation) associated with this alternative occur within the existing WTP buildings.	10	The alternative has a low potential for minor long term impact on the viability of terrestrial habitats as a small portion of terrestrial land in the park will be permanently lost due to the new above-grade access and controls structure of the new, sub-grade UV facility adjacent to the new reservoir. The new reservoir will be completely below grade and the topsoil and grass will be replaced. The permanant removal of a small number of trees may be required for the new reservoir.
	4%	Surface Water	10	The alternative will have no change to the current impact on surface water quality or quality, as there will be no changes to the existing plant intake/discharge.	10	The alternative will have no change to the current impact on surface water quality or quality, as there will be no changes to the existing plant intake/discharge.	10	The alternative will have no change to the current impact on surface water quality or quality, as there will be no changes to the existing plant intake/discharge.	10	The alternative will have no change to the current impact on surface water quality or quality, as there will be no changes to the existing plant intake/discharge.	10	The alternative will have no change to the current impact on surface water quality or quality, as there will be no changes to the existing plant intake/discharge.	10	The alternative will have no change to the current impact on surface water quality or quality, as there will be no changes to the existing plant intake/discharge.
	4%	Groundwater	10	The alternative will have no long term nor temporary impacts on groundwater quality or quantity, as no changes will be made.	10	The alternative has a low potential for impacts to groundwater quantity resulting from minor changes in surface permeability/infiltration due to the reservoir.	10	The alternative has a low potential for impacts to groundwater quantity resulting from minor changes in surface permeability/infiltration due to the reservoir.	10	The alternative has a low potential for impacts to groundwater quantity resulting from minor changes in surface permeability/infiltration due to the reservoir.	10	The alternative has a low potential for impacts to groundwater quantity resulting from minor changes in surface permeability/infiltration due to the reservoir.	10	The alternative has a low potential for impacts to groundwater quantity resulting from minor changes in surface permeability/infiltration due to the reservoir.
	4%	CLOS Sustainability - GHG from Energy Usage	10	The alternative will produce no additional GHG emissions as a result of maintaining the existing energy usages.	10	The alternative results in <5 additional tonnes CO_2 eq/year (~3.4 tonnes) from existing operations, as a result of increased energy usages from the the upgrades.	10	The alternative results in <5 additional tonnes CO_2 eq/year (~3.4 tonnes) from existing operations, as a result of increased energy usages from the the upgrades.	5	The alternative results in approximately 10.9 additional tonnes CO_2 eq/year from existing operations, as a result of increased energy usages from the the upgrades.	0	The alternative results in >15 additional tonnes CO_2 eq/year (~18.7 tonnes) from existing operations, as a result of increased energy usages from the the upgrades.	5	The alternative results in approximately 10.4 additional tonnes CO_2 eq/year from existing operations, as a result of increased energy usages from the the upgrades.
	4%	CLOS Sustainability - Chemical Usage	0	The alternative would require an increase in chlorine usage from current operations, assuming the primary pipeline to B Line Road is no longer relied upon for primary disinfection.	5	The alternative will require no change to amount of chlorine used, as a result of the new reservoir and clearwell upgrades providing sufficient disinfection to completely remove reliance on the primary pipeline to B Line Road.	5	The alternative will require no change to amount of chlorine used, as a result of the new reservoir providing sufficient disinfection to completely remove reliance on the primary pipeline to B Line Road.	10	The alternative will require a decrease in the amount of chlorine used, as a result of the UV disinfection process reducing the reliance on chlorine to achieve the required disinfection.	10	The alternative will require a decrease in the amount of chlorine used, as a result of the UV disinfection process reducing the reliance on chlorine to achieve the required disinfection.	10	The alternative will require a decrease in the amount of chlorine used, as a result of the UV disinfection process reducing the reliance on chlorine to achieve the required disinfection.
	4%	Soil and Geology	10	The alternative has no risk for encountering contaminated soil or causing erosion to lake shoreline areas during construction, as no changes to existing plant will be made.	0	The alternative has the highest risk of encountering contaminated soil and potentially causing erosion to lake shoreline areas during construction releative to the other alternatives, as the reservoir is the larger footprint option and will have a smaller offset from the shoreline areas compared to reservoirs for Alternatives 4.1, 4.2, and 4.3.	0	The alternative has the highest risk of encountering contaminated soil and potentially causing erosion to lake shoreline areas during construction releative to the other alternatives, as the reservoir is the larger footprint option and will have a smaller offset from the shoreline areas compared to reservoirs for Alternatives 4.1, 4.2, and 4.3.	5	The alternative has a moderate risk of encountering contaminated soil and potentially causing erosion to lake shoreline areas during construction, as the reservoir is the smallest footprint option and will have the greatest offset from the shoreline areas.	5	The alternative has a moderate risk of encountering contaminated soil and potentially causing erosion to lake shoreline areas during construction, as the reservoir is the smallest footprint option and will have the greatest offset from the shoreline areas.	5	The alternative has a moderate risk of encountering contaminated soil and potentially causing erosion to lake shoreline areas during construction, as the reservoir is the smallest footprint option and will have the greatest offset from the shoreline areas.
		Total Score	*60.0*		*55.0*		*55.0*		*60.0*		*55.0*		*60.0*	

