

Appendix B

MINUTES OF STEERING COMMITTEE MEETINGS

STEERING COMMITTEE MEETING #1

PROJECT: Town of Collingwood
Class EA Amendment for the R. A. Barker Water Treatment Plant Expansion
Ainley Job No. 119013

DATE: July 4, 2019

LOCATION: 43 Stewart Road, Collingwood (Boardroom)

TIME: 1:15 pm to 4:20 pm

PRESENT: Peggy Slama, Town of Collingwood
Ken Kaden, Town of Collingwood
Brian Sahely, AECOM
Mike Ainley, Ainley Group
Reid Mitchell, Ainley Group
Victoria Perejmybida, Ainley Group

DISTRIBUTION: All Present

1. Call to Order

The meeting commenced at 1:15pm.

2. Introductions
a. Primary Contact Information

The primary contact information for the Town of Collingwood (Town), Ainley and AECOM is outlined below:

Peggy Slama

- Email: pslama@collingwood.ca
- Phone: 705-445-1581, Ext. 3301

Ken Kaden

- Email: kkaden@collingwood.ca
- Phone: 705-445-1581 Ext. 3303
- Mobile: 705-351-2133

Brian Sahely

- Email: brian.sahely@aecom.com
- Phone: 1-905-747-7445
- Mobile: 1-416-716-6750

Mike Ainley

- Email: ainley.m@ainleygroup.com
- Phone: 705-445-3451 Ext. 136
- Mobile: 705-444-4466

Reid Mitchell

- Email: mitchell@ainleygroup.com
- Phone: 705-445-3451 Ext. 135

Tori Perejmybida

- Email: perejmybida@ainleygroup.com
- Phone: 705-445-3451 Ext. 119
- Mobile: 705-539-0149

b. Reporting Structure and Protocol

The Town's primary contact is Ken Kaden. Peggy Slama is to be copied on all required correspondence.

Brian Sahely is the primary contact for AECOM and will only require correspondence on technical aspects of the project. AECOM will provide all correspondence through Ainley.

Mike Ainley is the main contact for Ainley. Reid Mitchell and Tori Perejmybida are to be copied on all correspondence.

The project schedule identifies a number of teleconferences. The intention of the teleconferences is to allow for short discussions to advance the project. Ainley can meet with the Town in person however AECOM will use teleconference to reduce travel time.

3. Contract Documents
a. Status of Engineering Agreement

The engineering agreement has been executed.

4. Project Overview

The scope review list outlined below was discussed during the meeting.

- Collection and review of background information
- Existing plant performance/capacity review
 - The capacity review will determine the existing capacity of the plant through a desktop analysis. Collingwood just completed a report that will provide AECOM with the required information to complete the capacity analysis.

ACTION BY: Town of Collingwood / AECOM

- The Town needs to provide AECOM with the cleaning frequency of the plant filters.

ACTION BY: Town of Collingwood

- Archaeological review of the site
 - To commence as soon as possible.

ACTION BY: AECOM

- Natural environmental review of the site
 - To commence as soon as possible.

ACTION BY: AECOM

- Class EA Phase 1 & 2 public consultation
 - The notice of commencement is intended to be the only public consultation during Phase 1 and 2.
 - The Master Servicing Plan (MSP) is expected to provide the Phase 1 and 2 information required for this Class Environmental Assessment (Class EA).
 - Ainley and AECOM expect all planning information to come from the MSP. The Town will provide a copy of the MSP as soon as possible.

ACTION BY: Town of Collingwood

- Identification and evaluation of alternative design solutions
 - An initial list has been developed which was further discussed during the meeting. It was agreed that further discussion is required in order to finalize the lists of design solutions for both the Ultrafiltration system and the disinfection system.

ACTION BY: All

- Workshop with Town staff to confirm and short-list alternative design concepts
- Development of draft recommended alternative design solution(s)
- Class EA Phase 3 consultation (including PIC)
 - The Public Information Centre (PIC) will take place on the 3rd floor of the public library. The room will be booked by the Town once a date for the PIC is determined.

ACTION BY: Town of Collingwood

- Finalization and refinement of recommended alternative design solution(s)
- Preparation of Amendment to 2004 Environmental Study Report
 - The Town questioned whether an Amendment or Addendum to the 2004 Environmental Study Report (ESR) is required. An Amendment is required for any changes to the ESR to clarify ambiguities, streamlining the planning process where problems have arisen and where projects or activities were not previously included. An Addendum is required as a result of a time lapse of an ESR or where it is not feasible to implement the project in the manner outlined in the ESR. The preliminary classification is an Amendment but this will be confirmed as part of pre-consultation with MECP.

ACTION BY: Ainley Group

- Class EA Phase 4 consultation (Notice of Completion; 30-day public review)
- Issuance of final Amendment to the ESR

The following optional additional scope item was also discussed during the meeting.

- Provisional full condition assessment of the existing plant's structural, mechanical and electrical systems
 - AECOM identified that they require a scope of work to properly prepare a price for a condition assessment as assessment can vary significantly in price depending on the level of detail.
 - The Town's goal of a condition assessment is to determine if there are any major pieces of equipment that are worth saving for the plant upgrade/expansion as well as the structural/architectural suitability of the plant to support modifications and loads of potential new replacement process equipment.

- Based on the discussion it was determined that a condition assessment is an important factor in evaluating alternative plant expansion solutions, including price, and therefore should be completed early in the Class EA process.
- AECOM will provide an initial scope of work and price for the condition assessment.
- Additional scope can be determined during the initial assessment from a quick overview of the entire plant and through additional information from Town Operators at the plant. The need for additional condition assessments will be determined later in the project.

ACTION BY: AECOM

5. Required Project Information from Town and Third Parties
 a. Master Servicing Plan

A draft of the MSP was submitted by Cole to the Town for review and the Town's review comments have been provided back to the consultant. It is expected that the MSP report will not be finalized for several weeks. The Town will provide Ainley and AECOM with the relevant information from the draft report to allow the Class EA to proceed.

ACTION BY: Town of Collingwood

b. Design Constraints

AECOM inquired about the temperature of water that should be used to complete calculations for the Class EA. The filter efficiency is dependent upon the raw water temperature and decreases as the temperature decreases. Collingwood identified that they would like to proceed using the worst-case scenario of 0.5°C.

c. Existing and Ultimate Build-Out Demands

The Town provided Ainley with a breakdown of the required demands prior to the meeting. The Town confirmed that the built boundary numbers are the required demands at full build-out and include the maximum supply requests from Township of Clearview, Town of New Tecumseth and Town of the Blue Mountains (TOTBM). The breakdown does not include the non-potable water currently received by the east industries. Future industry potable water demand based on Ministry guidelines are included in the breakdown.

The Town will provide Ainley and AECOM with the existing records of maximum non-potable water demand to industries. The current demands are lower than historic demands, however there is a potential for it to increase.

ACTION BY: Town of Collingwood

In addition to providing the non-potable water demand records, the Town will provide an updated table identifying the breakdown of potable water demands (existing, 2032, 2044 and built boundary) including updated demands to TOTBM, Clearview and New Tecumseth to properly reflect their phased supply requests. The table will also show the proportion of water going through the Regional pipeline for each phase.

ACTION BY: Town of Collingwood

The breakdown showed a 50% split of water going through the Regional pipeline and the remainder being delivered directly into the Town's system at the WTP1. The Town identified that this split is based

on analysis completed during the MSP and is not an arbitrary assumption. The Town will confirm.

ACTION BY: Town of Collingwood

The membrane concentrate is currently discharged back to the bay instead of going to the east industries for their non-potable demands as it is not satisfactory for the required industrial process uses and meets the Ministry's quality requirements for discharge to the bay.

It was noted that the industrial water supply is hooked up to fire suppression at some of the industries. If a fire occurs there is a potential for the pumps to operate at 100% causing a significant increase in water going to industries. This would result in a decrease in output of treated water possibly resulting in the use of emergency storage to meet system needs similar to a fire being suppressed with treated water.

The supply commitment for Clearview is for a possible future servicing of Nottawa.

The TOTBM has requested up to 16,400 m³/day to satisfy potential future needs. Collingwood's response was that it will only provide the amount of water that can be delivered without having to complete upgrades to its distribution system.

d. Existing Plant Information Including Permit and Licenses

The Town will provide the most up to date PTTW, DWWP and all applicable licenses and permits (April 2019 DWWP provided at meeting).

ACTION BY: Town of Collingwood

The previous PTTW identified the potential to increase water taking however this was removed from the most recent PTTW. When an increase in water taking is required the Town will follow the required process including the completion of additional studies.

It was noted that a limitation on the existing site could be the size of the intake. The maximum instantaneous -capacity was previously established as 125,000 m³/day.

AECOM will review the changes to the DWWP to determine the plant upgrades that have occurred since the most up to date set of drawings were produced.

ACTION BY: AECOM

The Town confirmed that they are still experiencing issues with zebra mussels at the water intake. An investigation and report were completed to identify any issues. A chlorine line is in place to help rectify the zebra mussel issue. The Town identified that quagga mussels are not of concern, however the report should be reviewed to determine if any were present during the investigation. AECOM identified that the issue with quagga mussels is that chlorine needs to be utilized year-round instead of just in warmer months.

The Town identified that frazil ice is a concern when water levels are low. Water has not been low for several years and therefore this issue has not been experienced recently. The Town intends to look into the feasibility of using the chlorine line to pump air in the winter to help with removal of frazil ice. AECOM suggested that due to pressures in the line that it may not be feasible to use the existing chlorine duct, however AECOM will look into it as an option. The Town identified that either way they want to deal with the ice issues. Town Operation's may be able to provide water elevations that result in frazil ice.

e) Stakeholder List

Ainley reviewed the consultation records from the 2004 Class EA and asked about the extent of public consultation. The Town advised that the consultation records provided were from the immediately available files however they will review additional files to determine if more information is available. Ainley identified that a resident's concern with regards to sight lines may have only arisen during the design phase.

ACTION BY: Town of Collingwood

Ainley has updated the contact list based on the consultation records from the 2004 Class EA. The Town identified that they will provide a list of developers and surrounding properties that they want added to the agency contact list. Ainley presented a map of potential consultation areas surrounding the plant. The Town identified they would like to include properties within a 100 metre consultation area which encompasses the block around the water treatment plant. Once the agency consultation list has been updated it will be provided to the Town for final review.

ACTION BY: Town of Collingwood and Ainley Group

Ainley has contacted the MECP to obtain a list of indigenous communities that should be contacted during the Class EA. The Town will also determine if any additional communities should be contacted as part of the Class EA.

ACTION BY: Town of Collingwood

6. Review and Finalization of Draft Problem Statement

The problem statement is:

The current rated capacity of the Raymond A. Barker Water Treatment Plant is insufficient to accommodate the future water demands of the Town of Collingwood and its contractual commitments to supply treated water to other municipalities.

The statement will continue to be developed throughout the project and will be included in the ESR.

7. Review and Finalization of Draft Notice of Commencement and Letter

The notice of study commencement was reviewed during the meeting. The Town provided Ainley with comments. Ainley will update the notice and provide it to the Town for final review. The Town had no comments regarding the agency cover letter. The Town noted that the map (included in the Notice) will need to be "cleaned up" for publication in the newspaper.

ACTION BY: Ainley Group

The Town identified that the advertisement only needs to be posted in the Collingwood newspaper. The advertisement needs to be submitted on Thursday, a week before the it is in the paper. The advertisement is tentatively scheduled for publication on July 18, 2019, dependent on updating the required information on time.

8. Review of Preliminary Alternative Design Concepts

The Town would like the Class EA to identify the following staging:

- Stage 1 – Expand Water Treatment Plant to meet existing PTTW maximum limit.
- Stage 2 – Expand WTP to meet Full-Build predicted water demand (requiring an amendment to the existing PTTW).

The Town identified that the alternatives should proceed with less limitations as this is the beginning of the evaluation stage. Throughout the consultation process, evaluation constraints will be determined and allow for the preferred alternative to be identified.

The Town identified that they would like to keep the existing membrane building. The old plant can be repurposed or demolished as a majority of the building is currently empty.

AECOM identified that pressure filtration takes up more space than submersible filters and therefore if Collingwood wanted to use the existing building, submersible filters are the only option. The supplier (manufacturer) of the filters is a design issue and therefore does not need to be identified in the ESR.

The options identified in the proposal were reviewed. The following items were discussed:

Options 1 and 2 will be switched so that the 2004 preferred alternative is Option 1.

Ultrafiltration System Expansion Design Alternatives

Option 1 – 2004 Preferred Alternative

- AECOM will look at the current technology to determine the rated capacity of this option.
- The following disadvantage “much less potential capacity than required for development” will be updated to identify the reasons including guideline and regulation changes.

Option 2 – 2007 Design

- The reference to manufacturers will be removed from this alternative. The alternative will only make mention to the use of submersible membranes.
- The following advantage “meets Stage 1 and Stage 2 capacity requirements” is referring to the Stages identified in the proposal. Once the stages are determined for this Class EA this item will be updated.

Option 3 – New Plant on-site and repurposing the existing building

- This item was reviewed and no comments were made.

Option 4 – New Plant on-site and maintain existing filtration

- This item was reviewed and no comments were made.

Disinfection System and High-Lift Pumping Storage Expansion Design Alternatives

Option 1 – UV disinfection

Options 2- 4 – All options include disinfection using chlorine

- The Town identified that they want to reduce the current chlorine residual which will require additional chlorine contact volume for all these options.

Option 5 – Rapid acting disinfection products

- no comments were made during the meeting about this item.

The Town inquired about reviewing liquid chlorine versus chlorine gas alternatives. AECOM noted that the existing chlorine gas system is appropriate for the facility and does not require upgrades (other than a scrubber) to meet current standards and therefore it was agreed that there is no need to further consider changing the existing system.

9. Schedule of Major Deliverable

The following preliminary schedule of major deliverables was included in the meeting agenda however it was not discussed during the meeting due to time constraints.

1. Existing and ultimate build-out planning information (from Town)	Jul 9, 2019
2. Notice of Commencement (tentative publication date)	Jul 11, 2019
3. Existing Plant Performance/Capacity Review	Aug 2, 2019
4. Archaeological and natural features reviews of site	Aug 16, 2019
5. Final Phase 1 & 2 documentation (Technical Memorandum #1)	Sep 11, 2019
6. Development of design alternatives and workshop with Town	Sep 25, 2019
7. Draft Phase 3 documentation (draft Technical Memorandum #2)	Oct 16, 2019
8. Public Information Centre material	Nov 15, 2019
9. First Notice of PIC (tentative publication date)	Nov 28, 2019
10. Second Notice of PIC (tentative publication date)	Dec 5, 2019
11. Final Phase 3 documentation (Technical Memorandum #2)	Jan 29, 2020
12. Phase 4 documentation (Amendment to the ESR)	Feb 26, 2020
13. First Notice of Completion (tentative publication date)	Feb 27, 2020
14. Second Notice of Completion (tentative publication date)	Mar 5, 2020
15. Final Phase 4 documentation (Amendment to the ESR)	Jun 12, 2020

10. Other Business

The Town would like a boardroom (with washrooms and additional vehicle parking spaces) incorporated into the new design of the treatment plant.

The Town stated that the ESR will need to identify why the original project was put on hold and why it is now being re-examined. Ainley has started to prepare a history of the project that will be included as part of the ESR.

Multiple jurisdictional requirements for extra security and rapid response as well as the Provincial regulatory change from 0.1 NTU 95% of the time to 99% of the time resulted in all membrane manufacturers incorporating strainers upstream of the membranes for additional protection and direct integrity testing for more rapid response in the event of a membrane breach.

MECP continues to approve membrane replacements at existing plants utilizing older technology that does not incorporate strainers or direct integrity testing (including recent replacements of ZW500a&b membranes at the Collingwood plant with ZW500d membranes). It is not known if MECP has approved a corresponding increase in rated capacity in any of these plants (since the new ZW500 membranes have greater capacity than the older ones), nor is it known if MECP has approved major plant expansions or new plants using the old technology since the standards and regulations have changed. It was agreed that AECOM will contact the MECP to determine if ZW500 membranes can be used for an

expansion within the existing membrane building or if the plant would be subject to the new standards with respect to direct integrity testing. It was agreed that all new treatment outside of the existing plant footprint will meet the updated regulation and will include direct integrity testing.

ACTION BY: AECOM

A future meeting will be scheduled to discuss design options.

Any errors and/or omissions from these Minutes should be reported to the undersigned as soon as possible.

Minutes prepared by V. Perejmybida and finalized by:

A handwritten signature in black ink, appearing to read 'Mike Ainley', written over a horizontal line.

Mike Ainley, P. Eng, PMP
Ainley & Associates Limited

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MEETING MINUTES
Revised November 14, 2019

STEERING COMMITTEE MEETING #2

PROJECT: The Town of Collingwood
Updated Class EA for the R. A. Barker Water Treatment Plant Expansion
Ainley Job No. 119013

DATE: October 18th, 2019

LOCATION: 43 Stewart Road, Collingwood (Boardroom)

TIME: 10:30 a.m. – 3:15 p.m.

PRESENT: Peggy Slama, Town of Collingwood
Ken Kaden, Town of Collingwood
Marie Richardson, Town of Collingwood
John Vail, Town of Collingwood
Mike Ainley, Ainley Group
Reid Mitchell, Ainley Group
Jody Marks, Ainley Group
Brian Sahely, AECOM

DISTRIBUTION: All Present

1. Call to Order

The meeting was called to order at 10:30 a.m.

2. Purpose of Meeting

The purpose of the meeting was to discuss the updated scope and schedule, field and performance assessments, and preliminary Phase 3 ESR documentation working draft.

3. Updated Scope

A condition assessment of the existing water treatment plant was added to the scope of the assignment.

It was agreed that the 2004 ESR is no longer valid due to significant updates in planning, technology and consultation requirements. Therefore, it was determined that instead of an Amendment/Addendum to the 2004 ESR an Updated Phase 3 & 4 ESR will be prepared, referencing the Master Servicing Plan (including March 2019 PIC) to satisfy Phases 1 & 2.

4. Updated Schedule

An updated schedule/workplan was provided through updates to the Responsibility Matrix highlighting milestone submissions and events. Imminent milestones include:

- Incorporation of comments from this meeting into Phase 3 documentation (on-going).
Action Item: Ainley
- Finalization of field study reports with the feedback/comments from this meeting by end of October.
Action Item: AECOM

- November 19th workshop (Meeting #3) to present preliminary evaluation criteria with weighted values along with alternative design solutions.
Action Item: All
- December 13th submission of updated Phase 3 documentation incorporating alternative design solutions including preliminary recommended solution.
Action Item: Ainley/AECOM
- January 6th submission of Phase 3 PIC materials including draft Notice of PIC & Letter to Contact Agencies. (Additional detail on design solutions may also be submitted at this time).
Action Item: Ainley/AECOM
- January 10th meeting (Meeting #4) to discuss updated draft Phase 3 documentation, PIC material and detailed design solutions.
Action Item: All
- Finalization of draft notices and letters as well as draft Phase 3 documentation and other materials to be presented at the PIC by January 15th (Notice of PIC to be published January 16th and 23rd).
Action Item: All
- Phase 3 PIC to be held January 30th.
Action Item: All

The Town advised that a firm date for the finalization and publication of the MSP (needed to satisfy the Phase 1 & 2 requirements for the plant expansion) is not available at this time. However, a Notice of Completion in December is considered the earliest possible publication date. It was agreed that the Notice of Completion for the MSP must be published, the mandatory 30-day review period concluded and the MSP finalized prior to publication of the Notice of the Phase 3 PIC. The Town will advise Ainley of the progress of the MSP.

Action Item: Town

5. Field and Performance Reviews/Assessments

Natural Environment Review

The conclusions from this study are to implement mitigation measures specific to construction activities. There were no concerns or comments from the Town regarding the Natural Heritage Assessment.

Stage 1 Archaeological Assessment

The Stage 1 report identifies no further archaeological investigation is required. The Town noted that they have not received a formal letter from the Ministry of Tourism, Culture and Sport (MTCS) accepting the Stage 1 report and conclusions. AECOM will confirm with archaeologist that the Stage 1 report has been submitted to the MTCS and that when the letter is received it be forwarded to the Town.