Lake Huron WTP EA - Detailed Evaluation - ALL CRITERION HAVE EQUAL WEIGHTING

Category	Weighting	Criterion	Alternative 1 - Do Nothing No additions/changes to existing WTP		Alternative 2 Clearwell Upgrades and New Reservoir (10.7 ML)		Alternative 3 New Reservoir (13 ML)		Alternative 4.1 UV Disinfection at Settled Water Conduits, and New Reservoir (6.9 ML)		Alternative 4.2 UV Disinfection at Each Filter Effluent, and New Reservoir (6.9 ML)		Alternative 4.3 UV Disinfection at New Reservoir (6.9 ML)	
Social/Cultural	4%	Archaeological Sites	10	The alternative has little to no potential to impact archeological features, as no new areas are impacted.	5	The reservoir component of the alternative is located in both previously disturbed and undisturbed areas as identified in the Stage 1 AA, thereby having a moderate potential for archeological features. Other works (i.e. clearwell upgrades) associated with this alternative occur within the existing WTP buildings.	5	The alternative is located in both previously disturbed and undisturbed areas as identified in the Stage 1 AA, thereby having a moderate potential for archeological features.	5	The reservoir component of the alternative is located in both previously disturbed and undisturbed areas as identified in the Stage 1 AA, thereby having a moderate potential for archeological features. Other works (new UV building attachments to existing sedimentation building) associated with this alternative occur within the extents of the existing WTP property.	5	The reservoir component of the alternative is located in both previously disturbed and undisturbed areas as identified in the Stage 1 AA, thereby having a moderate potential for archeological features. Other works (i.e. UV implementation) associated with this alternative occur within the existing WTP buildings.	5	The alternative is located in both previously disturbed and undisturbed areas as identified in the Stage 1 AA, thereby having a moderate potential for archeological features.
	4%	Cultural/Heritage Features	10	The alternative will have no physical nor non-physical disturbance to known cultural or heritage features, as no new areas are impacted.	10	The alternative will have no physical nor non-physical disturbance to known cultural or heritage features, as the areas impacted are not within the vicinity of the two properties west of Hwy 21 identified by the CHSR as having potential cultural heritage value or interest.	10	The alternative will have no physical nor non-physical disturbance to known cultural or heritage features, as the areas impacted are not within the vicinity of the two properties west of Hwy 21 identified by the CHSR as having potential cultural heritage value or interest.	10	The alternative will have no physical nor non-physical disturbance to known cultural or heritage features, as the areas impacted are not within the vicinity of the two properties west of Hwy 21 identified by the CHSR as having potential cultural heritage value or interest.	10	The alternative will have no physical nor non-physical disturbance to known cultural or heritage features, as the areas impacted are not within the vicinity of the two properties west of Hwy 21 identified by the CHSR as having potential cultural heritage value or interest.	10	The alternative will have no physical nor non-physical disturbance to known cultural or heritage features, as the areas impacted are not within the vicinity of the two properties west of Hwy 21 identified by the CHSR as having potential cultural heritage value or interest.
	4%	Recreational Land Uses and Visual Landscape	10	The alternative results in no permanent reduction in available park space and no permanent loss of beach access, as no changes are made.	10	The alternative may result in a negligible permanent reduction in available park space, if reservoir access area is fenced off. The alternative results in no permanent loss of beach access.	10	The alternative may result in a negligible permanent reduction in available park space, if reservoir access area is fenced off. The alternative results in no permanent loss of beach access.	10	The alternative may result in a negligible permanent reduction in available park space, if reservoir access area is fenced off. The alternative results in no permanent loss of beach access.	10	The alternative may result in a negligible permanent reduction in available park space, if reservoir access area is fenced off. The alternative results in no permanent loss of beach access.	5	The alternative results in a small permanent reduction in available park space, as there will be a small above-grade access/controls structure for the UV facility. The alternative results in no permanent loss of beach access.
	4%	Impacts During Construction	10	The alternative will result in no distruption to traffic nor to the use of public areas, as no changes will be made. This alternative has no potential for dust,noise and/or vibration impacts to homeowners in proximity to the project site.	5	The alternative will cause a moderate duration of distruption to use of public areas during construction of the new reservoir within Port Blake Park. The alternative will have no significant impacts to traffic as road closures along Hwy 21 nor local roads are anticipated.	5	The alternative will cause a moderate duration of distruption to use of public areas during construction of the new reservoir within Port Blake Park. The alternative will have no significant impacts to traffic as road closures along Hwy 21 nor local roads are anticipated.	0	The alternative will cause a moderate duration of distruption to use of public areas during construction of the new reservoir within Port Blake Park. The alternative has the highest potential for dust,noise and/or vibration impacts to homeowners in proximity to the project site, as it requires the construction of a new building on the north side of the WTP and may result in noise or beach access issues for residents along Waterworks Rd.	5	The alternative will cause a moderate duration of distruption to use of public areas during construction of the new reservoir within Port Blake Park. The alternative will have no significant impacts to traffic as road closures along Hwy 21 nor local roads are anticipated.	5	The alternative will cause a moderate duration of distruption to use of public areas during construction of the new reservoir within Port Blake Park. The alternative will have no significant impacts to traffic as road closures along Hwy 21 nor local roads are anticipated.
	4%	Long-Term Community Impact	10	The alternative will have no long term impacts regarding traffic, noise, and vibration to local residents and requires no changes to existing land use designations, as no changes will be made to existing WTP operations.	10	The alternative will have no long term impacts regarding traffic, noise, and vibration to local residents, as the changes do not include nor require the ongoing operation of loud or disruptive equipment/machinery. The alternative requires no changes to existing land use designations.	10	The alternative will have no long term impacts regarding traffic, noise, and vibration to local residents, as the changes do not include nor require the ongoing operation of loud or disruptive equipment/machinery. The alternative requires no changes to existing land use designations.	10	The alternative will have no long term impacts regarding traffic, noise, and vibration to local residents, as the changes do not include nor require the ongoing operation of loud or disruptive equipment/machinery. The alternative requires no changes to existing land use designations.	10	The alternative will have no long term impacts regarding traffic, noise, and vibration to local residents, as the changes do not include nor require the ongoing operation of loud or disruptive equipment/machinery. The alternative requires no changes to existing land use designations.	10	The alternative will have no long term impacts regarding traffic, noise, and vibration to local residents, as the changes do not include nor require the ongoing operation of loud or disruptive equipment/machinery. The alternative requires no changes to existing land use designations.
	4%	CLOS Reliability/Availability - Reduction in Service Interruptions	5	The alternative maintains the existing potential for the number and duration of planned or unplanned service interruptions, as no changes are made.	10	The alternative reduces the potential for the number and duration of planned or unplanned service interruptions, due to the addition of the reservoir which can be used for supply in case of interruption of water production at the plant.	10	The alternative reduces the potential for the number and duration of planned or unplanned service interruptions, due to the addition of the reservoir which can be used for supply in case of interruption of water production at the plant.	10	The alternative reduces the potential for the number and duration of planned or unplanned service interruptions, due to the addition of the reservoir which can be used for supply in case of interruption of water production at the plant.	10	The alternative reduces the potential for the number and duration of planned or unplanned service interruptions, due to the addition of the reservoir which can be used for supply in case of interruption of water production at the plant.	10	The alternative reduces the potential for the number and duration of planned or unplanned service interruptions, due to the addition of the reservoir which can be used for supply in case of interruption of water production at the plant.
	4%	Planning Policy Compliance	10	The alternative is in compliance with local and regional planning policies, as no changes are necessary.	10	The alternative is in compliance with local and regional planning policies with respect to zoning and land use permissions.	10	The alternative is in compliance with local and regional planning policies with respect to zoning and land use permissions.	10	The alternative is in compliance with local and regional planning policies with respect to zoning and land use permissions.	10	The alternative is in compliance with local and regional planning policies with respect to zoning and land use permissions.	10	The alternative is in compliance with local and regional planning policies with respect to zoning and land use permissions.
		Total Score	*65.0*		*60.0*		*60.0*		*55.0*		*60.0*		*55.0*	