Action Item: AECOM

Existing Plant Performance/Capacity Assessment

AECOM highlighted sections in the draft report submitted to the Town with the intention of going through each highlighted item to discuss and confirm with the Town. The following is a summary of the edits and decisions:

- Section 2.1 Permit to Take Water: The relevancy of including the details of the older permit was questioned, but it was decided to keep the information as it provides a bit of history and it will help the Town when the current permit needs to be amended in January of 2021. The Town will not request an increase in the permitted taking at that time. The Application will simply be a renewal.
- Section 2.1 Permit to Take Water: Correction to the last sentence of the last paragraph to read "100.1 ML/d"

- Section 2.3 Water Demand: Last paragraph on page 2 add the stipulation of assuming linear growth.
- Section 2.3 Water Demand, Table 4: The Town reviewed the values in Table 4 and they seem to be accurate, but noted that the source of where the factors came from should be added to the Notes section of the table.
- Section 2.3 Water Demand, Table 4: Change Poplar Road reservoir to Davey reservoir.
- Section 2.3 Water Demand, Table 4: The MSP shows no specifics for short-term flows into Davey reservoir (currently approximately 10 L/s) and it may be necessary to revise both the MSP and Table 4 from the Performance/Capacity assessment for consistency regarding Phase 1 flows.
Action By: Town/AECOM
- Section 2.4 Storage Projections, Table 5: Add the Davey reservoir storage (2565 m³).
- Section 2.4 Storage Projections: It was agreed that 15 minutes equalization volume is acceptable for the high-lift pump equalization.
- Section 2.5 Water Quality Treatment Criteria, Table 6: Table 6 shows a disinfection target that meets the minimum Provincial requirement. There was discussion to show a more stringent target of at least 0.5-log Cryptosporidium, but this would exclude chlorination as a stand-alone disinfection option (UV can provide this level of disinfection). It was thus agreed that the target would remain as is and explained more fully in the evaluation of disinfection options.
- Section 2.5 Water Quality Treatment Criteria, Table 6: The Town advised that the Ministry of Environment, Conservation and Parks (MECP) will be putting an HAA requirement of 80 (µg/L) in place as of January 2020 and that this requirement should be added to Table 6.
- Section 2.5 Water Quality Treatment Criteria, Table 6: The Town confirmed that there have been no public complaints about taste and odour of the Town water, separate from chlorine. Due to this the rows for Geosmin (ng/L) and MIB (ng/L) can be removed from Table 6.
- Section 4.0 Capacity Review: Add a statement that indicates that adding upstream protection for membranes is considered a best practice. Further identify that there is a risk of loss of capacity if fibre breakages occur in membrane and therefore, strainers should be considered as part of the design.
- Section 4.1.1 Description, Dimension, Sizes: The Town confirmed that the statement regarding details of the pre chlorination system (last bullet point of section) is correct.
- Section 4.3.1 Description, Dimension, Sizes: The values presented in the first and sixth bullet points are correct.
- Section 4.3.1 Description, Dimension, Sizes, page 10: The tank size of 1,400 L day is correct. The citric acid tank size is to be corrected to 200L.
- Section 4.3.2 Capacity Assessment, Table 14: It was noted that design fluxes carried by Suez for new ZW500 membranes are lower than carried in earlier designs, resulting in lower design capacities for the same membranes. There are numerous factors affecting flux performance including quality of raw water, accepted life expectancy, and frequency of cleaning and frequency of exceeding optimal flux rates (e.g. lack of membrane redundancy). On this basis, the plant can be operated at the original design capacity; however, all expansion options (including replacement of existing membranes) will carry current recommended design fluxes as shown in the table. A comment explaining this will be added at the end of paragraph 4.3.2.
- Section 4.5.1 Description, Dimension, Sizes: Values of last sentence are correct.

- Section 4.5.2 Capacity Assessment: Duplicate bullet point “ZW1000 Membranes...” Delete duplicate.
- Section 4.5.2 Capacity Assessment: The cited Procedure for Disinfection of Drinking Water in Ontario has been updated in April 2019. Replace the cited statement to align with updated procedure.
- Section 4.5.2 Capacity Assessment, Table 16: It was noted that the disinfection capacity is currently managed using SCADA to adjust chlorine dosage to flow and that a comment explaining this will be added at the end of the paragraph immediately preceding Table 16.
- Section 4.6 High Lift Pumping, Table 17: Values in the table are correct.
- Section 4.6.2 Capacity Assessment Table 18: The Town questioned why the calculations were done using the high-water line when it would never be operated at that level. AECOM will review and recalculate using a more appropriate number.
- **REVISED.** Section 4.7 Chemicals (Excluding Membrane System) Table 19 and 20: Change the V-notch value for post-chlorination chlorinators #2 and #3 to 96kg/day.
- Section 4.7 Chemicals (Excluding Membrane System) Table 21: Change the total average design dosage (mg/L) to 2.3 and reference data with a date range of January – August 2019. The Town will provide AECOM the chlorine dosage trends.

Action Item: Town

- Section 4.7 Chemicals (Excluding Membrane System): Discussion on the Town’s practices of ordering and surplus holdings of chemicals resulted in the recommendation that the Town increase the amount of chlorine tanks in rotation and increase the size of the chemical storage area.
- Section 4.9.1 Description, Dimensions, Sizes – Standby Power: Remove last sentence referencing diesel generator being used to shave peak power demands as the Town does not practice this.
- Section 5.0 Capacity Assessment of Existing WTP Table 23: Add to membrane system comments ‘based on current flux standards and can increase if needed’.
- Section 5.0 Capacity Assessment of Existing WTP Table 23: Add to disinfection system comments ‘Free chlorine residual can increase if needed’.
- Section 6.1 Membrane Filtration: Statement in Option 1 – leave as it is written.
- Section 6.2 Disinfection: The Town noted that they do not have a specific agreement with the MECP. This section should be revised to indicate that the Town is addressing this issue by adjusting the dosage as necessary to achieve the required CT and MECP has not commented on the current management of the system.

AECOM will update the Existing Plant Performance/Capacity Assessment report with of the points summarized above and the report will be considered final. In addition to the summarized edits, the title and introduction section of the report will be updated to remove any reference of ‘amendment’.

Action Item: AECOM

WTP Condition Assessment

Discussions started with the future use/need for the industrial building on site. It was agreed that the industrial building will be demolished under all alternative design solutions.

The summary table within the report was discussed line by line to confirm designation and review details of scope of work. The following is a summary of the edits and decisions:

- Reference #1C: change designation of upgrades to 'future' stating that staff will follow standard health and safety (H&S) procedures when working around surge chamber.
- Reference #4E: Add statement that staff will follow standard H&S procedures.
- Reference #5D: Designation to remain as 'immediate' as the hand railing does not meet current code.
- Reference #5F: Change 'undergoing' to 'considered'. AECOM will add a cost.
- Reference #6B: Update costing to include a cost for coating of the membrane train walls because using the existing membrane trains is part of all alternative solutions going forward.

AECOM will update the WTP Condition Assessment report with of the points summarized above and the report will be considered final. In addition to the summarized edits, the covering letter within the document will be updated to remove any reference of 'amendment'.

Action Item: AECOM

The report provides a list of recommended studies to be completed including a comprehensive electrical load list to be used as a basis for determining the future total duty electrical loads for the Phase 1 and ultimate plant expansions. The Town will provide rough information on current electrical load demands but due to its age the Town does not intend to continue to use the existing generator moving to Phase 1 of the expansion. The Town indicated that for the purposes of identifying the alternative design solutions that it be assumed new generator(s) will be purchased.

Action By: Town

6. Preliminary Phase 3 ESR Documentation Working Draft

The Town provided their written comments to Ainley. There were no areas of concern and the Town clarified the following:

- Existing and Future Demands, Town of New Tecumseth: In the second paragraph remove two sentences starting from "In June 2016..."
- Existing and Future Demands, Town of Blue Mountains: There are two, not one, connections. They are located at Osler Bluff Road (active) and Grand Cypress Lane (closed).
- Existing and Future Demands, Township of Clearview: In first paragraph, first sentence – change 'identified' to 'requested'.

Ainley will update the Draft Phase 3 ESR based on the points summarized above and on hard copy comments provided by the Town.

Action item: Ainley Group

7. Additional Information

The Town requested that AECOM provide details of the suggested repairs to the flat roofing of the main plant building so that they can be added to the specifications for roofing repairs currently being undertaken by the Town. The Town would like the details of the roof conditions to compare with secondary quote/assessment.

Action By: AECOM

8. Other Business

REVISED. AECOM will provide a "wish list" of plant upgrades that are not related to the proposed increase in plant capacity (separate from and for the most part not included in the ESR), some of which have been identified in the AECOM Condition Assessment. However, elements relating to best practices with respect to design alternatives may be extracted from this list and included in the ESR.

Action Item: AECOM

9. Next Meeting

The next meeting (Workshop to Review Design Options) is scheduled for November 19th, 2019 at 43 Stewart Road, Collingwood (Boardroom). *Location subsequently changed to Ainley Boardroom at 280 Pretty River Parkway, Collingwood.*

10. Adjournment

The meeting was adjourned at 3:15 p.m.

Any errors and/or omissions from these Minutes should be reported to the undersigned as soon as possible.

Minutes prepared by J. Marks and finalized by:

M.W. Ainley, P. Eng, PMP
Ainley & Associates Limited

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MEETING MINUTES

STEERING COMMITTEE MEETING #3

PROJECT: The Town of Collingwood
Updated Class EA for the R. A. Barker Water Treatment Plant Expansion
Ainley Job No. 119013

DATE: November 19th, 2019

LOCATION: 280 Pretty River Parkway, Collingwood (Boardroom)

TIME: 10:35 a.m. – 4:45 p.m.

PRESENT: Peggy Slama, Town of Collingwood
Ken Kaden, Town of Collingwood
Marie Richardson, Town of Collingwood
John Vail, Town of Collingwood
Brian MacDonald, Town of Collingwood
Mike Ainley, Ainley Group
Reid Mitchell, Ainley Group
Jody Marks, Ainley Group
Brian Sahely, AECOM

DISTRIBUTION: All Present

1. Call to Order

The meeting was called to order at 10:35 a.m.

2. Purpose of Meeting

The purpose of the meeting was to discuss identification of alternative design concepts for implementing the Phase 1 & 2 (per MSP) recommended general solution of expanding the existing WTP.

3. Phase 1 and Phase 2 Water Demands

The project will be phased, with Phase 1 focused on expansion to the current limit of the Permit to Take Water (PTTW). At this time the demands have been confirmed for Collingwood and New Tecumseth water needs. The Town of Blue Mountains and Township of Clearview required water demands are preliminary and will be finalized during Phase 2 of the expansion.

4. Schedule

- The Town is tentatively scheduled to make a presentation to Council on the Master Servicing Plan (MSP) early December. The Town estimates the earliest timeline to be end of January for the close of the 30-day period of the Notice of Completion for the MSP but will confirm once there is more certainty.
- The Town noted that there must be flexibility to prequalify multiple membrane suppliers and not sole-source SUEZ. There was a discussion of the need for pilot testing to prequalify suppliers during the Class EA phase and it was agreed that pilot testing could be deferred to the design

phase – the Class EA conceptual drawings for the alternative designs will show building “boxes” as large as possible to accommodate multiple potential suppliers.

- For the purposes of the Class EA, pricing will be based on SUEZ membranes for all design alternatives, recognizing that a different supplier(s) may be pre-selected during the design phase. AECOM will remind SUEZ that additional information is required from them in order to price the design alternatives.

ACTION ITEM: AECOM

- The project team has received comments in response to the Notice of Commencement from the Ministry of Environment, Conservation and Parks (MECP) and the Nottawasaga Valley Conservation Authority (NVCA). It was agreed it would be beneficial to have a meeting with Ms. Lee Bull from the NVCA to discuss the Source Water Protection comments provided. Ainley will arrange a meeting with NVCA, Ainley and Town staff.

ACTION ITEM: AINLEY

- Ainley had previously issued a WTP Class EA Schedule which showed the Public Information Centre (PIC) to be held at the end of January 2020 but the PIC cannot be held before the MSP is finalized. It is now anticipated that the earliest date the PIC could be held is the last week of March 2020. Ainley will re-issue an updated schedule once the Town provides an update of the estimated completion of the MSP; however the interim schedule update based on an end of March PIC is as follows:

- Workshop for detailed review of short-listed design concepts by mid-January
- Submit final draft Alternatives Technical Memorandum (TM) by mid-February
- Workshop to review Alternatives TM and PIC material by end of February
- Advertise PIC by mid-March
- Hold PIC end of March
- Receive comments until mid-April and incorporate into ESR
- Submit ESR for 30-day review by end of April

ACTION ITEM: AINLEY/TOWN

5. Preliminary identification of Design Alternatives

AECOM highlighted sections in the working draft Alternative Selection Technical Memorandum submitted to the Town with the intention of going through each highlighted item to discuss and confirm with the Town.

As a general comment, the Town requested that the report and tables be revised to remove specific references to ZW500 or ZW1000 models except where referring to the current membranes.

The following is a summary of other edits and decisions that will be reflected in the final Technical Memo provided by AECOM:

- Section 2.2 Evaluation Process: Adjust the technical versus cost scoring to 70% technical and 30% cost.

ACTION ITEM: TOWN

- Section 2.2 Evaluation Process: Adjust the scoring range from 1-100 to be 1-10 with increments of 0.5. There will be no minimum threshold and scoring due to the alternatives being pre-screened.

- Table 3, row 'Distribution Free Chlorine Residual' column 'Proposed Performance Target': Change value range from 4.0 mg/L to be 3.0 mg/L. Add 'leaving the plant' to the line that reads '(target of 1.66 mg/L average)'.
- Table 3, row 'HAAs(µg/L)' column 'Ontario Requirement': Add the following statement 'based on a running annual average of quarterly samples measured at a point that is likely to have an elevated potential for formation of HAAs'.
- Table 3, row 'Turbidity (NTU)' column 'Ontario Requirement': The Town inquired about the source for the '<0.3 NTU, 100% of time' requirement and it was noted that it was typical practice. It was agreed that the value be removed from this column of the table as it is not an Ontario Requirement.
- Table 4, Notes #2: The Town will need to have an internal discussion on the demands and the year of commitment recorded for the Town of Blue Mountain. The Town also suggested revising the statement to make it clear that the total is 16,400m³/d not 16,400m³/d plus 6,000m³/d.
ACTION ITEM: TOWN
- Table 4, Notes #5: Add the following to the end of the note, 'If higher capacity is needed then this may come from the treated water supply given the restrictions of the PTTW.'
- Table 6, row 'Intake, Ultimate' column 'Recommended Upgrades': In the bottom paragraph referring to frazil ice, adjust the year from 2005 to 2009, '...has not occurred since before 2009.'
- Table 7 row 'Micro screening': AECOM clarified that the gravity by-pass around the new screening equipment can be provided.
- Table 8: Add installation of strainers on the industrial pump discharges as preferred by the Town.
- Options Concept Drawings: AECOM clarified that although the separate concept drawings for the various processes illustrate possible conflicts/overlaps when taken together, the individual building "box" locations are just initial estimates for the individual processes and that the preferred "total solution" design layout would show no conflicts/overlaps.
- Section 5.5.1 Current Capacity, third bullet point: The Town noted that membrane integrity test is done annually, not every two weeks and that the particle counter is not online.
- Section 5.5.1 Current Capacity, fifth bullet point – The Town noted that since they do not practice pre-chlorination year round, they are concerned with feeding the backpulse/CIP tanks with low pressure permeate water only (to reduce the loud noise when filling these tanks) and not the treated high pressure water that is currently used and that has a free chlorine residual.
ACTION ITEM: AECOM
- Section 5.5.1 Current Capacity, ninth and tenth bullet points: There was discussion about redundant versus standby trains and whether or not either should be considered in the expansion (there are currently no redundant or standby trains in the existing plant). It was agreed that redundant trains should be provided for all expansion design alternatives considered in the Class EA as this would maintain the plant capacity if one train was out-of-service for maintenance, membrane repairs and the monthly CIP process. If it is determined during detailed design that the capital cost of providing this redundancy is too high it can be removed.
ACTION ITEM: AINLEY
- Section 5.5.2.1 Maximum Capacity Capable from the Existing ZW500 Membrane Tanks: The Town questioned why these three options for membranes are a separate section of the report

that implies they would have insufficient capacity for the expansion requirements, since they can potentially be combined with other options to be part of an overall expansion solution. AECOM will review or rephrase this section.

ACTION ITEM: AECOM

- Section 5.5.2.2 Alternatives to Achieving Phase 1 and Ultimate Flows (third bullet, third sub-bullet): It is stated that 'any new membrane building is shown to be located east of the existing raw water building'. The Town noted that for this option there may be a need to infringe on the park/parking lot land and therefore the placement of a building within waterfront sightlines may be necessary. Ideally the waterfront should not have multiple buildings placed within sightlines for park users and residents and Ainley noted that the PIC material can identify that disrupting sightlines is not preferred.

ACTION ITEM: AINLEY

- Figure 6: The Town questioned the feasibility of constructing a new membrane building as close as shown to the shoreline, given their experience with erosion and issues with wave uprush. Due to the high risk this option may require construction of a seawall. AECOM stated that the existing plant and any new buildings will have the same risk from waves and so this issue will be consistent with any alternative being considered.
- Table 10, column 1 'Title' and column 2 'Option': Through discussion of the options (1-4) for membranes the development of a 5th and 6th option emerged:
 - Option 5 is described as the reverse of Option 2 (which is to increase the existing ZW500 membrane building capacity with some retrofit to achieve Phase 1 capacity and later construct a new membrane building), i.e. build a new plant first and then retrofit the old plant. This would eliminate the need for having the temporary trailers. Membranes in this option would be the short or tall ZW500d membranes in the old building and ZW1000s (or equal) in the new building. **Post meeting note**: This option was presented in the updated Technical Memorandum but not short-listed as explained in the updated TM.
 - Option 6 is described as designing the new plant for expansion to ultimate capacity, while continuing to use the existing membrane building until the current membranes for the remainder of their life only and then repurposing that area of the building. **Post meeting note**: This option was presented in the updated TM but not short-listed as explained in the updated TM. It was noted that the Town has the flexibility to implement this option as part of Option 3 (revised – previously Option 4) but it doesn't need to be its own option.
- Table 10, row '1A (Phase 1) column 'Retrofit of Existing ZW500 Building', 6th bullet': Keep this bullet, i.e. all ancillary pieces are to be updated in this option. For the EA, all options are to have equal state of the art upgrades including the existing ZW500 membrane system to allow for "apples to apples" comparison. This will allow a 70% Technical and 30% Cost comparison be equal for all options.
- Table 10, column 4 'Use/Removal of Existing ZW500 Membrane Building': The existing ZW1000 building is to be removed for all options.
- Filtration Technologies: The Town requested that other filtration technologies (e.g., conventional filtration) be mentioned in the TM and be eliminated as required.

ACTION ITEM: AECOM

- Section 5.6.2.1 Minimum Free Chlorine Residual Required for Primary Disinfection: It was agreed that the value of 1.5 will be the target average and that 1.0 will be the value for low-low alarm shut down.

- Table 8, high lift pump equalization: The Town confirmed 15 minutes.
- Figure 8: Move the CT chamber (green box) further to the left on the drawing and remove reference to alternate locations in the description (red font).
- Section 5.8.2 Upgrade Requirements: AECOM noted that hydraulic modeling and transient modeling should be completed in advance of detailed design. The Town will confirm/complete these models to ensure that by adding pumps the system will operate.
ACTION ITEM: TOWN
- Table 13: The Town noted that the jockey pump is not used; AECOM to update table accordingly.
- Table 18, row 'Phase 1' column 'Recommended Upgrades' 1st bullet: The Town noted that there is only one feed and therefore having two transformers does not seem appropriate. Remove last two sentences of bullet.
- Figure 12: Show only one proposed transformer.
- Table 18, row 'Phase 1' column 'Recommended Upgrades' 5th bullet: Add “for the process mechanical equipment” to the end of the sentence.
- Figure 13: Ainley noted that for the Class EA it will state that the option of having an external generator has been eliminated. There was also discussion on standards for placing diesel storage tanks within a short distance of a waterbody – this will be revealed through consultation with the MECP and NVCA.
ACTION ITEM: AINLEY
- Table 20, row 'Phase 1' column 'Recommended Upgrades': Change to read 'Replace PLCs and control wiring'.
- Table 21, row 'Phase 1' column 'Recommended Upgrades': Delete the first bullet since the Town replaced their HVAC system 6 years ago. Replace the bullet with 'install dehumidification in existing building.'
- Table 21, row 'Phase 1' column 'Recommended Upgrades, 3rd bullet: Change to 'Provide administrative staff facilities'. The Town will provide a formal list of requirements to ensure an 'apples to apples' comparison of space requirements for all design alternatives.
ACTION ITEM: TOWN
- Section 7 Technical Evaluation of Short-Listed Alternatives: AECOM requested from the Town information on floodplain area, maximum lake levels data and wave uprush to facilitate the technical evaluation.
ACTION ITEM: TOWN
- Section 7.2 Evaluation Criteria and Weights: Delete the last bullet referencing sole-source selection.
- Table 24 Evaluation Criteria and Rating, column 3: It was agreed that the secondary criteria will be:
 - Pathogen control (disinfection alternatives only)
 - Operation and maintenance requirements, including process complexity

- Ease of implementation (construction schedule)
- Process robustness (multi-barrier treatment)
- Minimize footprint and site impacts/architectural aesthetics

Post meeting note: The secondary criteria *Minimize truck traffic (during construction and operation)* under social considerations were then added back given that the various alternatives have varying amount of excavation and off-shore disposal of soils/rocks, as well as larger buildings, all of which impact truck traffic.

- Table 24 Evaluation Criteria and Rating, column 3: It was agreed that the PIC presentation material will include a board describing the evaluation criteria and weighting, along with explanations why certain secondary criteria typically listed are not included in the table, for example:

- Minimizing disinfection by-products
- Flexibility for future objectives including taste & odour control and potential emerging contaminants
- Compatibility with existing systems and site
- Flexibility for expansion (future phases)
- Proven track record
- Safety requirements
- Minimizing noise
- Minimizing odour
- Minimizing air emissions
- Minimizing residual impacts

ACTION ITEM: AINLEY

- Table 24 Evaluation Criteria and Rating, column 2: It was agreed that the primary criteria weight allocation will be:

- Water Quality = 30
- Technical considerations = 50
- Social Considerations = 20

Above criteria would apply for Disinfection alternatives. Regarding Membrane alternatives, Water Quality will be removed given similar performances for all alternatives.

Post meeting note: With Water Quality primary criteria removed, the scoring of the remaining primary criteria will be as follows:

- Technical considerations = 80
- Social Considerations = 20

- Section 8.1 Cost Assumptions: The Town will confirm the values of chlorine gas costs and power costs and also provide AECOM with the citric acid and sodium chlorite costs.

ACTION ITEM: TOWN

- Section 8.1 Cost Assumptions: It was agreed that an inflation rate of 3.0%, an interest rate of 5.5%, a market discount of 2.5% and a 20 year amortization period would be carried in the cost analysis. **Post meeting note:** Subsequent to the meeting the amortization period was revised to 30 years.

For the purposes of the cost analysis the Town will provide the estimated year they anticipate the Phase 2 (ultimate) start-up. **Post meeting note:** Subsequent to the meeting this was determined to be 2044, recognizing this may be more realistic than the conservative growth projections in the MSP.

- Section 10 Sensitivity Analysis: There will be a sensitivity analysis completed on the evaluation criteria, with detailed scoring to be finalized during the next project workshop.

6. Other Business

Ainley requested a financial statement from the Town stating how the project will be financed. This information is needed for the PIC.

ACTION ITEM: TOWN

7. Next Meeting

The next meeting (Workshop for Detailed Review of Short-Listed Design Concepts) is tentatively scheduled for January 10th, 2020 at 43 Stewart Road, Collingwood (Boardroom).

8. Adjournment

The meeting was adjourned at 4:45 p.m.

Any errors and/or omissions from these Minutes should be reported to the undersigned as soon as possible.

Minutes prepared by J. Marks and finalized by:



M.W. Ainley, P. Eng, PMP
Ainley & Associates Limited

MEETING MINUTES

STEERING COMMITTEE MEETING #4

PROJECT: The Town of Collingwood
Updated Class EA for the R. A. Barker Water Treatment Plant (WTP) Expansion
Ainley Job No. 119013

DATE: January 27, 2020

LOCATION: 43 Stewart Road, Collingwood (Boardroom)

TIME: 11:15 a.m. – 3:40 p.m.

PRESENT: Peggy Slama, Town of Collingwood
Ken Kaden, Town of Collingwood
Marie Richardson, Town of Collingwood
John Vail, Town of Collingwood
Mike Ainley, Ainley Group
Reid Mitchell, Ainley Group
Jody Marks, Ainley Group
Brian Sahely, AECOM
Laura Alvarez, AECOM

DISTRIBUTION: All Present

1. Call to Order

The meeting was called to order at 11:15 a.m.

2. Purpose of Meeting

The purpose of the meeting was to discuss more fully developed short-listed alternative design concepts for implementing the Phase 1 & 2 (per MSP) recommended general solution of expanding the existing WTP, including technical and costing evaluation and scoring.

3. Updated Schedule:

The Town published the Notice of Completion for the Master Servicing Plan (MSP) on December 19, 2019 with the 30-day review period closing on January 20, 2020. No Part II Orders were received. The MSP will be presented to Council at the upcoming Council Meeting for endorsement. The Town will forward copies of the comments received during the MSP 30-day review period to Ainley. Ainley is to ensure that those respondents are added to the contact list for consultation during the WTP Class EA.

ACTION ITEM: AINLEY/TOWN

The Public Information Centre (PIC) for the WTP Class ESR is tentatively scheduled to be held during the week of either March 23rd or March 30th. The optimal days for the PIC are Tuesday or Thursday from 4:00 – 8:00 p.m. The Town will check the availability at the Town library during those dates and confirm with Ainley.

ACTION ITEM: TOWN

An approximate timeline for the Environmental Study Report (ESR) completion based on the PIC being held in early April was estimated as follows:

- 2-week comment period during and immediately following in which the ESR will be finalized.

- First publishing of the Notice of Completion of the ESR in early May to kick off the mandatory 30-day review period, with closing of the review period in early June.
 - 4 weeks to finalize the ESR assuming no comments or bump up requests are received during the 30-day period review period.
 - Filing of the ESR with the Ministry in early July.
4. Review of Evaluation and Scoring of Alternatives and Preliminary Identification of Recommended Design Alternative(s):

AECOM focused on the evaluation and scoring criteria in Tables A2 (disinfection alternatives) and A1 (membrane alternatives) of the *Alternatives Selection Technical Memorandum-Rev.2* in order to discuss and confirm the final evaluation and scoring with the Town. The following is a summary of the decisions made at the meeting that will be reflected in the final Technical Memo provided by AECOM:

- **Table A2 – Detailed Technical Evaluation Scoring and Results for *Disinfection Alternatives***
 - Pathogen Control: Option 4 rationale modified to more directly compare against Option 5; scoring unchanged.
 - Operation and Maintenance: Option 5 scoring (out of 10) set to = 4.
 - Ease of Implementation: Option 4 scoring set to = 4 and Option 5 scoring set to = 7
 - Process Robustness: Option 4 scoring set to = 4 and Option 5 scoring set to = 9
 - Minimize Footprint: Option 4 scoring set to = 8 and Option 5 scoring set to = 6
 - Minimize Truck Traffic: No changes to the scoring
- **Table A1 – Detailed Technical Evaluation Scoring and Results for *Membrane Alternatives***
 - Option Description: Option 3 wording revised from ‘abandoned’ to ‘repurpose’
 - Operational and Maintenance: No changes to scoring
 - Ease of Implementation: Scoring (out of 10) confirmed as Option 1 = 7, Option 2.1 = 3, Option 2.2 = 4, and Option 3 = 8
 - Process Robustness: ‘multi-barrier treatment’ deleted from the title. No changes to scoring.
 - Minimize Footprint: Option 3 scoring set to = 6.
 - Minimize Truck Traffic: Correction to the rationale for Option 2.2 and 3 to identify Option 2.2 as having more excavation than Option 3. Scoring set to Option 1 = 4, Option 2.1 = 8, Option 2.2 = 9, and Option 3 = 7
- The weightings of criteria for each set of alternatives were also reviewed as part of a sensitivity analysis. The analysis considers the impact on the scoring by giving greater priority to factors such as minimizing the expansion footprint and temporary construction disruption at the expense of factors such as water quality and process robustness. The following adjustments for the purpose of the sensitivity analysis were confirmed:

	Membrane Options		Disinfection Options	
	Base Weight	Adjusted Weight	Base Weight	Adjusted Weight
Pathogen Control	N/A (all equal)	N/A (all equal)	35	25
Operational & Maintenance	40	35	25	30
Ease of Implementation	24	25	15	10
Process Robustness	16	5	10	5
Minimize Footprint	14	25	10	20
Minimize Truck Traffic	6	10	5	10

From the results of the sensitivity analysis exercise, the following alternatives had the highest cost-benefit analysis scores:

- **Membrane Alternative:** Repurpose Existing ZW500 Membrane Building and Construct New Membrane Building
- **Disinfection Alternative:** Practice UV Disinfection and Chlorinate in New CT Chambers.

In addition to finalizing the evaluation and scoring criteria for all membrane and disinfection alternatives, including adjusted weightings for sensitivity analysis, it was agreed that the following additional revisions will be reflected in the final Technical Memorandum:

- The drawing in the report illustrating Option 3 (Figure 14 page 27) will be adjusted so that the proposed membrane/administration building footprint is shown further north, further away from the shoreline area.
- The removal of the existing generator tanks within the existing generator building will be performed in the Ultimate Phase, instead of Phase 1 of the project
- Text and tables throughout the report will be checked to ensure that all references to membranes are generic unless describing existing equipment.
- With reference to an integrated drawing combining all recommended solutions presented at the meeting:
 - Due to vehicle accessibility concerns the Town requested that the proposed diesel and fuel tanks be shown on the north end of the property.
 - Existing pipes in the area where the proposed new membrane building will be constructed could be re-routed. This should be discussed during staging.
 - At this point, boxes will be used to represent the proposed recommended solutions in the conceptual drawings.
 - All proposed infrastructure must be contained within existing fence lines.
- The Town requested that a profile drawing of the buildings be created to enhance visualization of the buildings. The drawing should illustrate the perspective of pedestrians from the trail along the shoreline of the property as well as the view from the road.
- For budget planning purposes the Town requested that separate construction and engineering opinion of cost tables be prepared. Budget is based on 2024 cost.

5. Next Meeting

The next meeting (Workshop to Finalize the Alternatives Selection Technical Memorandum and Review PIC Material) is scheduled for February 27th, 2020 at 43 Stewart Road, Collingwood (Boardroom).

6. Other Business

Ainley noted that they will require the final drawings from AECOM at least 1 week prior to the PIC date, to incorporate into the presentation material.

6. Adjournment

This meeting was adjourned at 3:40pm.

Any errors and/or omissions from these Minutes should be reported to the undersigned as soon as possible.

Minutes prepared by J. Marks and finalized by:

A handwritten signature in black ink, appearing to read 'M.W. Ainley', written in a cursive style.

M.W. Ainley, P. Eng, PMP
Ainley & Associates Limited

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MEETING MINUTES

STEERING COMMITTEE MEETING #5

PROJECT: The Town of Collingwood
Updated Class EA for the R. A. Barker Water Treatment Plant (WTP) Expansion
Ainley Job No. 119013

DATE: February 27, 2020

LOCATION: 43 Stewart Road, Collingwood (Boardroom)

TIME: 11:00 a.m. – 1:30 p.m.

PRESENT: Peggy Slama, Town of Collingwood
Ken Kaden, Town of Collingwood
Marie Richardson, Town of Collingwood
John Vail, Town of Collingwood
Mike Ainley, Ainley Group
Reid Mitchell, Ainley Group
Jody Marks, Ainley Group (via videoconference)
Brian Sahely, AECOM (via videoconference)
Laura Alvarez, AECOM (via videoconference)

DISTRIBUTION: All Present

1. Call to Order

The meeting was called to order at 11:10 a.m.

2. Purpose of Meeting

The purpose of the meeting was to review the final draft Design Alternatives TM and draft PIC material, which included the Notice of PIC as well as the presentation material.

3. Updated Schedule

Since the last meeting the MSP has been endorsed by Council, the Town has forwarded copies of the comments received during the MSP 30-day review period to Ainley, and Ainley has added those respondents the contact list for consultation during the WTP Class EA. Scheduling of the Public Information Centre (PIC) for the WTP Class ESR has been confirmed for Tuesday, March 24th from 4:00 – 8:00 p.m. at the Town library.

An approximate timeline for the Environmental Study Report (ESR) completion following the PIC being remains as follows:

- 2-week comment period during and immediately following in which the ESR will be finalized.

- First publishing of the Notice of Completion of the ESR in early May to kick off the mandatory 30-day review period, with closing of the review period in early June.
- 4 weeks to finalize the ESR assuming no comments or Part II Orders are received during the 30-day period review period.
- Filing of the ESR with the Ministry in early July.

4. Review of Opinion of Costs

The opinion of costs provided in the draft TM were discussed. AECOM noted that the opinions of cost were consistent with the 2012 costs previously provided by AECOM, taking into account inflation and the increase in project scope as a result of additional replacements required due to aging of the existing facilities.

The opinion of costs incorporates contingencies and level of accuracy allowances and once the magnitudes of these allowances were agreed the opinion of costs for the Phase 1 and ultimate expansions (in 2020 dollars) were determined to be \$65 million and \$19 million respectively.

5. Review of Draft PIC Material

The draft Notice of PIC was approved subject to minor edits. A cover letter will be provided with Notices of PIC sent to contacts via mail. Email notification will include an attachment of the Notice of PIC.

The Notice of PIC will be issued in the March 12th and 19th editions of the Collingwood Connection newspaper. The Town will require the final version of the Notice of PIC by March 6th to submit to the newspaper. The Notice of PIC will also be uploaded to the Town's website for March 12th.

The draft PIC boards were reviewed and shall be revised as follows:

- For presentation purposes the boards will be revised to visually summarize as much information as possible, with more graphs and tables and fewer detailed technical and cost breakdowns and descriptions.
- The 'Welcome' and 'Comments' boards will note that all PIC material is available on the Town's web page.
- The PIC boards are to note that sensitivity analyses of the design alternatives were conducted which confirmed the recommending solutions and ranking of all alternatives.

The Design Alternatives and other technical reports will be available for viewing at the PIC and online for visitors wanting more details.

All comments provided on the PIC material will be updated and resubmitted to the Town prior to March 6, 2020.

ACTION ITEM: AINLEY/TOWN

6. Other Business

The Town will review and direct Ainley's response to an Agreement proposed by Saugeen Ojibway Nation (SON) for SON's third-party review of the project.

ACTION ITEM: TOWN

There was discussion of the potential need to complete a noise assessment as part of the Class EA since MECP has been requiring this on several recent projects. It was determined that a noise assessment could be deferred to the detailed design phase in this case because of the nature of the project, i.e. a water project in which all major equipment would be located inside buildings where noise levels can be well controlled, and also because it can be assumed with reasonable certainty that the new equipment would have lower noise levels than the existing equipment it would replace.

7. Next Meeting

The next meeting (to review the draft Environmental Study Report and draft Notice of Completion following the March 24, 2020 Public Information Centre) is scheduled for April 14th, 2020 at 43 Stewart Road, Collingwood (Boardroom).

8. Adjournment

This meeting was adjourned at 1:30pm.

Any errors and/or omissions from these Minutes should be reported to the undersigned as soon as possible.

Minutes prepared by J. Marks and finalized by:

A handwritten signature in black ink, appearing to read 'M.W. Ainley', written in a cursive style.

M.W. Ainley, P. Eng, PMP
Ainley & Associates Limited

STEERING COMMITTEE MEETING #6

PROJECT: The Town of Collingwood
Updated Class EA for the R. A. Barker Water Treatment Plant Expansion
Ainley Job No. 119013

DATE: **June 24, 2020**

LOCATION: Teams Meeting (Videoconference)

TIME: 10:00 a.m. – 12:00 Noon

ATTENDEES: Ken Kaden, Town of Collingwood
Heather McGinnity, Town of Collingwood
Mike Ainley, Ainley Group
Reid Mitchell, Ainley Group
Jody Marks, Ainley Group

DISTRIBUTION: All present

1. Call to Order

The meeting was called to order at 10:00am.

2. Purpose of Meeting

The purpose of the meeting was to review of Comments and Responses from the PIC, Draft ESR and Draft Notice of Completion Including Cover Letter

3. Review of Comments and Responses from PIC

Two letters were drafted by Ainley in response to the comments received during the Public Information Centre period. The team reviewed each letter and the following comments were noted:

- Response letter to New Tecumseth – The Town confirmed that the wording of the response was satisfactory with no revisions required.
- Conservation Authority (NVCA Response letter to Nottawasaga Valley) – The Town requested minor edits to the response with respect to commitments.

ACTION: AINLEY

4. Review of Draft ESR

Prior to this meeting an updated Draft Environmental Study Report (ESR) was circulated to the project team incorporating the Town's first round of comments. The edits incorporating the Town's comments were approved. Additional comments discussed at this meeting are listed below:

- General Comment – References to the Phase 3 'preferred solution' should be changed to 'preferred design' throughout the document.
- General Comment – Be more specific throughout the document with phase references (e.g. Phase 1 expansion and/or Ultimate phase expansion), including Class EA 'phase' references (e.g. 'Phase 3 of the Class EA process' as opposed to 'this phase').
- Executive Summary – Revise the executive summary to state that no disruption to the shoreline is anticipated from the work in either expansion phase. Ensure that this revision is reflected in the other areas of the ESR.
- Section 3.2 Planning Context – Additional subheadings and details are required to clarify the information as it pertains to the *Clean Water Act* and the *Conservation Authorities Act*.
- Section 6.2 Intake – Revise the terminology regarding the capacity of the intake.
- Section 6.2 Intake and Low Lift Pumping Station – Revise these bullets to be consistent with each other.

- Section 12.3 Potential for Climate Change to Impact this Project – Provide further information on stormwater control measures being considered (i.e. pre to post development recharge mitigation, Low Impact Development features, etc.).

Ainley will revise the Draft ESR to incorporate the noted comments.

ACTION: AINLEY

5. Review of Draft Notice of Completion Including Cover Letter

The team reviewed the draft Notice of Completion of and covering letter. There were no comments from the Town on the covering letter. With respect to the Notice of Completion the Town asked Ainley to confirm that there have been no recent amendments to the MEA Municipal Class EA document referenced in the Notice of Completion. Ainley responded that there have been clarifications but no formalized amendments since 2015. Prior to advertising the Notice of Completion Ainley will confirm that no amendments have been subsequently published.

A discussion ensued regarding the level of details the Notice should provide. It was agreed that the Notice should provide a general overview, with specific details provided in the ESR.

ACTION: AINLEY

6. Other Business

Ainley noted that the current process for consultation during COVID-19 stipulates that posting electronic copies is acceptable. It is not necessary to provide a hard copy for viewing in a public venue, however every effort should be made to accommodate viewing of a hard copy if requested.

7. Next Steps/Schedule

Ainley will revise the documents as agreed and re-submit to the Town for review. The target of mid-July to publish the Notice of Completion remains unchanged.

8. Next Meeting

The date and time of the next meeting is to be determined.

9. Adjournment

The meeting was adjourned at 12:00pm.

Any errors and/or omissions from these Minutes should be reported to the undersigned as soon as possible.

Minutes prepared by J. Marks and finalized by:



M.W. Ainley, P. Eng, PMP
Ainley & Associates Limited

Appendix C

Town of Collingwood

Raymond A. Barker Water Treatment Plant

EXISTING PLANT PERFORMANCE/CAPACITY ASSESSMENT

AECOM Canada Ltd.

November 4, 2019

Town of Collingwood
Raymond A. Barker Water Treatment Plant
**Existing Plant Performance/
Capacity Assessment**

Prepared by:

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www.aecom.com

Project No.: 60609900

Date:

November 4, 2019

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The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

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- represents AECOM's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
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This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

June 29, 2020

Mr. Ken Kaden
Project Coordinator Environmental Services
Town of Collingwood
43 Stewart Road
Collingwood, ON, L9Y4M7

Dear Mr. Kaden:

Project No: 60609900

RE: Raymond A. Barker WTP - Existing Plant Performance/Capacity Assessment

We are pleased to submit the *Existing Plant Performance/Capacity Assessment Technical Memorandum for the Raymond A. Barker WTP*.

Should you have any comments, please do not hesitate to contact the undersigned.

Sincerely,

AECOM Canada Ltd.



Brian Sahely, M.A.Sc., P.Eng.
Senior Process Engineer/Project Manager
brian.sahely@aecom.com

Distribution List

# of Hard Copies	PDF Required	Association / Company Name
0	1	Town of Collingwood Ainley & Associates

Revision Log

Draft #	Revised By	Date	Issue / Revision Description
1	BS	November 4, 2019	Issued for Review

AECOM Signatures



Report Prepared By:

 Brian Sahely, M.A.Sc., P.Eng.
 Senior Process Engineer/Project Manager



Report Reviewed By:

 Martin Gravel, P.Eng.
 Senior Process Engineer/Project Manager

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Appendices

Not applicable

1. Introduction

1.1 Background

The Town of Collingwood Master Servicing Plan (MSP) has identified the need to expand the existing 31.14 ML/d Raymond A. Barker Water Treatment Plant which currently has insufficient capacity to accommodate future water demands for the Town of Collingwood and its contractual commitments to supply treated water to other municipalities.

A Class Environmental Assessment (EA) previously filed in September 2004 has now expired. It is no longer valid due to significant updates in planning, technology and consultation requirements. Therefore, instead of an Amendment/Addendum to the 2004 Environmental Study Report (ESR), an Updated Phase 3 & 4 ESR will be prepared, referencing the MSP (including March 2019 PIC) to satisfy Phases 1 & 2.