Lake Huron WTP EA - Detailed Evaluation - ALL CRITERION HAVE EQUAL WEIGHTING

Category	Weighting	Criterion	Alternative 1 - Do Nothing No additions/changes to existing WTP		Alternative 2 Clearwell Upgrades and New Reservoir (10.7 ML)		Alternative 3 New Reservoir (13 ML)		Alternative 4.1 UV Disinfection at Settled Water Conduits, and New Reservoir (6.9 ML)		Alternative 4.2 UV Disinfection at Each Filter Effluent, and New Reservoir (6.9 ML)		Alternative 4.3 UV Disinfection at New Reservoir (6.9 ML)	
Technical	4%	Improvements to Primary Disinfection	0	The alternative does not achieve primary disinfection under all conditions, and relies upon the use of the primary pipeline to B Line Road.	10	The alternative can achieve primary disinfection under all conditions, due to the additional contact time provided by the reservoir.	10	The alternative can achieve primary disinfection under all conditions, due to the additional contact time provided by the reservoir.	10	The alternative can achieve primary disinfection under all conditions, due to the additional layer of disinfection provided by the UV reactors.	10	The alternative can achieve primary disinfection under all conditions, due to the additional layer of disinfection provided by the UV reactors.	10	The alternative can achieve primary disinfection under all conditions, due to the additional layer of disinfection provided by the UV reactors.
	4%	Impact on DBP Formation	0	The alternative may increase DBP formation under certain operating conditions, such as increased flow conditions or removal of reliance on primary pipeline to B Line Road for primary disinfection contact time.	5	The alternative provides some opportunity to eliminate pre-chlorination thereby reducing contact with DBP precursors, due to the addition of the new reservoir providing the opportunity to reduce pre-chlorination.	5	The alternative provides some opportunity to eliminate pre-chlorination thereby reducing contact with DBP precursors, due to the addition of the new reservoir providing the opportunity to reduce pre-chlorination.	10	The alternative provides the ability to reduce DBP formation by reducing chlorination as a result of the introduction of UV disinfection.	10	The alternative provides the ability to reduce DBP formation by reducing chlorination as a result of the introduction of UV disinfection.	10	The alternative provides the ability to reduce DBP formation by reducing chlorination as a result of the introduction of UV disinfection.
	4%	Ease of Implementatation	10	The alternative poses no issues for space availability nor constructability, as no changes to the existing plant will be made. Any operational changes needed can be easily implemented	5	The alternative has sufficient space available for the construction of the reservoir component, however it poses moderate constructability issues for the implementation of the new baffle walls and overflow weirs. Requires accessing and working within the existing clearwells which are located below the plant's filters.	10	The alternative poses a low risk of issues with space availability and constructability issues, as there is sufficient space available for the construction of the reservoir in the park.	5	The alternative has some limitations on space availablility for the construction of the UV building attachment on the north settled water conduit, due to the proximity to the carbon and chlorine buildings.	0	The alternative has minimal space available for the retrofitting of the new UV reactors and associated equipment on each of the filter effluent piping within the filter gallery, which elimates the competition of certain UV vendors and equipment availability.	10	The alternative poses a low risk of issues with space availability and constructability issues, as there is sufficient space available for the construction of the reservoir and UV chamber in the park.
	4%	Future Proofing	0	The alternative has the least ability to accomodate future more stringent primary disinfection regulatory requirements and changes in source water quality, as no changes are being made to the existing plant.	5	The alternative has some ability to accomodate a change in current CT credits for pre-treatment, due to the addition of more CT within the existing clearwells and the new reservoir	5	The alternative has some ability to accomodate a change in current CT credits for pre-treatment, due to the addition of more CT within the new reservoir	10	This alternative has the best ability to accomodate future more stringent primary disinfection regulatory requirements and changes in source water quality, due to UV disinfection providing multi-barrier approach and adaptability to more strigent microbial requirements. Also provides the opportunity for modifications to allow for reduced chlorine application.	10	This alternative has the best ability to accomodate future more stringent primary disinfection regulatory requirements and changes in source water quality, due to UV disinfection providing multi-barrier approach and adaptability to more strigent microbial requirements. Also provides the opporunity for modifications to allow for reduced chlorine application.	10	This alternative has the best ability to accomodate future more stringent primary disinfection regulatory requirements and changes in source water quality, due to UV disinfection providing multi-barrier approach and adaptability to more strigent microbial requirements. Also provides the opporunity for modifications to allow for reduced chlorine application.
	4%	Potential for System Expandability for Redundancy	0	There is no potential to provide redundancy, as no new equipment/infrastruture will be implemented.	5	The alternative has moderate space available for future expansions of the new reservoir, as the proposed reservoir is the larger footprint option and thereby resulting in slightly less area for expansion.	5	The alternative has moderate space available for future expansions of the new reservoir, as the proposed reservoir is the larger footprint option and thereby resulting in slightly less area for expansion.	5	The alternative has moderate space available to implement a redundant reactor within the new UV building attachment on the north settled water conduit, due to the proximity to the carbon and chlorine buildings. The alternative has the greatest potential and space availability for future expansions of the new reservoir, as the proposed reservoir is the smallest footprint option.	0	The alternative has no ability to implement a redundant reactor per filter due to space limitations. The alternative has greatest potential and space availability for future expansions of the new reservoir, as the proposed reservoir is the smallest footprint option.	10	The alternative has a high potential and space availablity for including redundant reactors within the UV vault, as well as due to the reservoir being the smallest footprint option.
	4%	Compatibility with Plant HGL	5	The alternative has no issues with accomodation of existing WTP HGL as no new equipment/infrastructure will be added, however it will require operational changes to the current standard operating procedure (low-lift pumping ramp up to accommodate EMS strategy).	5	The alternative can be accomodated in the existing WTP HGL, but requires minor operational changes (low-lift pumping ramp up to accommodate EMS strategy).	5	The alternative can be accomodated in the existing WTP HGL, but requires minor operational changes (low-lift pumping ramp up to accommodate EMS strategy).	5	The alternative can be accomodated in the existing WTP HGL, but requires minor operational changes (low-lift pumping ramp up to accommodate EMS strategy).	5	The alternative can be accomodated in the existing WTP HGL, but requires minor operational changes (low-lift pumping ramp up to accommodate EMS strategy).	5	The alternative can be accomodated in the existing WTP HGL, but requires minor operational changes (low-lift pumping ramp up to accommodate EMS strategy).