The MSP determined the need to increase the ultimate plant capacity identified in the 2004 Class EA (75 MLD) to 101 MLD for current full build-out projections and commitments to other municipalities. Prior to determining alternatives to achieve the ultimate capacity, an assessment of the existing plant needs to first be conducted.

1.2 Objectives of this Memorandum

The objective of this memorandum is to review the performance and capacity of the Raymond A. Barker WTP.

1.3 Memorandum Outline

The outline of this memorandum is shown in Table 1.

Table 1 Memorandum Outline

Section No.	Description
1	Presents the project background, objectives and provides an outline of this report.
2	Presents the design criteria for the plant.
3	Discusses historical water quality data.
4	Reviews the various plant unit processes as well as their capacities.
5	Presents a capacity assessment of the existing WTP.
6	Discusses alternatives to immediately achieve the plant rated capacity per the latest Municipal Drinking Water License.
7	Discusses the plan for reviewing alternatives to achieve future plant capacities.

2. Design Criteria

2.1 Permit to Take Water

There is a Permit to Take Water (PTTW) No. 3451-8CZMJC which authorizes the withdrawal of water up to 68.25 ML/d (47,400 L/min). This PTTW is dated as January 28, 2011 and is valid until January 31, 2021.

The previous PTTW 91-P-3037, dated January 15, 2001, had authorized the withdrawal of water per Taking Rate 1 as shown in Table 2. As stated in this PTTW, Taking Rate 2 does not become effective until the OWRA Section 52 approval for the water works at the higher rate has been issued. This Taking Rate 2 of 100.1 ML/d was removed from the recent PTTW mentioned above.

Table 2 Permit to Take Water Data for Nottawasaga Bay

Parameter	Taking Rate 1		Taking Rate 2	
Maximum Amount Taken Per Minute	45,500 L/min	65,520 m ³ /d	69,510 L/min	100,094 m ³ /d
Maximum Amount Taken Per Day	68,250,000 L/d	68,250 m ³ /d	100,100,000 L/d	100,100 m ³ /d
Maximum Number of Hours of Taking Per Day	24		24	
Average Number of Hours of Taking Per Day	24		24	
Maximum Number of Days of Taking Per Year	365		365	

2.2 Plant Rated Capacity in MDWL

The original Certificate of Approval (CofA) rated the plant for 27,355 m³/d, given the capacity of the ZW500 membrane system. This rating was then revised in a CofA amendment to incorporate the 3,785 m³/d ZW1000 ultrafiltration mobile package unit, for a total plant rated capacity of 31,140 m³/d, which has since been carried forward to the current Municipal Drinking Water License (MDWL) no. 100-101, Issue no. 3.

2.3 Water Demand

Monthly treated water flowrates for 2017 and 2018 can be found in Table 3. As shown, the maximum daily treated water flowrate for 2017 (21,143 m³/d) and 2018 (24,277 m³/d) reached 68% and 78%, respectively, of the plant rated capacity of 31,140 m³/d.

Table 3 Daily Treated Water Flowrates (2017 to 2018)

Month	2017 Flowrates (m ³ /d)			2018 Flowrates (m ³ /d)		
	Minimum	Average	Maximum	Minimum	Average	Maximum
January	16,125	17,562	19,059	15,929	17,868	19,073
February	15,361	16,952	18,305	16,188	18,317	20,713
March	14,662	17,048	18,509	15,248	18,149	19,269
April	13,709	16,235	17,914	15,824	17,302	18,908
May	15,311	17,498	19,752	12,649	18,067	20,099
June	16,717	18,998	20,529	17,728	20,997	23,231
July	9,528	17,718	20,482	18,082	22,032	24,277
August	15,925	19,045	21,143	14,873	19,985	23,839
September	16,368	19,104	20,892	17,852	20,061	21,491
October	15,223	17,787	19,738	15,691	18,600	20,401
November	15,493	17,251	18,493	14,642	17,660	19,061
December	8,614	16,699	18,486	13,446	16,851	18,927
Minimum	8,614	16,235	17,914	12,649	16,851	18,908
Average	14,420	17,658	19,442	15,679	18,824	20,774
Maximum	16,717	19,104	21,143	18,082	22,032	24,277
% Max./ Rated Capacity	-	-	68%	-	-	78%

The Town of Collingwood Master Servicing Plan (MSP) provided water demand projections with a summary of the demands during key periods provided in Table 4. The year for Phase 1 (i.e., 2038) was chosen based on limiting the required intake raw water instantaneous flows to below the current PTTW of 68.25 ML/D. The flows for 2038 were calculated by averaging the flows for 2032 and 2044 as provided in the MSP and assuming a linear growth.

Table 4 Water Demand Projections for the Raymond A. Barker WTP

Phase #	Intake	Industrial Well	WTP			
	Intake Raw Water Inst. ⁶ Flows (m ³ /d)	Industrial Flows ⁵ (m ³ /d)	CT Chambers Inst. Flows ⁴ (m ³ /d)	Total Net Treated Water Flows ³ (m ³ /d)	Municipal Pipeline Flows ² (m ³ /d)	Regional Pipeline Flows ¹ (m ³ /d)
1 (approx. Year 2038)	65,222	2,000	56,900	51,871	32,757	19,114
Ultimate	125,186	2,000	110,867	101,069	51,483	49,586

Notes:

1. Includes approximately 18,250 m³/d (Phase 1) and 33,500 m³/d (Ultimate) for the Town of New Tecumseth; and, 0 m³/d (Phase 1) and 4,854 m³/d (Ultimate) for the Township of Clearview (Nottawa). 864 m³/d (Phase 1) and 11,232 m³/d (Ultimate) of Collingwood water goes through the Regional pipeline to the Davey reservoir/pumphouse to service Zone 2.
2. Includes approximately 27,621 m³/d minus 864 m³/d (Phase 1) and 46,315 m³/d minus 11,232 m³/d (Ultimate) for the Town of Collingwood; and, approximately 6,000 m³/d (Phase 1) and 16,400 m³/d (Ultimate) for the Town of Blue Mountains.
3. Sum of Municipal and Regional pipeline flows.
4. Given approximate membrane permeate factor of 1.10 to account for membrane downtime, backwash wastewater volume, but excluding the constant bleeding of water for ZW500d membranes that do not impact the flowrate to the CT chambers (information obtained from SUEZ).
5. Even though the original required industrial demand was 16,418 m³/d, industrial flows since 2017 never exceeded 2,000 m³/d, so this number was used as agreed by the Town.
6. Multiplication of CT chambers instantaneous flows by an approximate raw water factor of 1.11 to account for constant bleeding of water for ZW500d membranes, and then summation of the industrial flows (information obtained from SUEZ).

The MSP also provided average day demands of approximately 40,179 m³/d (2038 flows) for Phase 1 and 81,244 m³/d for ultimate flow. This equates to a MDD/ADD ratio of 1.291 for Phase 1 and 1.244 for the ultimate flow.

2.4 Storage Projections

Table 5 shows the existing water storage tanks in the Town of Collingwood to provide a total storage capacity of 9,073 m³, which excludes the storage provided by the on-site clearwell (high lift wet well) and the chlorine contact (CT) tanks located at the WTP.

Table 5 Existing Water Storage Tanks in the Town of Collingwood

Tank	Location	Volume (m ³)
Chlorine contact (CT) tanks	WTP (assuming H.W.L. of 178.5 m)	856
Clearwell (high lift wet well)	WTP (assuming H.W.L. of 178.1 m and 1.5 m submergence for high lift pumps)	555
Reservoir	Ted Carmichael West End Booster Pumping Station	6,800
Elevated tank	Hume Street, Central Park	2,273
Davey reservoir	Poplar Sideroad	2,565
Total		13,049
Total (excluding storage at WTP)		11,638

To provide operational flexibility of the high lift pumps, the high lift wet well at the WTP will be excluded from system storage calculations. All future on-site storage will be designed to provide the following:

- Adequate disinfection of the plant water (based on MECP disinfection requirements)

- On-site usage, including cleaning of the membranes (included in the high lift pump equalization volume requirement), and,
- High lift pump equalization (maximizing the hydraulic retention time of the high lift pumps combined). A target of 15 minute equalization volume is assumed for the purpose of this technical memorandum.

All future off-site storage will be provided per the MSP.

2.5 Water Quality Treatment Criteria

Table 6 presents the Ontario water quality treatment criteria for selected water quality parameters and the proposed performance targets for the Raymond A. Barker WTP.

Table 6 Water Quality Treatment Criteria for the Raymond A. Barker WTP

Parameter	Ontario Requirement	Proposed Performance Target
Ontario Drinking Water Quality Standards (ODWQS)		
<i>Cryptosporidium</i>	2-log reduction	4-log reduction
<i>Giardia</i>	3-log reduction (incl. 0.5-log inactivation from disinfection)	4-log reduction (incl. 0.5-log inactivation from disinfection)
Viruses	4-log reduction (incl. 2-log inactivation from disinfection)	4-log reduction (incl. 2-log inactivation from disinfection)
HAA5 (µg/L)	80	60 LRAA
Total THMs (µg/L)	100 based on a running annual average of quarterly samples measured at a point reflecting the maximum residence time in the distribution system (LRAA)	80 LRAA
Turbidity (NTU)	< 0.1 NTU, 99% of time < 0.3 NTU, 100% of time	< 0.1 NTU, 99% of time < 0.3 NTU, 100% of time
Distribution Free Chlorine Residual (mg/L)	0.05 to 4.0 mg/L free chlorine residual	0.05 to 4.0 mg/L free chlorine residual (target of 1.66 mg/L average)
Ontario Drinking Water Quality Objectives and Guidelines (ODWQOG)		
Corrosive/water stability	-	Non-corrosive and stable water
Taste & Odour	Inoffensive	Inoffensive

3. Historical Water Quality Data

3.1 Raw Water Data

3.1.1 Raw Water Source

The raw water source for the WTP is Georgian Bay of Lake Huron.

3.1.2 Raw Water Turbidity

Between 2017 and 2018, raw water turbidity ranged between 0.09 and 15.5 NTU with an average of 0.91 NTU (Figure 1 and Table 7). Only 24% of the samples exceeded 1.0 NTU and 0.1% of the samples exceeded 10 NTU.

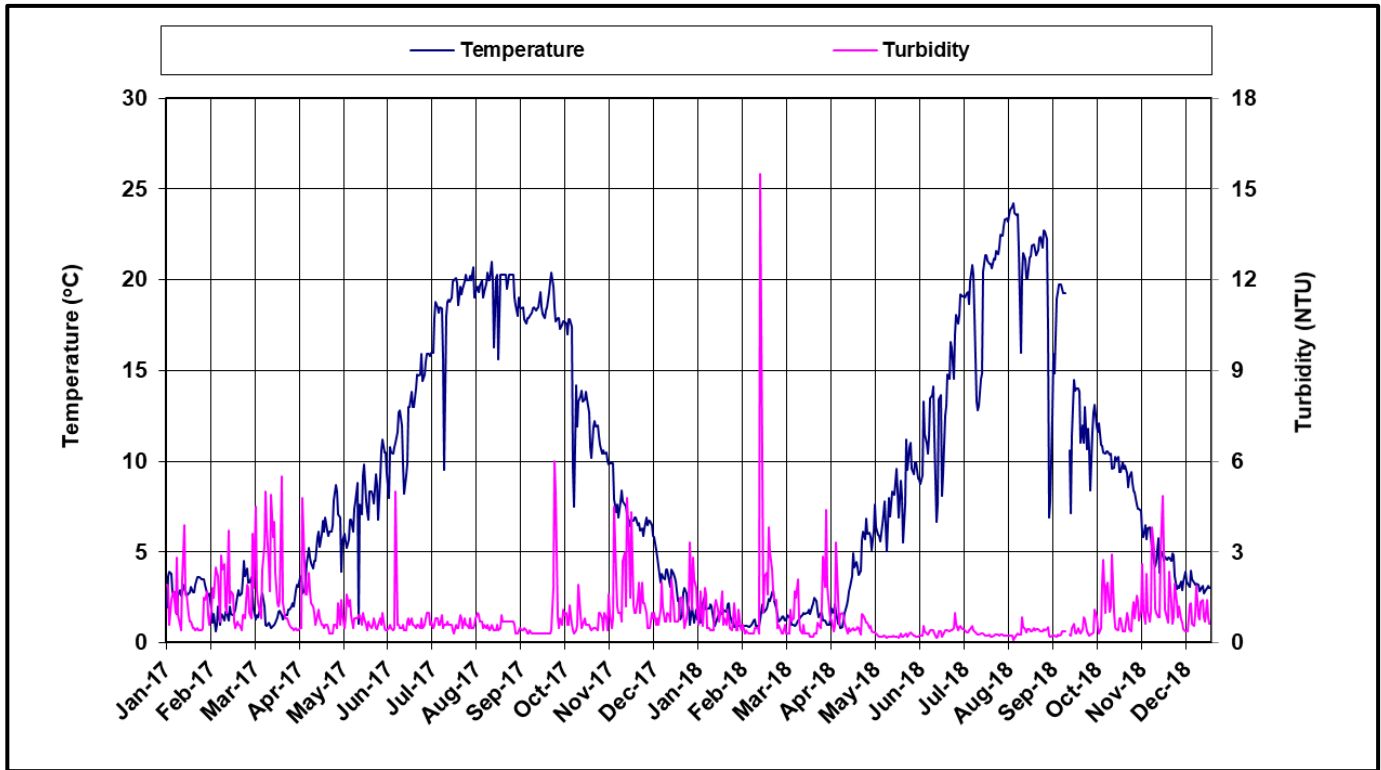


Figure 1 Plot of Raw Water Temperature and Turbidity (2017 to 2018)

Table 7 Raw Water Turbidity (NTU) Data (2017 to 2018)

Source	SC	Min.	Avg.	Max.	% Samples > 0.3 NTU	% Samples > 1.0 NTU	% Samples > 10 NTU
Daily Data	728	0.09	0.91	15.50	82.3%	23.6%	0.1%

3.1.3 Raw Water Temperature

Between 2017 and 2018, raw water temperature ranged between 0.6 and 24.2°C with an average value of 9.0°C (Figure 1 and Table 8). 80% of the samples exceeded 2°C and 38% of the samples exceeded 10°C.

Table 8 Raw Water Temperature (°C) Data (2017 to 2018)

Source	SC	Min.	Avg.	Max.	% Samples > 2°C	% Samples > 10°C	% Samples > 20°C
Daily Data	728	0.60	9.00	24.22	80%	38%	9%

3.1.4 Taste and Odour

Taste and odour can be experienced in the treated water during the warmer months. The major cause of this taste and odour is most likely due to the presence of 2-methylisoborneol (MIB) and geosmin, which are algae metabolites. The threshold number for MIB is 4.0 ng/L, while that for geosmin is 8.5 ng/L.

Geosmin and MIB data (from July 26, 2005) were less than the threshold numbers. Given that there tends to be no public complaints regarding taste and odour, geosmin and MIB tend not to be measured to know whether there has actually been any occurrences in the raw or treated water.

3.2 Treated Water Quality Data

3.2.1 Treated Water Turbidity

Between 2017 and 2018, treated water turbidity ranged between 0.03 and 0.07 NTU with an average of 0.034 NTU (Table 9). The maximum treated water turbidity meets the proposed performance target in Table 6. In fact, 91% of the samples remained below 0.05NTU, with 100% of the samples remaining below 0.1 NTU.

Table 9 Treated Water Turbidity (NTU) Data (2017 to 2018)

Source	SC	Min.	Avg.	Max.	% Samples < 0.05 NTU	% Samples <0.1 NTU	% Samples <0.3 NTU
Daily Data	728	0.030	0.034	0.070	91%	100%	100%

3.2.2 Ontario Drinking Water Quality Standards

A review of the treated water quality data between 2017 and 2018 from the 2017 and 2018 Annual Compliance Reports showed the following:

- None of the measured health related parameters in the Ontario Drinking Water Quality Standards (ODWQS) exceeded the maximum acceptable concentrations (MAC).
- None of the measured non-health related parameters exceeded the aesthetic objectives (AO) or operational guidelines (OG).

3.2.3 Potential for Formation of Disinfection By-Products (DBPs)

Table 10 shows a summary of the trihalomethane (THM) and haloacetic acid (HAA) data in the distribution system between 2017 and 2018. THMs and HAAs have never exceeded the performance targets in Table 6, whether calculated as the running annual average of quarterly samples or even a single data/measurement occurrence.

Table 10 Disinfection By-Products ($\mu\text{g/L}$) Data (2017 to 2018)

Source	SC	Min.	Avg.	Max.
THM Quarterly Data	8	15	38	59
HAA Quarterly Data	5	17	21	27

3.2.4 Membrane Permeate Water Ultraviolet Transmittance (UVT)

In March 2019, The UVT in the membrane permeate water ranged between 94 and 97%, with an average of 96% (Table 11).

Table 11 Membrane Permeate Water UVT (%) Data (March 2019)

Source	SC	Min.	Avg.	Max.
Data on Various Days	27	94%	96%	97%

3.2.5 Treated Water Free Chlorine Residual

Between 2017 and 2018, the treated water free chlorine residual ranged between 0.90 and 1.99 mg/L with an average of 1.66 mg/L (Table 12).

Table 12 Treated Water Free Chlorine Residual (mg/L) Data (2017 to 2018)

Source	SC	Min.	Avg.	Max.
Daily Data	728	0.90	1.66	1.99

3.3 Summary

Given the water quality data presented in this section, there are no new treatment processes that need to be added to the Raymond A. Barker WTP to improve the treated water quality to meet the proposed performance targets in Table 6 and the parameters of the ODWQS/ODWQOG not included in Table 5. This means that expansion of the plant needs to focus on capacity limitations which will be discussed in the next section.

4. Capacity Review

4.1 Raw Water Intake Facilities

4.1.1 Description, Dimensions, Sizes

The raw water intake facilities consist of the following:

- A raw water intake concrete pipe between the intake crib in the Nottawasaga Bay of Georgian Bay and a surge relief chamber with the intake length being 765 m and diameter of 1067 mm, with flared elbow intake inside a crib structure
- A 24 m long, 1067 mm diameter pipe between the surge relief chamber and the raw water wet wells
- Two (2) inlet channels, also known as raw water wet well 1, used to convey water to a raw water wet well 2 with dimensions 2.14 m W x 10.44 m L x 4.93 m SWD to give a total effective volume of 110 m³ of raw water wet well 2
- A 15 kW (20 hp) mixer in the inlet channel 1 in the raw water wet well 1 used to increase the hydraulic grade line of the water in the raw water wet well 2
- A 750 mm diameter raw water supply ductile iron pipe, extending from the raw water wet well 2 to the membrane feed chamber

- A 600 mm diameter raw water bypass ductile iron pipe extending from the surge relief chamber to the membrane feed chamber
- A pre-chlorination system consisting of one (1) 50 mm diameter pipe to the surge chamber reduced to one (1) 25 mm diameter pipe to dose chlorine at the intake crib and intake exit at the beginning of the inlet wells in raw water wet well 1

4.1.2 Capacity Assessment

Given the following factors:

- a low water level (LWL) of Nottawasaga Bay to be 175.6 m (occurred in 1964 for Lake Huron)
- the obvert of the intake pipe to be at an elevation of 172.95 m
- submergence of the intake pipe in the raw water well to be 100 mm, and
- a C factor of 110,

the instantaneous capacity of the intake pipe is calculated to be approximately **125,000 m³/d**, which is similar to the intake ultimate raw water instantaneous flow projections (Table 4). This instantaneous flowrate equates to a velocity of 1.62 m/s.

The intake net capacity is thus calculated to be **100,917 m³/d** (i.e., 125,000 m³/d instantaneous flowrate subtracting 2,000 m³/d for industrial flows and then dividing by 1.11 raw water factor, followed by dividing by a membrane permeate factor of 1.10). Note that a higher Nottawasaga Lake level than 175.6m and a higher intake C factor than 110 will result in a higher intake net capacity.

4.2 Industrial (Unfiltered) Water Supply Plant

4.2.1 Description, Dimensions, Sizes

There is a separate industrial water supply plant to serve a separated unfiltered water distribution system with industries at the east end of the Town of Collingwood. This industrial water supply plant consists of the following:

- One (1) wet well
- Two (2) vertical turbine pumps and one (1) horizontal split case pump (characteristics shown in Table 13) that operate 24 hours per day based on the pressure at the industries
- One (1) 600 mm inlet pipe from the raw water wet well
- One (1) 250 mm inlet pipe from the membrane concentrate pumps
- Backflow preventors at the industries at the cross connection between the municipal and industrial water supply pipes to allow for provision of emergency supply of municipal water for process water requirements, each backflow preventer comprising two independent check valves with intermediate relief valves, shutoff valves and test cocks
- Instruments as follows:
 - One (1) turbidity meter (AIT-08) to monitor raw water turbidity in 600 mm inlet pipe from raw water wet well
 - One (1) level transmitter (LIT-08) to monitor water level in industrial wet well
 - One (1) turbidity meter (AIT-07) to monitor turbidity on the pump header
 - One (1) pressure indicating transmitter (PIT-02) to monitor pressure on the pump header
 - One (1) flowmeter (FIT-03) to monitor flowrate on the pump header

Table 13 Description of Industrial Pumps

Pump No.	Flowrate (L/s)	TDH (m)	Type	Motor (kW)	RPM	Soft Start?	VFDs?	Duty/ Standby
1	50.5	71.0	Vertical turbine	45	1770	Yes	Yes	Duty
2	126.2	71.0	Vertical turbine	112	1770	Yes	Yes	Duty
3	119.9	66.4	Horizontal split case pumps	112	1785	Yes	No	Duty

4.2.2 Capacity Assessment

Table 13 shows the capacity of the industrial pumps, with the firm capacity being 170.4 L/s (14,723 m³/d). Even though the firm capacity is slightly less than the original desired maximum day flowrate of 16,418 m³/d, Table 4 shows the target flowrate required from the industrial pumping station to be reduced considerably to 23 L/s (2,000 m³/d).