Lake Huron WTP EA - Detailed Evaluation - ALL CRITERION HAVE EQUAL WEIGHTING

Category	Weighting	Criterion	Alternative 1 - Do Nothing No additions/changes to existing WTP		Alternative 2 Clearwell Upgrades and New Reservoir (10.7 ML)		Alternative 3 New Reservoir (13 ML)		Alternative 4.1 UV Disinfection at Settled Water Conduits, and New Reservoir (6.9 ML)		Alternative 4.2 UV Disinfection at Each Filter Effluent, and New Reservoir (6.9 ML)		Alternative 4.3 UV Disinfection at New Reservoir (6.9 ML)	
	4%	Operation Flexibility	0	The alternative will maintain existing level of operational flexibility, however it will not remove reliance on primary pipeline to B Line Road for primary disinfection as no new changes will be made.	5	The alternative will increase operational flexibility from a storage perspective only, with the addition of the new reservoir providing additional storage at the plant.	5	The alternative will increase operational flexibility from a storage perspective only, with the addition of the new reservoir providing additional storage at the plant.	10	The alternative will increase operational flexibility from both primary disinfection and storage perspective, as the addition of both the reservoir and UV disinfection process provides a backup option should UV reactors fail, as storage is available in the reservoir.	5	The alternative will increase operational flexibility from both primary disinfection and storage perspective, as the addition of both the reservoir and UV disinfection process provides a backup option should UV reactors fail, as storage is available in the reservoir. However, this alternative has limitations on improving operational flexibility from a primary disinfection standpoint as it uses medium pressure reactors which require more ramp up time compared to LPHO reactors.	10	The alternative will increase operational flexibility from both primary disinfection and storage perspective, as the addition of both the reservoir and UV disinfection process provides a backup option should UV reactors fail, as storage is available in the reservoir.
	4%	Maintenance	10	The alternative requires no new maintenance activities and poses no additional risks compared to existing operation, as no changes will be made.	10	The alternative is simple to maintain and requires low maintenace frequency, as the new reservoir and new clearwell features will require periodic inspections (~3-5 years) but nothing further. The operation and maintenance of the new assets for this alternative poses a low risk to occupational health and safety.	10	The alternative is simple to maintain and requires low maintenace frequency, as the new reservoir will require periodic inspections (~3-5 years) but nothing further. The operation and maintenance of the new assets for this alternative poses a low risk to occupational health and safety.	5	The alternative requires a moderate frequency of maintenance for the upkeep of the UV reactors (including lamp replacement, inspections, cleaning). The operational and maintenance of the new assets for this alternative poses a low risk to occupational health and safety.	0	The alternative requires a moderate frequency of maintenance for the upkeep of the UV reactors (including lamp replacement, inspections, cleaning). The operational and maintenance of the new assets for this alternative poses some risk to occupational health and safety, due to the new UV reactors causing a reduction in space in an already space-constrained working environment.	5	The alternative requires a moderate frequency of maintenance for the upkeep of the UV reactors (including lamp replacement, inspections, cleaning). The operational and maintenance of the new assets for this alternative poses a low risk to occupational health and safety.
	4%	Permits and Approvals	0	The renewal of existing permits/approvals for the alternative may be difficult as demands increase, as receiving approvals for pre-treatment through the existing process may require onerous negociations with uncertain outcomes.	5	Obtaining or renewal of the permits/approvals for this alternative are anticipated to be achievable, but as the reservoir footprint is in closer proximity to the Ausable Bayfield Conservation Authority regulatory boundary, additional studies (EIS) and mitigation measures by regulatory agency may be required.	5	Obtaining or renewal of the permits/approvals for this alternative are anticipated to be achievable, but as the reservoir footprint is in closer proximity to the Ausable Bayfield Conservation Authority regulatory boundary, additional studies (EIS) and mitigation measures by regulatory agency may be required.	10	Obtaining or the renewal of the permits/approvals associated with the new UV disinfection process of this alternative are anticipated to be easily achievable.	10	Obtaining or the renewal of the permits/approvals associated with the new UV disinfection process of this alternative are anticipated to be easily achievable.	10	Obtaining or the renewal of the permits/approvals associated with the new UV disinfection process of this alternative are anticipated to be easily achievable.
		Total Score	*25.0*		*55.0*		*60.0*		*70.0*		*50.0*		*80.0*	
Economic	4%	Capital Costs	10	The alternative has a capital cost of <$20M (~$0M - no changes)	5	The alternative has a capital cost between $20M - $40M (~$33.37M)	5	The alternative has a capital cost between $20M - $40M (~$35.01M)	5	The alternative has a capital cost between $20M - $40M (~$38.67M)	5	The alternative has a capital cost between $20M - $40M (~$27.86M)	5	The alternative has a capital cost between $20M - $40M (~$37.32M)
	4%	Life Cycle Costs	10	The alternative has a lifecycle cost of <$20M ($0.84M)	5	The alternative has a lifecycle cost between $20M - $40M (~$33.67M)	5	The alternative has a lifecycle cost between $20M - $40M (~$35.30M)	5	The alternative has a lifecycle cost between $20M - $40M (~$39.01M)	5	The alternative has a lifecycle cost between $20M - $40M ($28.28M)	5	The alternative has a lifecycle cost between $20M - $40M (~$37.50M)
		Total Score	*20.0*		*10.0*		*10.0*		*10.0*		*10.0*		*10.0*	
		TOTAL	170.0		180.0		185.0		195.0		175.0		205.0	
		RANK	6		4		3		2		5		1	