4.3 ZW500 Membrane System

4.3.1 Description, Dimensions, Sizes

There is a ZW500 membrane system located inside the plant and consisting of the following:

- A membrane feed chamber with dimensions 1.00 m W x 17.97 m L x 3.15 m SWD with an effective volume of 56.6 m³
- Five (5) membrane trains, consisting of ZW500 membranes as summarized in Table 14. As shown, the membrane trains consist of three generations of membranes: original 1998 ZW500a membranes, and ZW500b and ZW500d membranes installed between 2005 and 2018.
- Five (5) concrete tanks to house the submerged membranes, with each tank having dimensions 3.05 m W x 15.25 m L x 2.45 m SWD to give an effective volume of 114.0 m³ per tank and a sump with dimensions 1.40 m W x 3.05 m L x 1.30 m SWD to give an effective volume of 5.6 m³ per sump, to give a total effective volume in each tank of 119.6 m³
- Six (6) variable speed permeate/backpulse pumps (5 duty, 1 shelf standby), each pump rated at 126 L/s at a TDH of 15.24 m with a 37 kW (50 hp) motor
- Six (6) positive displacement air blowers (5 duty, 1 standby) for air scouring the membranes as well as keeping the solids in suspension, with each blower rated at 680 L/s at a backpressure of 36 kPa with a 37 kW (50 hp) motor
- Six (6) concentrate pumps (5 duty, 1 shelf standby) to pump membrane concentrate from the membrane tanks to the industrial well, with each pump rated at 39 L/s at a TDH of 16.76 m with a 7.5 kW (10 hp) motor
- An air extraction system consisting of six (6) air removal vacuum pumps (5 duty, 1 shelf standby) to extract air from the membrane permeate headers, with each pump rated at 48 m³/h at 41 kPa with a 1.5 kW (2.0 hp) motor and five (5) air separation columns, with a column on each membrane permeate header
- A clean-in-place (CIP) system for chemical cleaning of the membranes, consisting of one (1) 12.3 m³ CIP concrete tank (2.40 m W x 2.84 m L x 1.80 m SWD), with piping manifolded to the five membrane trains
- A backpulse system for backwashing the membranes, consisting of one (1) 23.8 m³ backpulse concrete tank (2.84 m W x 4.66 m L x 1.80 m SWD) with piping manifolded to the five membrane trains to the permeate/backpulse pump for each train
- Two (2) air compressors and air dryers (1 duty, 1 standby) for membrane integrity testing and valve actuation, each compressor with a 11.1 kW (15 hp) motor
- One (1) turbidity meter on each membrane permeate pipe to monitor turbidity in the membrane permeate

- One (1) flowmeter on each membrane permeate pipe to measure membrane permeate and backpulse flows
- One (1) flowmeter on each membrane concentrate pipe to measure concentrate flows
- Chemical feed systems for dosing chemicals required for membrane filtration system including:
 - 12% sodium hypochlorite for organic cleaning during the CIP process, consisting of two (2) 1,400 L day tanks (one located in the chlorine gas cylinder storage room and the other located in the chlorinator room) and one (1) chemical metering pump
 - 50% citric acid for inorganic cleaning during the CIP process, consisting of one (1) 200 L day tank in the blower room and one (1) chemical metering pump

4.3.2 Capacity Assessment

Table 14 shows the net capacity of each ZW500 membrane train at a design temperature of 2°C and a CIP frequency greater than 30 days. As shown, the total net capacity of the ZW500 system given the amount/type of cassettes/modules currently installed and the fluxes shown is **23,113 m³/d**, which is lower than the desired net capacity of 27,355 m³/d.

It should be noted that the original design fluxes at the time of plant construction were approximately 25% more than that shown in Table 14 which would produce a net capacity of 28,975 m³/d, exceeding the desired net capacity. This means that if the membranes are operated at the original design fluxes, then the desired net capacity can be achieved.

For the purpose of this report, the fluxes in Table 14 will be used given the quality of raw water, accepted life expectancy, frequency of cleaning, etc. Future plant expansion options (including replacement of existing membranes) will also carry the design fluxes in this table.

It should also be noted that the ZW500 membrane system is not fed by micro-strainers to remove fine particles that could otherwise damage the membranes. There is thus the potential for a reduction in plant capacity if membrane modules are isolated from operation given major fibre breakages from fine particles. Future plant expansion options will consider the installation of micro-strainers ahead of the membrane system(s), whether the existing or new membrane systems.

Table 14 ZW500 System Design Data

Train	Membrane Type	Installation Date	# of cassettes/train ¹	# of modules/cassette ²	Area per module (m ²)	Total Area (m ²)	Inst. Flux (Lmh) ³	Net Flux (Lmh) ³	Net Capacity (m ³ /d)
A	ZW500b	2014	15	8	60.39	7,246	27.6	25.16	4,376
B	ZW500d	2018	15	20	32.52	9,755	27.6	25.16	5,890
C	ZW500b	2005	10	8	60.39	6,317	27.6	25.16	3,815
	ZW500a	1998	4	8	46.45				
D	ZW500b	2012	10	8	60.39	5,203	27.6	25.16	3,142
	ZW500a	1998	1	8	46.45				
E	ZW500d	2017	15	20	32.52	9,755	27.6	25.16	5,890
Total			68	-	-	38,276	-	-	23,113

Notes:

- Each train can hold a maximum of 15 cassettes. Previously, there weren't enough ZW500a/b modules that did not reach their end of life that would have allowed trains C or D to house 15 cassettes, hence the lesser amount of cassettes in these trains.
- Each ZW500a/b cassette can hold a maximum of 8 modules; while, each ZW500d cassette can hold a maximum of 20 modules.
- Obtained from SUEZ on September 11, 2019. These fluxes are consistent with the current fluxes (that were de-rated about 10 years ago due to TMP limitations) and based on backwashing every 30 minutes with a 30 second backpulse (plus valve actuation duration).

4.4 ZW1000 Membrane System

4.4.1 Description, Dimensions, Sizes

There is a ZW1000 membrane system located outside the plant and consisting of the following:

- One (1) mobile package unit in two (2) temporary timber structures with dimensions 4.72 m W x 9.60 m L and 3.35 m W x 12.19 m L
- One (1) membrane train, consisting of ZW1000 membranes as summarized in Table 15
- One (1) 35 m³ steel tank to house the submerged membranes and backwash/CEB/CIP storage tank (~16 m³)
- One (1) raw water vertical turbine feed pump, installed in the membrane feed chamber in the WTP, and rated at 73.8 L/s at a TDH of 10.6 m
- One (1) 0.5 mm S.P. Kinney Model "AP" 200 mm automatic strainer to remove fine debris from the raw water supply to prevent damage to the membranes
- One (1) variable speed multi-purpose permeate/backpulse/CEB/CIP pump rated at 36.6 to 75.7 L/s at a TDH of 13.7 m with a 37 kW (50 hp) motor
- One (1) drain pump rated at 54 to 82 L/s at a TDH of 7.6 m with a 18.6 kW (25 hp) motor to drain the water in the steel membrane tank
- One (1) vacuum pump rated at 39 m³/h at 68 kPa to remove air released from the solution under vacuum that occurs as the water passes through the membrane to the permeate collection piping
- One (1) air blower for air scouring the membranes and rated at 30 L/s at a backpressure of 31 kPa with a 0.19 kW (0.25 hp) motor
- One (1) air compressor, air receiver and air dryer for membrane integrity testing and valve actuation
- One (1) particle counter and turbidity meter on the membrane permeate pipe to monitor particle counts and turbidity in the membrane permeate

- One (1) flowmeter on the membrane permeate pipe to measure membrane permeate and backpulse flows
- Chemical feed systems for dosing chemicals required for membrane filtration system including:
 - 12% sodium hypochlorite for organic cleaning during the CIP process and chemical cleaning during the CEB process, consisting of one (1) 200 L day tank and one (1) 178 L/min air diaphragm chemical metering pump for the CIP process and one (1) 108 L/h motor driven pump for the CEB process
 - 50% citric acid for inorganic cleaning during the CIP process, consisting of one (1) 200 L day tank and one (1) 178 L/min air diaphragm chemical metering pump

4.4.2 Capacity Assessment

Table 15 shows the net capacity of the ZW1000 membrane system at a design temperature of 2°C and a CIP frequency greater than 30 days to be **4,543 m³/d**, which is higher than the desired net capacity of 3,785 m³/d.

Table 15 ZW1000 System Design Data

Train	Membrane Type (ZW)	Installation Date	# of cassettes/train	# of modules/cassette	Area per module (m ²)	Total Area (m ²)	Inst. Flux (Lmh) ¹	Net Flux (Lmh) ¹	Net Capacity (m ³ /d)
Mobile Unit	ZW1000V3	2017	1	48	41.81	8,027	26.85	23.58	4,543
		2012	3	48	41.81				

Notes:

1. Obtained from SUEZ on September 23, 2019.

4.5 Disinfection

4.5.1 Description, Dimensions, Sizes

Disinfection for the WTP is provided by dosing chlorine (using chlorine gas) to the common membrane permeate pipe which conveys water into a feed channel which splits the water to two (2) chlorine contact (CT) chambers for disinfection before the water overflows a weir into the clearwell.

The dimensions of each chamber is 7.73 m W x 18.78 m L x 2.95 m SWD, to give a total effective volume of 816 m³.

4.5.2 Capacity Assessment

The existing chlorine contact (CT) chambers were originally designed to provide sufficient contact time for 3-log inactivation of viruses, given a total requirement of 4-log inactivation of viruses and 1-log credit provided to the membranes by the Ministry of the Environment (MOE) at that time. However, the following changes have occurred since the design of the plant:

- **Removal of Virus Removal Credits from the Membranes:** The latest MDWL has provided no credits to the membranes for virus removal. This is consistent with other membrane plants in Ontario even though the following December 2010 MWH reports showed the following:
 - **ZW500 Membranes:** Challenge experiments with MS2 virus have shown that the log removal achieved by the membrane is in the range of 2.0- to 4.7-logs. MS2 virus removal was greater than 2.2-log, 95% of the time.

- **ZW1000 Membranes:** Challenge experiments with MS2 virus have shown that the log removal achieved by the membrane is in the range of 2.6- to 5.8-log. MS2 virus removal was greater than 2.5-log, 95% of the time.

In terms of guarantee, membrane suppliers typically don't guarantee virus removal because there is no means of confirming the virus removal in the field, and the membrane integrity test (MIT) doesn't have the required resolution for viruses since they are so small.

- *Procedure for Disinfection of Drinking Water in Ontario (MOE, 2006)* states that 0.5-log inactivation of *Giardia* cysts shall be provided regardless of the treatment technology provided. This is part of the multi-barrier approach for disinfection.

Table 16 shows the net capacity of the CT chambers to achieve 0.5-log *Giardia* inactivation to be **21,423 m³/d** at 0.5°C and 41,399 m³/d at 10°C. Operations have stated that the chlorine dosage (and thus free chlorine residual) is modified depending on the water temperature and plant flowrate, so as to ensure adequate disinfection at all times.

Table 16 Disinfection Calculations in Existing CT Chambers Using Chlorine

Parameter	Value	
Disinfection required	0.5-log <i>Giardia</i>	
Infrastructure providing disinfection	Two chlorine contact (CT) chambers	
Net volume of above infrastructure (m ³)	816 (at H.W.L. of 178.50 m and effective footprint of 138.25 m ²)	
Minimum free chlorine residual to be maintained at end of above infrastructure (mg/L)	1.66 (2017 to 2018 average free chlorine residual)	
T ₁₀ /T (superior baffling conditions)	0.7	
Lowest design water temperature (°C)	0.5	10
Highest design treated water pH	8.1	
Instantaneous Capacity of CT chambers (m ³ /d)	23,565	45,539
Membrane permeate (instantaneous) factor	1.10	
Net Capacity of CT chambers (m ³ /d)	21,423	41,399

4.6 High Lift Pumping

4.6.1 Description, Dimensions, Sizes

Water from each CT chamber overflow separate weirs into the clearwell with dimensions 9.27 m W x 17.36 m L x 4.95m SWD to give a total effective volume of 797 m³. Given a typical operating SWD of 4.45m (based on February to October 2019 data as stated by plant operations) and a maximum high lift pump suction pipe submergence of 1.5 m, a net operating volume of 475 m³ can be achieved.

There are two sets of high lift pumps (HLPs) in this clearwell as listed below and described in Table 17:

- Four (4) pumps discharging water into a 400 mm 316SS high lift header inside the plant which conveys water through a 400 mm ductile iron pipe outside the plant to the Municipal WSS

- Three (3) pumps discharging water into a 316 SS high lift header inside the plant which conveys water to twin 400 mm and then one 600 mm concrete pressure pipe outside the plant and within the Collingwood boundary to the Regional Water Supply System (WSS) to supply water to the Town of New Tecumseth (total length of 600 mm pipe between the plant and the Town of New Tecumseth is 58 km)

The HLPs for the Municipal WSS are currently operated to maintain pre-set water levels in the elevated tank off-site, however, in the future they can also be operated to maintain system pressures.

The HLPs for the Regional WSS are operated to maintain water levels in the Parsons Road Reservoir in the Town of New Tecumseth; however, in the future they can also be operated to maintain system pressures.

Table 17 Description of High Lift Pumps

LLP No.	Flowrate (L/s)	TDH (m)	Type	Motor (kW)	RPM	Soft Start?	VFDs?	Duty/ Standby
Municipal WSS								
1	56.7	57	Vertical turbine	41	1800	Yes	Yes	Duty (Jockey)
2	138.6	55	Vertical turbine	112	1200	Yes	Yes	Duty
3	138.6	55	Vertical turbine	112	1200	Yes	Yes	Duty
4	138.6	55	Vertical turbine	112	1200	Yes	No	Standby
Regional WSS								
1	132.5	55	Vertical turbine	186	1800	Yes	Yes	Duty
2	132.5	55	Vertical turbine	186	1800	Yes	Yes	Duty
3	132.5	55	Vertical turbine	186	1800	Yes	Yes	Standby

4.6.2 Capacity Assessment

Table 17 showed the capacity of the Municipal and Regional HLPs, with the firm capacity being **334 L/s (28,850 m³/d)** and **265 L/s (22,890 m³/d)**, respectively.

Given a net operating volume in the clearwell (high lift wet well) of 475 m³, the hydraulic retention time (HRT) in the clearwell at different flowrates are presented in Table 18. As shown, the existing clearwell can provide 22 minutes HRT at the current plant rated capacity. The HRT reduces to 7 minutes at the plant's ultimate built-out capacity. If the plant staff will like to achieve a minimum of 15 minutes HRT, the net capacity of the clearwell is **45,600 m³/d**.

Table 18 Hydraulic Retention Time (min) in the Clearwell at Varying Net Flowrates

Tank Location	High Lift Pumping Flowrate (m ³ /d)		
	Current Rated Capacity	Phase 1 (2038)	Ultimate
	31,140	51,871	101,069
HRT (min) ¹	22	13	7

Notes:

1. Assume net HLWW/clearwell operating volume = 475 m³ based on a typical operating SWD of 4.45m (based on February to October 2019 data as stated by plant operations) and a maximum high lift pump suction pipe submergence of 1.5 m.

4.7 Chemicals (Excluding Membrane System)

4.7.1 Description, Dimensions, Sizes

Chlorine gas is the only chemical used at the plant for providing disinfection. The chlorine gas system is located in its own rooms with the following:

- Five (5) one ton chlorine gas containers
- Two (2) weigh scales with a 4-20 mA output, each scale capable of holding one ton chlorine gas container
- One (1) vacuum regulator and two (2) vacuum switches to control from which container gas is being drawn and to switch automatically from the duty to the standby container, when the duty is empty, to ensure a continuous supply of chlorine gas
- One (1) chlorine gas detector
- Three (3) chlorinators (2 duty, 1 standby) located in a separate room to the chlorine gas containers with characteristics shown in Table 19

Table 19 Characteristics of Chlorinators

Chlorinator #	Process	Chlorinator Capacity (kg/d)	V-notch & Rotameter Capacity (kg/d)	Chlorine Dosage Location	Control
1	Pre-chlorination	226	34	Intake crib and intake exit at raw water wet well 1	Paced to combined readings of flowmeters on high lift header
2	Primary Disinfection	226	96	Membrane permeate header upstream of chlorine contact chamber	Paced to common membrane permeate header flowmeter and free chlorine residual analyzer (i.e., compound loop)
3	Standby to above	226	96	-	-

There is no chlorine gas scrubber at the plant.

4.7.2 Capacity Assessment

Table 20 shows the instantaneous capacity of the chlorinators and existing rotameters. As shown the chlorinators net capacity is **103,013 m³/d**; while, the v-notch and rotameter net capacity is **43,758 m³/d** (excluding the standby chlorinator).

Table 20 Capacity of Chlorinators

Chlorinator #	Peak Design Dosage (mg/L)	Chlorinator Capacity (kg/d)	V-notch & Rotameter Capacity (kg/d)	Chlorinator Capacity (m ³ /d)		V-notch & Rotameter Capacity (m ³ /d)	
				Instantaneous	Net ^{1,2}	Instantaneous	Net ^{1,2}
1	1.0	226	34	226,000	183,783	34,000	26,255
2	2.0	226	96	113,000	103,013	48,000	43,758
3	2.0	226	96	113,000	103,013	48,000	43,758

Notes:

1. Based on subtracting 2,000 m³/d and dividing by 1.22 (i.e., 1/1.11/1.10) for chlorinator 1.
2. Based on an instantaneous factor of 1.10 for chlorinators 2 and 3.

Table 21 shows the storage capacity of the chlorine gas containers given various design dosages. As shown, five (5) chlorine gas containers can provide over 30 days of chlorine gas storage given a net *average* day design flow of 59,916 m³/d and a total average design dosage of 2.3 mg/L. This equates to a net *rated (maximum day)* capacity of 74,537 m³/d given a MDD/ADD ratio of 1.244 (Section 2.3).

Typically, plant operations order containers once two of them are empty. By the time that the containers arrive on-site, three containers may be empty. For future plant expansions, the storage capability of containers should be provided based on N-3 containers. If this policy is followed now, a net *average* day design flow of 23,966 m³/d can be achieved, which equates to a net *rated (maximum day)* capacity of 30,941 m³/d. A higher capacity can be achieved by ordering containers more frequently.

Table 21 Storage Capacity of Chlorine Gas Containers

# of Chlorine Gas Containers	Total Average Design Dosage (mg/L) ²	Average Day Net Design Flow Given # Days Storage (m ³ /d) ¹			
		7 days	30 days	60 days	90 days
1	2.3	51,357	11,983	5,992	3,994
2	2.3	102,713	23,966	11,983	7,989
3	2.3	154,070	35,950	17,975	11,983
4	2.3	205,427	47,933	23,966	15,978
5	2.3	256,783	59,916	29,958	19,972

Notes:

1. Based on an instantaneous factor of 1.10 assuming that the majority of the chlorination will be practiced within the CT chambers.
2. **Based on** SCADA data between January and August 2019.

4.8 Residue Management

4.8.1 Description, Dimensions, Sizes

There are three (3) types of wastewater generated at the WTP:

- **Sanitary sewage generated from toilets and drains** - This wastewater flows by gravity to the nearby sanitary sewer.

- **Membrane backwash wastewater** – The membrane concentrate pumps continuously discharge this wastewater to the industrial well, after which this wastewater then gets pumped to the industries. There is also a 250 mm diameter bypass outfall to the Bay.
- **Membrane CIP wastewater with high or low pH** – The membrane concentrate pumps discharge this wastewater to the nearby sanitary sewer.

Regarding the discharge of wastewater to the Bay, the existing Municipal Drinking Water License (MDWL) 100-101 (Issue No. 3) mandates that the total suspended solids shall not exceed an annual average concentration of 25 mg/L.

4.8.2 Capacity Assessment

Not applicable.

4.9 Building Services

4.9.1 Description, Dimensions, Sizes

Standby Power

There is one (1) standby generator with characteristics presented in Table 22. This generator was originally sized to provide standby power to all electrically driven units, such that 100% of the plant rated capacity can be provided during power outages under normal operating conditions.

Table 22 Characteristics of Standby Generator

Parameter	Value
Standby Generator	
No. of generators provided	1
Location of generator	Separate building
Type	Diesel
Prime rating	1,000 kW
Standby rating	1150 kW
Electrical rating	600 V, 3 pH, 60 Hz, 0.8 PF
Type of cooling	Radiator
Fuel Storage	
No. of tanks for fuel storage	4
Type of fuel tank	Double wall steel
Capacity per fuel tank	2,270 L
Location of fuel tank	Standby generator room
kW, fuel usage, operating hrs @ 100% Load	600 kW, 245 LPH fuel usage, 37 operating hours
kW, fuel usage, operating hrs @ 50% Load	300 kW, 123 LPH fuel usage, 19 operating hours

Electrical

A 44 kV primary cable runs from the terminal hydro pole to a 2000kVA pad mounted transformer, which is wound to transform 44kV to 600/347V. A single cable carries 600V power from the substation to the switchgear and motor control centre (MCC) in the diesel generator building. Electric wires then stem from this MCC to the other MCCs listed below:

- MCC at the industrial building to house mainly the starters for the industrial feed pumps
- MCC in the control room in the WTP to house the starters for most of the ZW500 system equipment except the blowers and compressors
- MCC in the blower room in the WTP to house mainly the starters for the blowers and compressors
- MCC in the control room in the WTP to house the starters for the high lift pumps for the Municipal Pipeline
- MCC in the Workshop in the WTP to house the starters for the high lift pumps for the Regional Pipeline
- MCC in the temporary building to house the starters for the ZW1000 system equipment

Heating and Ventilation

Generator Building

The generator building is electrically heated by a series of unit and wall style electric heaters. All ventilation in the generator building is provided by a series of exhaust fans and motorised dampers. Exhausts from the diesel generator are vented directly to the roof, through a series of silencers and on to a short stack to the outside. The heat produced from the diesel generator is passed through a heat exchanger to a radiator located on the roof. The radiator is a 50% blend of ethylene glycol.

WTP

Heating and cooling for the three offices, the electrical room and the corridor are provided by a HVAC system located on the roof. The remainder of the plant is heated with unit heaters with built-in or wall mounted thermostats that can be set on a room to room basis.

The washrooms and the storage room have a separate ventilation system which is exhausted to the roof. Every other room in the plant has its own intake and exhaust either to the roof or the side of the building.

Due to the increased humidity in the membrane and pump room, dehumidifiers have been installed to remove excess moisture from the air. These are activated by humidistat controllers located within the given rooms.

Overall SCADA and Communication

There are six (6) Allen Bradley programmable logic controls (PLCs) located at the plant to control the following processes:

- Generator
- Industrial feed pumps
- ZW500 membrane system

- ZW1000 membrane system
- Plant processes
- Regional high lift pumps

All of the PLCs have a human manual interface (HMI), except those for the industrial and Regional pumps, allowing the operator to check the status of the equipment specific to the PLC.

System monitoring and data collection is done by SCADA (RSView) with one computer located in the chief operator's office at the WTP and another computer located in the industrial building.

There is also a PLC located at the Ted A Charmichael reservoir which is connected to the main plant PLC at the WTP via a leased line from Bell Canada. Additionally, there is a remote terminal unit (RTU) at the elevated storage tank with radio communication between this RTU and the PLC for the plant processes. Finally, there are PLCs located at the Georgian Meadows Booster Pumping Station and the Osler Booster Pumping Station, which are all connected to the PLC for the Municipal high lift pumps via a leases line from Bell Canada.

System alarms that are generated are dispatched to the local Fire Department by the electronic dialling system. The Fire Department then dispatches the on call personal.

4.9.2 Capacity Assessment

There is a preference by the Town for the standby generator to provide sufficient power for 100% plant firm capacity and for the diesel storage system to provide 24 hours storage at this firm capacity. This is currently being achieved at the plant current rated capacity.

5. Capacity Assessment of Existing WTP

Table 23 shows the equivalent net plant capacity assessment of existing unit processes, while Figure 2 plots this data.

Table 23 Equivalent Net Plant Capacity Assessment of Existing Unit Processes

Process	Equivalent Net Plant Capacity (m ³ /d)	Comments
Intake	125,000	Note that a higher Nottawasaga Lake level than 175.6m and a higher intake C factor than 110 will result in a higher intake net capacity. This capacity accounts for in-plant water recycling and industrial pumping resulting in 100,917m ³ /d available for potable water delivery.
Membrane System	27,656	Sum of 23,113 m ³ /d (ZW500 system) and 4,543 m ³ /d (ZW1000 system) at 2°C and 30 days CIP frequency and design fluxes as shown in this report. This is based on current flux standards and can be increased if needed. This capacity assumes no substantial fibre breakages that will require membrane modules to be isolated, resulting in a reduction of plant capacity.
Chlorine Contact Chambers	21,423	Based on providing 0.5-log inactivation of <i>Giardia</i> cysts at 0.5°C, pH of 8.1 and 1.66 mg/L average free chlorine residual. The free chlorine residual can be increased as needed to achieve sufficient disinfection.
Clearwell	45,600	Based on providing 15 minutes high lift equalization volume.
Municipal HLPs	28,850	Firm capacity of pumps shown. Note that the Municipal HLPs cannot be reviewed on their own given that the plant feeds both the Municipal HLPs and the Regional HLPs.
Regional HLPs	22,890	Firm capacity of pumps shown. Note that the Regional HLPs cannot be reviewed on their own given that the plant feeds both the Municipal HLPs and the Regional HLPs.
Chlorinator	103,013	Limited by CT chamber chlorinator.
V-notch & Rotameter	43,758	For chlorination in the CT chamber.
Chlorine Gas Storage	30,941	Based on 2 chlorine gas containers providing 30 days average day design flow and dosage.

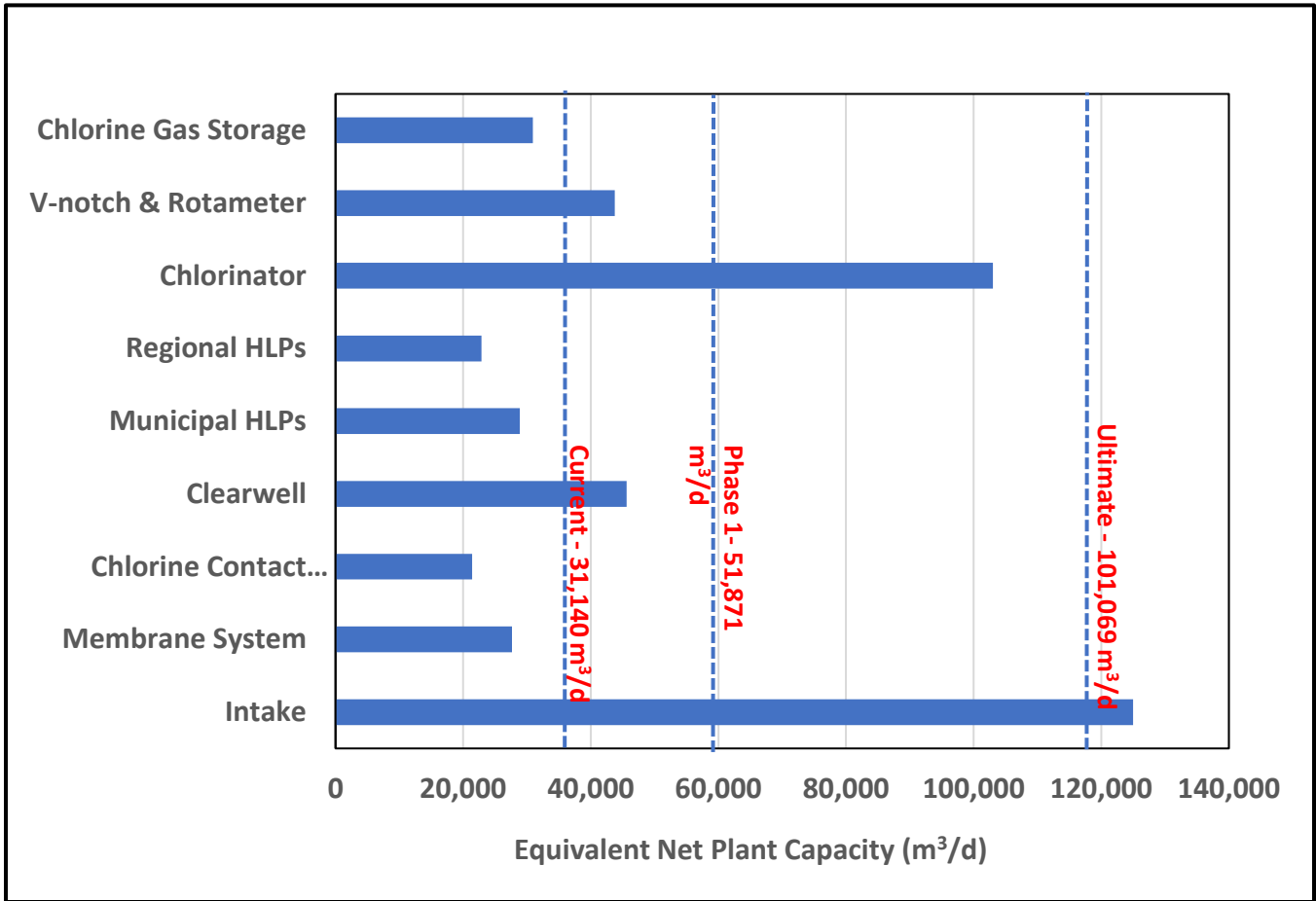


Figure 2 Equivalent Net Plant Capacity of Unit Processes

6. Achieving Plant Rated Capacity Immediately per MDWL

6.1 Membrane Filtration

Table 23 showed that the plant currently cannot achieve adequate membrane filtration capacity given the plant net rated capacity of 31,140 m³/d per the MDWL. However, the plant can achieve adequate membrane filtration capacity given the 2017 and 2018 maximum day flowrates of 21,143 and 24,277 m³/d, respectively (Table 3).

To achieve the MDWL plant net rated capacity, the following options can be considered by plant staff as an interim measure:

- **Option 1:** Operate the membrane systems at an additional 13% instantaneous flux. This may increase the clean-in-place (CIP) frequency, which may be manageable by plant staff.
- **Option 2:** Replace the ZW500a/b membranes in trains C and D with ZW500d membranes (populating the entire tanks) similar to trains B and E.

6.2 Disinfection

Table 23 showed that the plant cannot achieve adequate disinfection for either the plant rated capacity in the MDWL or the 2017/2018 maximum day flowrates. This issue has already been addressed in a report by GHD entitled *Evaluation of Alternatives* and dated July 19, 2019.

Operations have stated that the chlorine dosage (and thus free chlorine residual) is modified depending on the water temperature and plant flowrate, so as to ensure adequate disinfection at all times.

7. Achieving Future Plant Capacities

A subsequent technical memorandum will be prepared to review alternatives for the various unit treatment processes to achieve the future plant capacities listed in Table 4. This new technical memorandum will also screen the alternatives and then provide a cost-benefit analysis to determine the preferred alternatives.

Appendix E

**Town of Collingwood
Raymond A. Barker Water Treatment Plant
Class Environmental Assessment
NATURAL ENVIRONMENT TECHNICAL REPORT**

AECOM Canada Ltd.

November 4, 2019

Town of Collingwood

Water Treatment Plant Class Environmental Assessment

Natural Environment Technical Report

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1. Introduction

AECOM Canada Ltd. (AECOM) has been retained by Ainley and Associates Limited to conduct natural environment studies to support the Class Environment Assessment (EA) for the Raymond A. Barker Ultrafiltration Water Treatment Plant (WTP) expansion.

As part of the Town of Collingwood's Master Servicing Plan process, the Town has identified the need to expand the existing Raymond A. Barker WTP to accommodate future water demands for the Town of Collingwood and its contractual commitments to supply treated water to other municipalities. A Class EA was previously filed on September 2004 for the plant expansion has now expired. The Town has determined the need to prepare an updated Class EA to confirm or amend the preferred solution(s) identified in the original EA by addressing changes to regulations and design standards, advances in technology and adjustments to phasing based on current water demand projections, and to convey this information to a list of stakeholders and interested parties that has expanded since 2004.

The purpose of this report is to provide the results for the natural environment assessment. The property limits and natural environment study area are shown in **Figure 1**.

2. Legislative Requirements

2.1 Fisheries Act, 1985 (as amended)

Several changes to the Fisheries Act occurred since the Class EA previously filed on September 2004. The following provides a brief synopsis of the relevant changes.

In light of the November 2013 changes to the Fisheries Act, a modified review process for in-water works is now in practice. Per the requirements of the revised regulation and the Fisheries Protection Program, a qualified environmental professional is required to conduct a Self-Assessment, of proposed project activities to determine whether DFO needs to review the project. The Self-Assessment will include a description of the proposed work proposed project works outlining activities proposed in or near water, and how these project works will be completed; including construction materials, methods, and equipment that will be used. The potential effects of the proposed project should be identified with a description and size of the footprint (in m²) of affected fish habitat. This ideally would be addressed concurrent with the advancement of detailed design (ideally at 60 to 90% complete).to ensure that the construction methods and footprints are final.

Further, on June 21, 2019, Bill C-68 (An Act to amend the Fisheries Act and other Acts in consequence) was passed into law. This included several changes to the habitat provisions and associated sections. However, Coming into Force provisions of Bill-C68 specifically excluded several Section and Subsection references, many of which were related to the habitat provisions: These Sections and Subsections were initially excluded until fixed by Order(s) in Governor in Council; which typically occurs following development of regulations and policies by DFO. Regulation and policy regarding the approach to impact assessment for Projects near water and guidance as to how to avoid causing death of fish and the Harmful Alteration, Disruption or Destruction of fish habitat (HADD) was released by DFO on August 28, 2019. Based on this newly released guidance, it is AECOMs understanding that project activities should consider best practices to protect fish and fish habitat as documented in the newly released Standards and Codes of Practice. Should in-water works be required to facilitate the construction of the preferred alternative, such that a temporary disruption to fish and fish habitat may occur and/or residual permanent effects are possible, a Self- Assessment and/or Request for Review to DFO would be required.

2.2 Migratory Bird Convention Act, 1994

Canada's *Migratory Birds Convention Act, 1994* (MBCA) is intended to protect migratory birds, their eggs and their active nests. The MBCA includes more than 700 species of birds, including songbirds, woodland birds, waterfowl, shorebirds and seabirds. Environment and Climate Change Canada (ECCC) administers the Act, but numerous other agencies are responsible for consideration of migratory birds under the Act. The MBCA prohibits the possession, destruction and harm of migratory birds and/or their active nests and prohibits the release of harmful substances in areas frequented by migratory birds.

2.3 Endangered Species Act, 2007

Ontario's *Endangered Species Act, 2007* (ESA) provides protection of provincial Species at Risk (SAR) and their habitats. Subsection 9(1) prohibits the "killing, harming, harassing, possessing, buying, selling, trading, leasing or

transporting species listed as threatened, endangered or extirpated". Subsection 10(1)(a) of the ESA states that "No person shall damage or destroy the habitat of a species that is listed on the Species at Risk in Ontario (SARO) list as an endangered or threatened species". The ESA also includes preparation of recovery strategies for species ranked as Threatened or Endangered, and management plans for those ranked as Special Concern.

Protection for SAR and their habitats is provided under the ESA by restricting activities that may affect them. Where a proposed activity will impact protected species or habitat, changes to timing, location and methods of the proposed activity should be considered, wherever feasible, to avoid impacts to SAR. Where impacts cannot be avoided or mitigated, a permit process may be initiated. The Ontario Ministry of the Environment, Conservation and Parks (MECP) may grant a permit, or other authorization, for activities that would otherwise not be allowable under the ESA. Several permit types are available, depending on the nature of the proposed work and may include conditions for the activity to meet which aid in protection or recovery of the targeted SAR.

2.4 Provincial Policy Statement

The *Provincial Policy Statement (PPS)* is the complimentary policy document to the Ontario *Planning Act, 1990*. Issued under the authority of Section 3 of the *Planning Act, 1990*, the PPS provides direction on matters of provincial interest related to land use planning and development, and promotes the provincial "policy led" planning system that recognizes and addresses the complex inter-relationship among environmental, economic and social factors in land use planning.

The PPS identifies the following natural heritage features to be protected:

- Significant habitat of endangered or threatened species;
- Significant wetlands;
- Significant woodlands in Ecoregions 6E and 7E;
- Significant valley lands in Ecoregions 6E and 7E;
- Significant wildlife habitat;
- Significant areas of natural and scientific interest; and
- Fish habitat.

2.5 Conservation Authorities Act, 1998

Portions of the study area are located within areas regulated by the Nottawasaga Valley Conservation Authority (NVCA) under Section 28 of the of the *Conservation Authorities Act, 1990*. These "Regulated Areas" are established where development could be subject to flooding, erosion or dynamic beaches, or where interference with wetlands and alterations to shorelines and watercourses might have an adverse effect on those environmental features. Any proposed development, interference or alteration within a Regulated Area will require a permit from NVCA under the *Development, Interference with Wetlands and Alterations to Shorelines and Watercourses*, Ontario Regulation 172/06.

2.6 Simcoe County Official Plan

The study area is situated in lands designated as Settlements under Schedule 5.1 of the County of Simcoe Official Plan (2016). There are no wetlands or areas of natural and scientific interest according to Schedule 5.2.2 and 5.2.3, respectively, of the County of Simcoe Official Plan (2016)

2.7 Town of Collingwood Official Plan

Lands within the study area are designated as Residential, Recreation and Environment Protection under Schedule 'A' – Land Use Plan of the Town of Collingwood Official Plan (2019). Environment Protection areas include lands unsuitable for development due to inherent natural hazards such as susceptibility to flooding or erosion, poor drainage, organic soils or steep slopes. Lands within the study area designated as Environment Protection areas occur along the Nottawasaga Bay shoreline

3. Methods

Prior to field investigations, a background review was completed to obtain information on known natural heritage features and species records in the vicinity of the study area. Results of the background information review are discussed as part of **Section 4** of this report.

3.1 Background Information

Background information was obtained from the following sources:

- Ontario Ministry of Natural Resources and Forestry (MNRF) Land Information Ontario (2019a);
- MNRF Make-a-Map: Natural Heritage Areas Application and NHIC Rare Species Records (2019b);
- DFO Aquatic SAR Maps (2019);
- Ontario Breeding Bird Atlas (OBBA; BSC et al., 2006);
- Ontario Reptile and Amphibian Atlas (ORAA; Ontario Nature, 2019a);
- Bat Conservation International (BCI) species range maps (2019);
- Ontario Butterfly Atlas (OBA) website (Macnaughton et al., 2019);
- NVCA Fisheries Habitat Management Plan (2009); and
- NVCA's Interactive Map (2019).

In addition, correspondence was initiated on September 6, 2019 with the MNRF Midhurst District and NVCA to request additional information pertaining to natural heritage features and fish community records relevant to the study area. A response had not been yet received at the time this report was prepared.

3.2 Field Investigations

In order to supplement available background information as described in **Section 3.1** above, AECOM ecologists conducted field investigations on August 29, 2019 to establish existing conditions of the natural environment within the study area (as defined in **Section 1**).

3.2.1 Aquatic

On August 29, 2019 AECOM ecologists conducted detailed fish habitat assessments to document the existing conditions of Nottawasaga Bay (a sub-bay of Georgian Bay) within the study area (**Figure 1**). Field reconnaissance focused on identifying and describing fish habitat features that may influence fish community composition. Data collection during field investigations included documentation of the following:

- Documentation of surrounding natural features and land uses (i.e., wetland, agriculture, etc.);
- Site dimensions and bank stability;
- Water clarity, water colour, presence and type of macrophytes and algal growth, evidence of runoff;
- Identification of limiting fish habitat features;
- Identification of pollution sources (i.e., tile drain discharges, other piped discharges and road runoff); and,
- A photographic record of the site to document habitat conditions.

3.2.2 Terrestrial

Field investigations included the following:

- Vegetation community classification and mapping, including documentation of dominant species associations, following the *Ecological Land Classification for Southern Ontario: First Approximation and its Application* (Lee *et al.*, 1998) to Ecosite or Vegetation Type;
- List of plant species observed;
- List of wildlife species observed;
- Direct observations or evidence of wildlife habitat on man-made structures;
- Assessment of habitat potential based on wildlife observations and site conditions; and,
- Location of any Species of Conservation Concern, SAR or their habitat.