Evaluation Results - Total Scoring (All Criterion Weighted Equally)

Alternative Nos.	Title of Alternatives	Natural Environment Score	Social/Cultural Score	Technical Score	Economic Score	Total Score	Ranking	
1	Do Nothing	60	65	25	20	**170**	6	
2	Clearwell Upgrades and New Reservoir (10.7 ML)	55	60	55	10	**180**	4	
3	New Reservoir (13 ML)	55	60	60	10	**185**	3	
4.1	UV Disinfection at Settled Water Conduits, and New Reservoir (6.9 ML)	60	55	70	10	**195**	2	
4.2	UV Disinfection at Each Filter Effluent, and New Reservoir (6.9 ML)	55	60	50	10	**175**	5	
4.3	UV Disinfection at New Reservoir (6.9 ML)	60	55	80	10	**205**	1	PREFERRED

Sensitivity Analysis (5 Scenarios)

Scenario 1 - Each Category Weighting of 25%

Alternative Nos.	Title of Alternatives	Natural Environment Score	Social/Cultural Score	Technical Score	Economic Score	Total Score	Ranking	
1	Do Nothing	21.4	23.2	6.9	25.0	**76.6**	1	PREFERRED
2	Clearwell Upgrades and New Reservoir (10.7 ML)	19.6	21.4	15.3	12.5	**68.8**	5	
3	New Reservoir (13 ML)	19.6	21.4	16.7	12.5	**70.2**	4	
4.1	UV Disinfection at Settled Water Conduits, and New Reservoir (6.9 ML)	21.4	19.6	19.4	12.5	**73.0**	3	
4.2	UV Disinfection at Each Filter Effluent, and New Reservoir (6.9 ML)	19.6	21.4	13.9	12.5	**67.5**	6	
4.3	UV Disinfection at New Reservoir (6.9 ML)	21.4	19.6	22.2	12.5	**75.8**	2	