3.2.2.1 Significant Wildlife Habitat

The MNRF generally categorizes SWH into four categories. These categories as well as a brief description are provided below:

- **Seasonal Concentration Areas** – these areas are where wildlife species occur annually in aggregations at certain times of the year. Seasonal Concentration Areas are sometimes highly concentrated with members of a given species, or several species within relatively small areas (MNRF, 2015);
- **Rare Vegetation Communities or Specialized Habitats for Wildlife** – rare vegetation communities often contain rare species, specifically plants and small invertebrates which depend on such habitats for their survival. One of the most important criteria for assessing rare vegetation communities is the current representation of the community in the planning areas based on its area relative to the total landscape or number of examples within the planning area (MNRF, 2015). Similarly, some wildlife species require large areas of suitable habitat for their long-term survival. Specialized habitat for wildlife is a community or diversity-based category; therefore, the more wildlife species a habitat contains, the more significant the habitat becomes to the planning area;
- **Habitat for Species of Conservation Concern** – include wildlife species that are listed as Special Concern or rare, that are declining, or are featured species of the habitat type (MNRF, 2015); and
- **Animal movement corridors** – animal movement corridors are elongated areas used by wildlife to move from one habitat to another. These areas are important in ensuring genetic diversity in populations, allowing seasonal migration and movement throughout a home range.

SWH includes the habitat of Species of Conservation Concern (SOCC). For the purposes of this Report and in accordance with guidance documents (MNR, 2000 and 2010), SOCC consists of the following:

- Species with Provincial S-rank assigned by the Natural Heritage Information Centre (NHIC) as S1 (critically imperiled), S2 (imperiled) or S3 (vulnerable);
- Species listed as Special Concern under the ESA; and,
- Species identified as nationally endangered or threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), which are not protected under the ESA.

The *Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E* (MNRF, 2015) outline recommended criteria, based on science and expert knowledge, for identifying SWH within Ecoregion 6E, which encompasses the study area. The schedules include a description of the wildlife habitat, indicator wildlife species, and criteria used for

determining significance, and were used to assess for the presence/absence of candidate or confirmed SWH within the study area. The assessment included screening suitable habitat (candidate SWH) criteria and indicator wildlife species required to confirm presence against habitat conditions and wildlife species observed during field investigations.

3.3 Species at Risk

In order to provide a comprehensive understanding of all SAR and SOCC potentially occurring within the study area, secondary sources listed in **Section 3.1** were consulted to determine species that have been previously recorded in the vicinity of the study area. A habitat assessment was completed for each of these SAR or SOCC to determine whether there is suitable habitat for the species present within the study area. This assessment was based on the characterization of vegetation communities using aerial photograph interpretation and then further refined after ELC community delineation during field investigations. The objective of this exercise was to evaluate the probability of occurrence, whereby the following rankings were applied:

- Low Probability: no suitable habitat identified within the study area or no recent (i.e., within 20 years) occurrence record;
- Medium Probability: potentially suitable habitat identified within the study area; or,
- High Probability: highly suitable habitat identified within the study area or species identified during field investigations.

SOCC are not afforded protection under the ESA but have been included in the habitat assessment to avoid future implications should the status of these species change under the Act. Furthermore, habitat for SOCC is considered SWH under the PPS, as described in **Section 2.4**, and associated *Natural Heritage Reference Manual* (MNR, 2010).

4. Results

4.1 Aquatic

4.1.1 Background

The shoreline of Nottawasaga Bay supports a variety of warm and coldwater fish species, including significant smallmouth bass populations, localized habitats supporting northern pike and walleye, spawning/early rearing habitats for lake trout and lake whitefish, and seasonal nursery/adult feeding habitats for migratory rainbow trout and chinook salmon. (NVCA, 2009). **Table 1** provides fish species found along the Nottawasaga Bay shoreline.

Table 1: Fish Species Found Along the Nottawasaga Bay Shoreline (NVCA, 2009)

Common Name	Scientific Name
Smallmouth Bass	<i>Micropterus dolomieu</i>
Walleye ¹	<i>Sander vitreus</i>
Northern Pike ¹	<i>Esox lucius</i>
Yellow Perch	<i>Perca flavescens</i>
Rock bass	<i>Ambloplites rupestris</i>
Pumpkinseed	<i>Lepomis gibbosus</i>
Rainbow Trout	<i>Oncorhynchus mykiss</i>
Lake Trout	<i>Salvelinus namaycush</i>
Brown Trout	<i>Salmo trutta</i>
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>
White Sucker	<i>Catostomus commersonii</i>
Longnose Gar	<i>Lepisosteus osseus</i>
Lake Whitefish	<i>Coregonus clupeaformis</i>
Round Whitefish	<i>Prosopium cylindraceum</i>
Common Carp	<i>Cyprinus carpio</i>

Note: 1. Predominantly in Collingwood Harbour (NVCA, 2009)

4.1.2 Field Investigations

The study area within the Nottawasaga Bay waterfront is primarily developed parklands and gravel beach. The banks are primarily composed of placed boulder to protect the shoreline from erosion, with a of gravel beach on the west side of the 130 m buffer area. No aquatic vegetation was observed, with cover primarily provided by depth. Riparian vegetation was primarily manicured lawn with sparsely placed coniferous trees, providing no canopy coverage. No fish or significant fish habitat were observed.

Overall, the Nottawasaga Bay waterfront provides direct fish habitat for migration, refuge, feeding and rearing; however, conditions are non-limiting throughout with no specialized habitat (critically limiting spawning habitat) identified. A photographic log of habitat conditions is provided in **Appendix A**.

4.2 Terrestrial

The study area is located within the Lake Simcoe-Rideau Ecoregion (Ecoregion 6E). An Ecoregion is defined by a characteristic range and pattern of climatic variables including temperature, precipitation and humidity that

determine associated vegetation types, soil formation and other ecosystem processes and biota (MNR, 2007). This Ecoregion falls within The Great-Lakes St. Lawrence Forest Region (MNR, 2007). Uplands are dominated by sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), white ash (*Fraxinus americana*) and eastern hemlock (*Tsuga canadensis*) whereas lowlands contain green ash (*Fraxinus pennsylvanica*), silver maple (*Acer saccharinum*), red maple (*Acer rubrum*) and eastern white cedar (*Thuja occidentalis*) (Crins et al. 2009).

4.2.1 Designated Areas, Ecological Communities and Vegetation

The study area is largely developed, dominated by residential and industrial land uses with parkland along the northern Nottawasaga Bay shoreline. There are no designated natural heritage features or areas (e.g., significant wetlands, etc.) within the study area. No ecological communities were identified within the study area. Vegetation consisted of manicured lawn with predominately planted trees including blue spruce (*Picea pungens*), Norway spruce (*Picea abies*), Norway maple (*Acer platanoides*), freeman's maple (*Acer X freemanii*) and eastern white cedar. There were, however, narrow strips of unmaintained vegetation observed along the Nottawasaga Bay shoreline adjacent to the property boundary but were too small (<0.5 ha) as per *Ecological Land Classification for Southern Ontario: First Approximation and its Application* (Lee et al., 1998) to be mapped or considered an ecological community. Furthermore, a small (<0.5 ha) Cattail Mineral Shallow Marsh (MAS2-1) inclusion occurred within a drainage ditch along Ontario Street.

A list of plant species observed within the study area is provided in **Appendix B**. A total of 47 plant species were recorded; of which 20 (43%) were native and 27 (57%) were non-native. No SAR, SOCC or regionally rare plants were observed.

4.2.2 Wildlife and Wildlife Habitat

4.2.2.1 Birds

According to the OBBA (BSC et al., 2006), 116 bird species have been recorded within the 10 km by 10 km square (17NK62) that encompasses the study area. **Table 1**, provided in **Appendix C**, lists these bird species and their status under the ESA. Of the 116 bird species, six are listed as Threatened and five are listed as Special Concern under the ESA. In addition, there are records for two provincially rare species. As described in **Section 2.4**, confirmed habitat for Special Concern and provincially rare (S1, S2 and S3) species is considered SWH.

Species listed as Threatened with records in the vicinity of the study area included Bank Swallow (*Riparia riparia*), Barn Swallow (*Hirundo rustica*), Bobolink (*Dolichonyx oryzivorus*), Chimney Swift (*Chaetura pelagica*), Eastern Meadowlark (*Sturnella magna*) and Eastern Whip-poor-will (*Antrostomus vociferus*). Species listed as Special Concern with records in the vicinity of the study area included Common Nighthawk (*Chordeiles minor*), Eastern Wood-pewee (*Contopus virens*), Evening Grosbeak (*Coccothraustes vespertinus*), Red-headed Woodpecker (*Melanerpes erythrocephalus*) and Wood Thrush (*Hylocichla mustelina*). Black-crowned Night Heron (*Nycticorax nycticorax*) and Purple Martin (*Progne subis*) are considered provincially rare with S-ranks of S3B, S3N and S3S4B, respectively. These species are further discussed in **Section 4.2.3**.

Suitable breeding habitat for migratory birds is generally limited within the study area, represented by isolated trees and shrubs that are either planted or occur naturally within narrow strips of unmaintained vegetation observed along the Nottawasaga Bay shoreline adjacent to the property boundary and along Ontario Street. Birds incidentally observed during field investigations included the following species: Northern Cardinal (*Cardinalis cardinalis*), Blue Jay (*Cyanocitta cristata*), American Crow (*Corvus brachyrhynchos*) and Ring-billed Gull (*Larus delawarensis*).

4.2.2.2 Reptiles and Amphibians

Data available through the ORAA indicate a total of 14 species recorded between 1960 and 2018 within the 10 km by 10 km square (17NK62) that encompasses the study area. **Table 2**, provided in **Appendix C**, lists these reptile and amphibian species and their ESA statuses. Of these 14 reptile and amphibian species, Massasauga (Great Lakes / St. Lawrence population) (*Sistrurus catenatus* pop. 1), is listed as Threatened and therefore afforded protection under the ESA; however, occurrence record for this species is considered historical (greater than 20 years old). There are recent occurrence records for Snapping Turtle (*Chelydra serpentina*) and Western Chorus Frog (Great Lakes/St. Lawrence – Canadian Shield population) (*Pseudacris maculata* pop. 1), which are considered SOCC. SAR and SOCC are discussed further in **Section 4.2.3**.

Suitable breeding habitat for amphibians is generally limited within the study area to a narrow strip of unmaintained wetland vegetation that occurs within a ditch along Ontario Street. Beaches and a gravel pedestrian path and parking lot within the study area may provide turtle nesting habitat; however, these areas likely receive too much disturbance as a result of human noise and activity.

4.2.2.3 Mammals

The majority of mammals that have the potential to occur within the study area are likely common, tolerant to disturbance and have secure populations in Ontario with the exception of Little Brown Myotis (*Myotis lucifugus*), Eastern Small-footed Myotis (*Myotis Leibii*), Northern Myotis (*Myotis septentrionalis*), and Tri-coloured Bat (*Perimyotis subflavus*), which are listed as Endangered and protected under the ESA and further discussed in **Section 4.2.3**.

4.2.2.4 Butterflies

According to the OBA (Macnaughton *et al.*, 2019), 25 butterfly species have been recorded across the 10 km by 10 km square (17NK62) that encompasses the study area; these are summarized in **Table 3** in **Appendix C**. All of these species are common and have secure populations in Ontario with the exception of Monarch (*Danaus plexippus*), which is listed as Special Concern under the ESA and was observed on the property incidentally during field investigations on August 29, 2019; this species is further discussed in **Section 4.2.3**.

4.2.2.5 Significant Wildlife Habitat

The presence of candidate SWH within the study area is generally limited given the lack of ecological communities. However, the Nottawasaga Bay and shoreline, which included sandy areas as well as armour rock, within the study area represents the following candidate SWHs:

Seasonal Concentration Areas:

- Waterfowl Stopover and Staging Areas (Aquatic)
- Shorebird Migratory Stopover Area
- Turtle Wintering Areas
- Reptile Hibernaculum

Specialized Habitats for Wildlife:

- Turtle Nesting Areas

The study area also provides candidate or confirmed habitat for the following three SOCC:

Special Concern and Rare Wildlife Species

- Monarch;
- Snapping Turtle; and
- Western Chorus Frog.

The potential presence of SOCC within the study area, based on occurrence records within the general Project area identified through the background review, is further discussed in **Section 4.2.3** below.

With the exception of Monarch habitat for which Monarchs were observed foraging within the study area, the presence of SWH could not be confirmed as species-specific surveys were not completed; as such, a precautionary approach will be taken with respect to these candidate habitats for the purpose of the impact analysis.

4.3 Species at Risk and Species of Conservation Concern

A total of 22 SAR and SOCC have been recorded within or in the vicinity of the study area based on a review of background information; these species are listed in **Table 2** below.

Table 2: SAR and SOCC Records for the Vicinity of the Study Area

Taxa	Common Name	Scientific Name	S-Rank	ESA Status	Source	Last Observation Date
Fish	Lake Sturgeon (Great Lakes - Upper St. Lawrence River population)	<i>Acipenser fulvescens</i> pop. 3	S2	THR	NHIC	01/09/2010
Bird	Bank Swallow	<i>Riparia riparia</i>	S4B	THR	OBBA	2001-2005
	Barn Swallow	<i>Hirundo rustica</i>	S4B	THR	OBBA	2001-2005
	Bobolink	<i>Dolichonyx oryzivorus</i>	S4B	THR	OBBA	2001-2005
	Chimney Swift	<i>Chaetura pelagica</i>	S4B,S4N	THR	OBBA	2001-2005
	Eastern Meadowlark	<i>Sturnella magna</i>	S4B	THR	OBBA	2001-2005
	Whip-poor-will	<i>Antrostomus vociferus</i>	S4B	THR	OBBA	2001-2005
	Common Nighthawk	<i>Chordeiles minor</i>	S4B	SC	OBBA	2001-2005
	Eastern Wood-Pewee	<i>Contopus virens</i>	S4B	SC	OBBA	2001-2005
	Evening Grosbeak	<i>Coccothraustes vespertinus</i>	S4B	SC	OBBA	2001-2005
	Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	S4B	SC	OBBA	2001-2005
	Wood Thrush	<i>Hylocichla mustelina</i>	S4B	SC	OBBA	2001-2005
	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	S3B,S3N	-	OBBA	2001-2005
	Purple Martin	<i>Progne subis</i>	S3S4B	-	OBBA	2001-2005
Reptile	Massasauga (Great Lakes / St. Lawrence population)	<i>Sistrurus catenatus</i> pop. 1	S3	THR	ORAA	19-Jul-94
	Snapping Turtle	<i>Chelydra serpentina</i>	S4	SC	ORAA	30-Jun-18
Amphibian	Western Chorus Frog (Great Lakes - St. Lawrence - Canadian Shield population)	<i>Pseudacris maculata</i> pop. 1	S3	-	ORAA	15-Apr-12
Insects	Monarch	<i>Danaus plexippus</i>	S2N,S4B	SC	OBA	2018
Mammals	Little Brown Myotis	<i>Myotis lucifugus</i>	S3	END	BCI	N/A
	Eastern Small-footed Myotis	<i>Myotis leibii</i>	S2S3	END	BCI	N/A
	Northern Myotis	<i>Myotis septentrionalis</i>	S3	END	BCI	N/A
	Tri-colored Bat	<i>Perimyotis subflavus</i>	S3?	END	BCI	N/A

Appendix D provides this habitat assessment for each 22 SAR or SOCC including their habitat preferences and assessment of potential occurrence in the study area, based on the results of the field investigations. Through this

assessment, two SAR and three SOCC were determined to have moderate to high potential to occur within the study area based on the presence of suitable habitat as described below.

Lake Sturgeon (Great Lakes - Upper St. Lawrence River population) was identified with a moderate probability of occurrence and is listed as Endangered under the ESA. This species inhabits freshwater lakes and rivers with soft bottoms of mud, sand or gravel, preferring depths of 5-20 m (MECP, 2019a). The Nottawasaga River, which outlets into Nottawasaga Bay, provides known spawning habitat; therefore, this species could occur in Nottawasaga Bay at the outer limits of the study area.

Barn Swallow is listed as Threatened under the ESA. Barn Swallows occur in close association with humans, building their cup-shaped mud nests almost exclusively on structures such as open barns, under bridges and in culverts (MECP, 2019b). Barn Swallows forage in open habitats with an abundance of insects, including fields, wetlands and over water (Heagy *et al.*, 2014). Although neither this species nor nests were observed during field investigations, it was identified with a moderate probability of occurrence due to the suitable nesting and foraging habitat are present within the property boundaries.

Monarch was identified with a high probability of occurrence and is listed as Special Concern under the ESA. Monarch caterpillars are confined to meadows and open areas where milkweed, their primarily food source, grows (MECP, 2019c). During the late summer and fall, Monarchs begin migrating from Ontario to central Mexico and can be found passing through many habitats. Although no meadows or fields are present within the study area, common milkweed (*Asclepias syriaca*) plants are present within the property and the species was observed incidentally during field investigations on August 29, 2019.

Snapping Turtle was identified with a moderate probability of occurrence and is listed as Special Concern under the ESA. Snapping Turtles prefer shallow, slow moving freshwater aquatic or semi-aquatic habitats with soft muddy bottoms and leaf litter or debris (COSEWIC, 2008; MECP, 2019d). Females usually nest in sandy or gravelly areas along streams (MECP, 2019d); however, nest sites may be some distance from water and include gravel road shoulders, freshly dug soil, etc. (COSEWIC, 2008). Snapping Turtles hibernate by burying themselves under debris or mud of streams, lakeshore or wetlands (COSEWIC, 2008). This species was not observed during field investigations; however, species-specific surveys were not completed. The Nottawasaga Bay with adjacent sandy and gravelly areas within the study area may provide suitable habitat.

The Great Lakes / St. Lawrence – Canadian Shield population of **Western Chorus Frog** was identified with a moderate probability of occurrence and is provincially ranked by the NHIC as Vulnerable (S3). This species inhabits almost any fishless pond including temporary ponds with at least 10 cm of quiet water. Habitats include woodland ponds, swamps, marshes, floodplains, rain-flooded meadows and ditches (Ontario Nature, 2019b). This species was not observed during field investigations; however, amphibian call surveys were not completed. Suitable habitat within the study area is represented by a Cattail Mineral Shallow Marsh inclusion that occurs within a drainage ditch along Ontario Street, beyond the property boundaries.

5. Impact Assessment and Mitigation Measures

The site plan is provided in **Figure 2**. Expansion of the Raymond A. Barker Ultrafiltration WTP involves increasing capacity by adding more membrane treatment capacity, adding a new low lift pumping station, UV building and other process upgrades.

A general discussion of the potential impacts and recommended avoidance or mitigation measures is provided below.

5.1 Aquatic Habitat

5.1.1 *Potential Effects*

Construction

Nottawasaga Bay in Georgian Bay provides habitat for fishes; however, at the time of this report, no in-water works are proposed and therefore is not anticipated that fish habitat will be directly affected by the construction of the Project. The use of machinery; however, in or around the Nottawasaga Bay shoreline poses risk of fuel contamination and spills from equipment use. Further, removal of vegetation and earth moving activities may result in increased exposed soils and increased soil erosion and sedimentation to the waters of Georgian Bay. Sedimentation and soil erosion, as well as runoff of contaminated water resulting from fuel contamination and spills may cause indirect effects on fish and fish habitat, such as limiting the aquatic species' ability to carry out their life processes and decreasing fish habitat quality. Nonetheless, the potential indirect effects on fish and fish habitat as a result of construction of the Project are considered low, provided that the avoidance and mitigation measures described in **Section 5.1.2** are effectively implemented.

Operations

It is anticipated that there may be increased water and sediment runoff from the expanded paved areas into the adjacent waters of Georgian Bay, as result of increased impervious surfaces, use of road salt and/or fuel spill from operating equipment or machines which may indirectly affect the quality of fish habitat immediately adjacent to the shoreline. However, the potential effects on fish and fish habitat as result of operation are considered to be low, provided that the avoidance and mitigation measures described in **Section 5.1.2** are effectively implemented.

5.1.2 *Mitigation Measures*

The following mitigation measures are recommended:

Erosion and Sediment Control

- Although no in-water works are proposed, as a best management practice, consideration can be given (wherever possible) to scheduling works near water to respect the timing windows to protect fish, including their eggs, juveniles, spawning adults and/or organisms upon which they feed.