Scenario 2 - 40% Weighting for Natural Environment

Alternative Nos.	Title of Alternatives	Natural Environment Score	Social/Cultural Score	Technical Score	Economic Score	Total Score	Ranking	
1	Do Nothing	34.3	18.6	5.6	20.0	**78.4**	1	PREFERRED
2	Clearwell Upgrades and New Reservoir (10.7 ML)	31.4	17.1	12.2	10.0	**70.8**	5	
3	New Reservoir (13 ML)	31.4	17.1	13.3	10.0	**71.9**	4	
4.1	UV Disinfection at Settled Water Conduits, and New Reservoir (6.9 ML)	34.3	15.7	15.6	10.0	**75.6**	3	
4.2	UV Disinfection at Each Filter Effluent, and New Reservoir (6.9 ML)	31.4	17.1	11.1	10.0	**69.7**	6	
4.3	UV Disinfection at New Reservoir (6.9 ML)	34.3	15.7	17.8	10.0	**77.8**	2	

Scenario 3 - 40% Weighting for Social/Cultural

Alternative Nos.	Title of Alternatives	Natural Environment Score	Social/Cultural Score	Technical Score	Economic Score	Total Score	Ranking	
1	Do Nothing	17.1	37.1	5.6	20.0	**79.8**	1	PREFERRED
2	Clearwell Upgrades and New Reservoir (10.7 ML)	15.7	34.3	12.2	10.0	**72.2**	5	
3	New Reservoir (13 ML)	15.7	34.3	13.3	10.0	**73.3**	4	
4.1	UV Disinfection at Settled Water Conduits, and New Reservoir (6.9 ML)	17.1	31.4	15.6	10.0	**74.1**	3	
4.2	UV Disinfection at Each Filter Effluent, and New Reservoir (6.9 ML)	15.7	34.3	11.1	10.0	**71.1**	6	
4.3	UV Disinfection at New Reservoir (6.9 ML)	17.1	31.4	17.8	10.0	**76.3**	2	

Scenario 4 - 40% Weighting for Technical

Alternative Nos.	Title of Alternatives	Natural Environment Score	Social/Cultural Score	Technical Score	Economic Score	Total Score	Ranking	
1	Do Nothing	17.1	18.6	11.1	20.0	**66.8**	5	
2	Clearwell Upgrades and New Reservoir (10.7 ML)	15.7	17.1	24.4	10.0	**67.3**	4	
3	New Reservoir (13 ML)	15.7	17.1	26.7	10.0	**69.5**	3	
4.1	UV Disinfection at Settled Water Conduits, and New Reservoir (6.9 ML)	17.1	15.7	31.1	10.0	**74.0**	2	
4.2	UV Disinfection at Each Filter Effluent, and New Reservoir (6.9 ML)	15.7	17.1	22.2	10.0	**65.1**	6	
4.3	UV Disinfection at New Reservoir (6.9 ML)	17.1	15.7	35.6	10.0	**78.4**	1	PREFERRED

Scenario 5 - 40% Weighting for Economic

Alternative Nos.	Title of Alternatives	Natural Environment Score	Social/Cultural Score	Technical Score	Economic Score	Total Score	Ranking	
1	Do Nothing	17.1	18.6	5.6	40.0	**81.3**	1	PREFERRED
2	Clearwell Upgrades and New Reservoir (10.7 ML)	15.7	17.1	12.2	20.0	**65.1**	5	
3	New Reservoir (13 ML)	15.7	17.1	13.3	20.0	**66.2**	4	
4.1	UV Disinfection at Settled Water Conduits, and New Reservoir (6.9 ML)	17.1	15.7	15.6	20.0	**68.4**	3	
4.2	UV Disinfection at Each Filter Effluent, and New Reservoir (6.9 ML)	15.7	17.1	11.1	20.0	**64.0**	6	
4.3	UV Disinfection at New Reservoir (6.9 ML)	17.1	15.7	17.8	20.0	**70.6**	2	