- All work will be scheduled in order to avoid wet, windy and rainy periods that may increase erosion and sedimentation.
- Proposed works will not occur in water and remain above the High Water Mark of Nottawasaga Bay.
- An Erosion and Sediment Control Plan for the work site will be implemented prior to the start of construction and will minimize the risk of sedimentation to the waterbody during all phases of construction.
- Erosion and sediment control measures will be maintained until all disturbed ground has been permanently stabilized, any suspended sediment has resettled to the bed of the waterbody and/or settling basin and runoff water is clear. The plan will, where applicable, include:
 - Installation of effective erosion and sediment control measures before starting work to prevent sediment from entering the waterbody.
 - Measures for managing water flowing onto the site, as well as water being pumped/diverted from the site such that sediment is filtered out prior to the water entering a waterbody.
 - Measures will be undertaken to contain and stabilize any waste material (e.g., dredging soils, construction waste and materials, commercial logging waste, uprooted or cut aquatic plants, accumulated debris) above the High Water Mark (HWM) to prevent re-entry.
 - Inspection and maintenance of erosion and sediment control measures and structures will happen regularly during the course of construction, especially during a major storm event.
 - Repairs to erosion and sediment control measures and structures will take place if damage occurs.
 - Non-biodegradable erosion and sediment control materials will be removed once site is stabilized.
 - Detailed design should incorporate site management practices (e.g., Site grading, curb controls, catch basins) to manage impervious surface runoff and impacts from road de-icing during the operation of the new facility to negate the effects of increased runoff to the receiving waters of Nottawasaga Bay

Operation of Machinery

- Activities near water will be planned to ensure that such materials such as paint, primers, blasting abrasives, rust, solvents, degreasers, grout or other chemicals do not enter Nottawasaga Bay.
- A response plan for spills will be developed before work commences. This plan will be implemented immediately in the event of a sediment release or spill of a deleterious substance and keep and emergency spill kit on site.
- Building material used near watercourse will be handled and treated in a manner to prevent the release or leaching of substances into the water that may be deleterious to fish.
- All construction materials will be removed from site upon project completion.

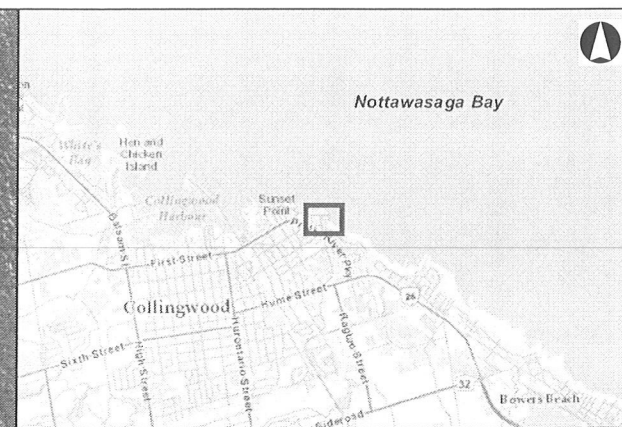
Use of Industrial Equipment

- Confirm that machinery arrives on site in a clean condition and is maintained free of fluid leaks, invasive species and noxious weeds.
- Wash, refuel and service machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water.
- Refuelling shall happen at least 30 m away from Nottawasaga Bay on a refuelling pad to prevent spills from entering the watercourse. Confirm that equipment arrives on site clean and in good working order.

- Stockpiled materials or equipment will be stored within the construction footprint but shall be kept at least 30 m away from Nottawasaga Bay.
- Remove all construction materials from site upon project completion.

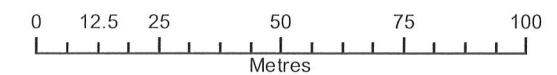
Shoreline Re-vegetation and Stabilization

- Clearing of riparian vegetation should be kept to a minimum; use existing trails, roads or pathways wherever possible to avoid disturbance to the riparian vegetation and prevent soil compaction. When practicable, prune or top the vegetation instead of grubbing/uprooting, if required; and,
- The shoreline and/or banks disturbed by any activity associated with the project should be immediately stabilized to prevent erosion and/or sedimentation, preferably through re-vegetation with native species suitable for the site. Salt-tolerant, native species should be considered.



Legend

- Property Boundary (County of Simcoe Parcel Data, 2019)
- 120m Review Buffer



Raymond A. Barker WTP Site

Site Plan and Property Boundary

Sep 16, 2019	1:1,500	Datum: NAD 1983 UTM Zone 17N Source: MNRF Image: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, * when printed 11"x17"
P#: 60609900	V#: 1	



Figure 2

This drawing has been prepared for the use of AECOM's client and may not be used, reproduced or relied upon by third parties, except as agreed by AECOM and its client, as required by law or for use by governmental reviewing agencies. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that modifies this drawing without AECOM's express written consent.

Data Location: C:\Users\Stephane.Chouinard\Desktop\GIS\Projects\RaymondA.BarkerWTP\GIS\StudyArea_Location.mxd
Date Saved: 9/16/2019 12:18:48 PM User Name: Stephanie.Chouinard

5.2 Vegetation

5.2.1 Potential Effects

No designated areas or ecological communities exist within the study area; therefore, no negative impacts to these features are anticipated. The study area is situated within an urbanized landscape with vegetation limited to mostly manicured lawn with planted trees or narrow strips of unmaintained vegetation observed along the Nottawasaga Bay shoreline and Ontario Street. Potential effects to vegetation include:

- Removal of and/or damage to trees.

Vegetation clearing, excavation and grading that may be required to accommodate infrastructure may negatively affect vegetation (including tree branches, trunks and roots) directly by resulting in the loss of natural cover. Damage to vegetation may occur through soil removal and / or disturbance and compaction; increased erosion and sedimentation; and accidental soil or water contamination by oils, gasoline, grease and other materials from construction equipment and materials storage and handling.

During the operations phase of the Project, it is anticipated that there will be no significant potential effects on vegetation cover beyond the initial removal at the construction phase.

5.2.2 Mitigation Measures

The following mitigation measures are recommended:

- Minimize vegetation removal to the extent possible and limit to within the construction footprint;
- Clearly delineate the construction footprint to avoid accidental damage to retained vegetation. Delineation will be in the form of construction fencing and/or silt fence barriers with the latter implemented if erosion and sediment control is also required;
- Prune any tree limbs or roots that are accidentally damaged by construction activities using proper arboricultural techniques within 48 hours of damage;
- Additional mitigation measures specific to trees, including Town of Collingwood By-law permitting requirements, may be required;
- Revegetate cleared areas as soon as reasonably possible using native plant species;
- Store stockpile materials or equipment within the construction footprint; and
- Ensure machinery is maintained free of fluid leaks.

5.3 Wildlife and Wildlife Habitat

5.3.1 Potential Effects

Potential effects to wildlife during construction include:

- Loss and/or degradation of wildlife habitat; and
- Morality, harm and/or disturbance/displacement of wildlife.

In general, the study area provides low quality habitats to common wildlife species that are tolerant to disturbances given the urbanized landscape. Nevertheless, trees or unmaintained strips of riparian vegetation observed within

the study area may support breeding birds including species protected under the MBCA. Construction activities such as vegetation removal and trimming may harm wildlife or result in mortality including damage of nests. Noise and increased human activity associated with construction activities have the potential to negatively impact wildlife behaviour through disturbance/displacement. Displacement of breeding migratory birds and/or destruction of their active nests may occur if vegetation removal for the construction of the Project occurs during the overall nesting period (April 1 to August 31). This overall nesting period covers most federally protected migratory bird species that may occur in the study area but varies with species and habitat type (ECCC, 2018). The potential effects on breeding birds are considered low provided that the avoidance and mitigation measures described below are implemented.

Exposed sand or gravel areas and armour rock along the Nottawasaga Bay shoreline represents candidate significant Shorebird Migratory Stopover Area, Reptile Hibernaculum and Turtle Nesting Areas. Furthermore, Monarch and common milkweed were observed within the study area and there is potential for the occurrence of the following additional SOCC: Snapping Turtle and Western Chorus Frog. SWH may be negatively affected by the following construction activities: vegetation clearing and site grading, excavation, construction of temporary stockpile areas, and transportation of equipment and materials. These construction activities may result in the direct loss or degrade wildlife habitat through soil removal/disturbance and compaction, increased erosion and sedimentation, and accidental soil or water contamination by oils, gasoline, grease and other materials from construction equipment and materials storage or handling. Given the potential presence of slow-moving turtles such as Snapping Turtle, there may an increased risk of wildlife mortality on-site from collisions with vehicles or heavy equipment.

The Nottawasaga Bay represents candidate significant Waterfowl Stopover and Staging Areas (Aquatic) and Turtle Wintering Areas; given that no in-water works are proposed, no direct impacts are anticipated. Potential indirect effects on these candidate SWH that may result from Project construction, as described above, are considered low, provided that the avoidance and mitigation measures described in **Section 5.3.2** are effectively implemented.

Wildlife and wildlife habitat are not anticipated to be significantly affected by the operation phase of the Project, as species occurring within the study area are tolerant to disturbances associated with urban settings.

5.3.2 Mitigation Measures

The following mitigation measures are recommended:

- Avoid clearing of riparian vegetation;
- Minimize vegetation removal to the extent possible and limit to within the construction footprint;
- Revegetate cleared areas as soon as reasonably possible using native plant species, including herbaceous flowering species;
- Store stockpile materials or equipment within the construction footprint and >30 m from a wetland or waterbody;
- Ensure machinery is maintained free of fluid leaks;
- Vehicle/construction equipment maintenance, washing and refuelling to be done in a specified area at least 30 m away from all wetlands and/or waterbodies or as designated by the local regulatory authority;
- Conduct vegetation clearing and trimming outside of the overall bird nesting period (April 1st to August 31st) to avoid incidental take and limit disturbance to migratory birds or their nests. If vegetation removal or trimming must occur during the overall bird nesting period (April 1st to August 31st), nest and nesting activity searches may be conducted by a qualified biologist, no more than 24

hours in advance and within 'simple' habitats or if minor vegetation clearing is required, to ensure that no active nests of breeding birds are destroyed and thereby prevent contravention of the MBCA;

- If an active nest or confirmed nesting activity of a protected bird is observed, the area will be protected and no construction activities will occur until the young have fledged or until the nest is no longer active, as confirmed by a qualified biologist. The radius of the buffer will depend on species, level of disturbance and landscape context (ECCC, 2018), which will be confirmed by a qualified biologist, but will protect a minimum of 10 m around the nest or nesting activity.
- Note that simple habitats refer to habitats that contain few nesting spots or few species of migratory birds, where identification of active nests or confirmed nesting activity can be completed with confidence. Generally, the entire study area may be considered as simple habitat.
- In the event that a Snapping Turtle is encountered within the limits of construction, construction staff will temporarily stop work in the immediate area to allow it to leave the area on its own. If the Snapping Turtle is not moving on its own accord and is not nesting, it can be relocated safely outside of the construction limits to a suitable habitat nearby by an individual qualified in safe handling of wildlife. If the Snapping Turtle is noted to be nesting within the construction limits (this would typically occur in June during the turtle nesting season) or a suspected nest is found, a qualified Biologist should be notified immediately for further direction.
- Workers must never threaten, harass or injure wildlife.

5.4 Species at Risk

No in-water work is proposed; therefore, no direct impacts to Lake Sturgeon or their habitat are anticipated. Potential indirect effects on Lake Sturgeon or their habitat that may result from Project construction or operation, as described in **Section 5.1.1**, are considered low, provided that the avoidance and mitigation measures described in **Section 5.1.2** are effectively implemented.

No Barn Swallows or their nests were identified during field investigations; however, the existing building on the property provide suitable nesting habitat. Protected habitat of Barn Swallow is centred on nests as described in accordance with the General Habitat Description (MNRF, 2013). Although no negative impacts to this species or habitat are anticipated at this time, buildings should be examined prior to construction activities, if conducted during the overall bird nesting period (April 1st to August 31st), to confirm species presence or absence.

6. Summary

- ✦ There are no designated natural heritage features or areas (e.g., significant wetlands, etc.) or ecological communities within the study area.
- ✦ Vegetation consisted of manicured lawn with predominately planted trees and/or non-native and invasive plants.
- ✦ Trees or unmaintained strips of riparian vegetation observed within the study area may support breeding birds including species protected under the MBCA; therefore, clearing should occur outside of the overall bird nesting period (April 1st to August 31st).
- ✦ Proposed works should avoid the Nottawasaga Bay and shoreline as it represents the following candidate SWH: Waterfowl Stopover and Staging Areas (Aquatic), Shorebird Migratory Stopover Area, Turtle Wintering Areas, Reptile Hibernaculum and Turtle Nesting Areas. Additional field investigations may be required to confirm presence or absence at detail design.
- ✦ Monarch and common milkweed were confirmed present within the property boundaries. There is also potential for occurrence of the following additional SOCC within the study area: Snapping Turtle and Western Chorus Frog. Potential impacts to these species or their habitat are considered low provided implementation of avoidance and mitigation measures identified above.
- ✦ Potential habitat for Barn Swallow and Lake Sturgeon were identified within the study area; however, potential negative impacts to these species or their habitat is considered low provided implementation of avoidance and mitigation measures identified above.

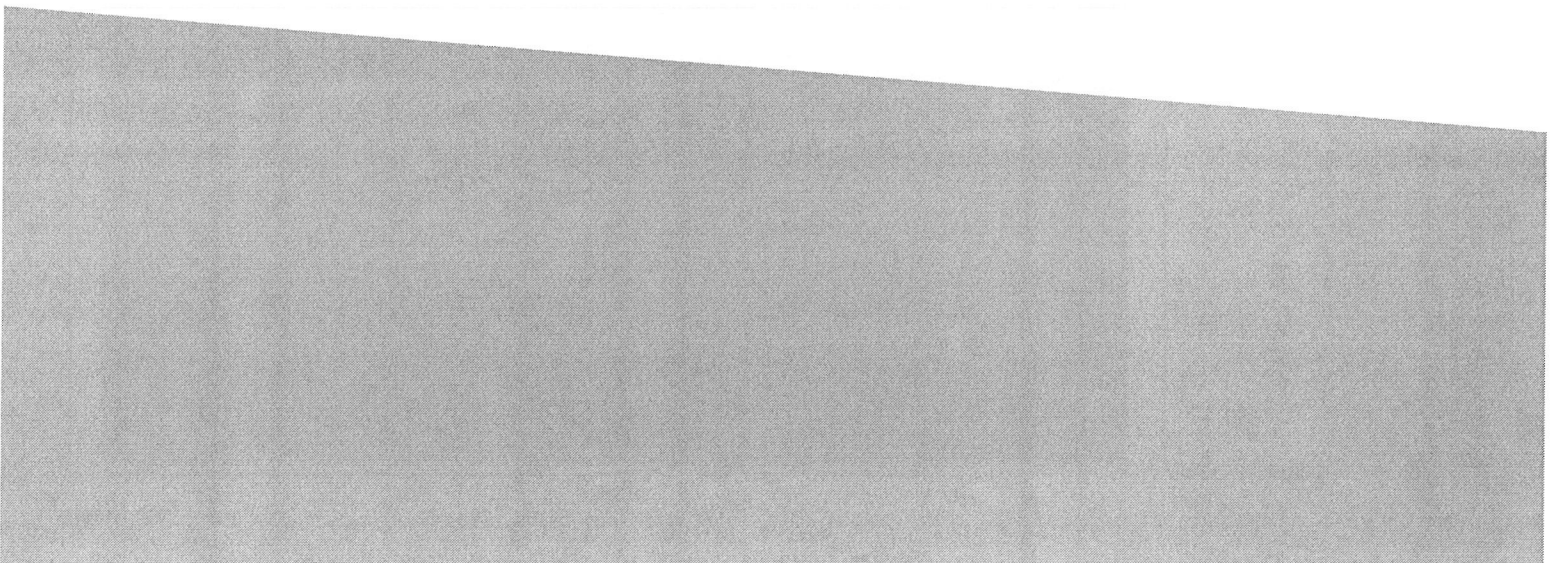
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Appendix **A**

Aquatic Photographic Log



Client Name: Town of Collingwood	Site Location Raymond A. Barker Ultrafiltration Water Treatment Plant	Project No. 60609900
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Photo No. 1	Date 8/29/2019
Direction Photo Taken East	
Description Nottawasaga Bay shoreline and riparian vegetation.	

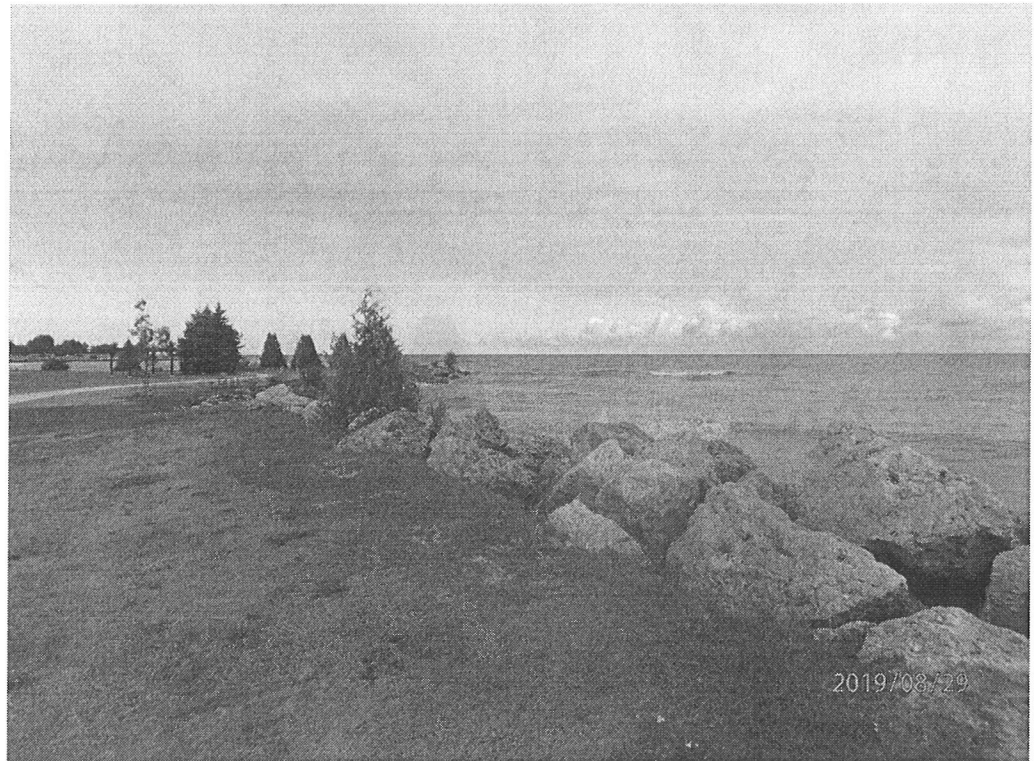
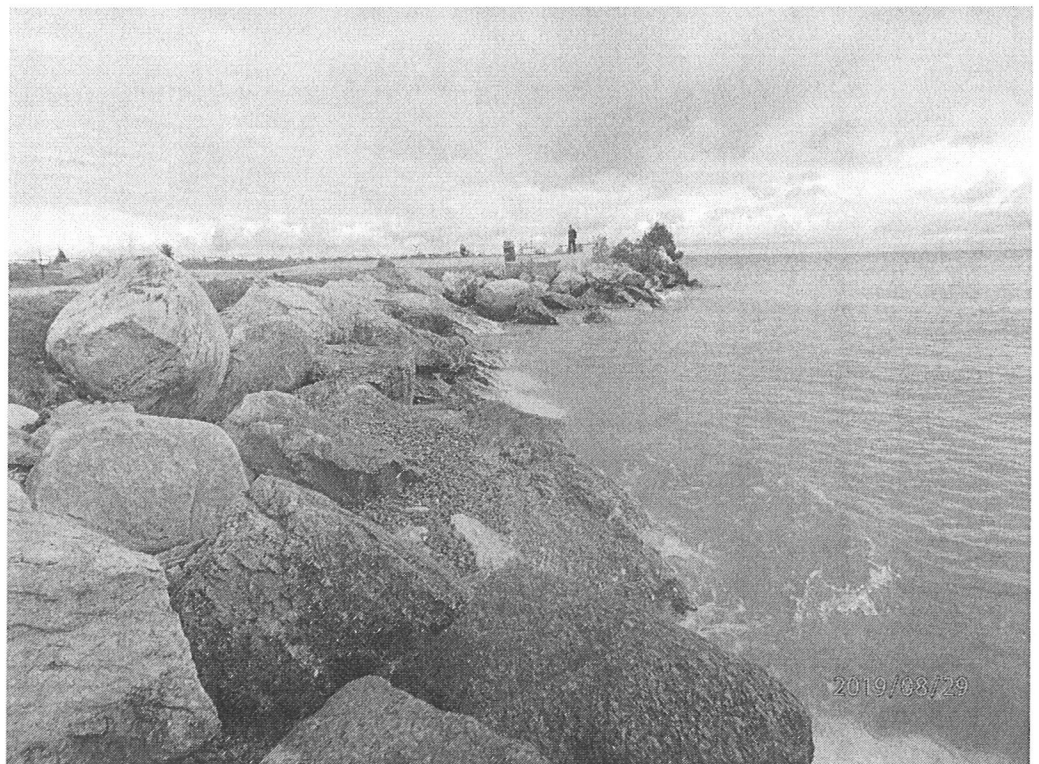


Photo No. 2	Date 8/29/2019
Direction Photo Taken North	
Description Placed boulder at shoreline; adjacent pedestrian pathway.	



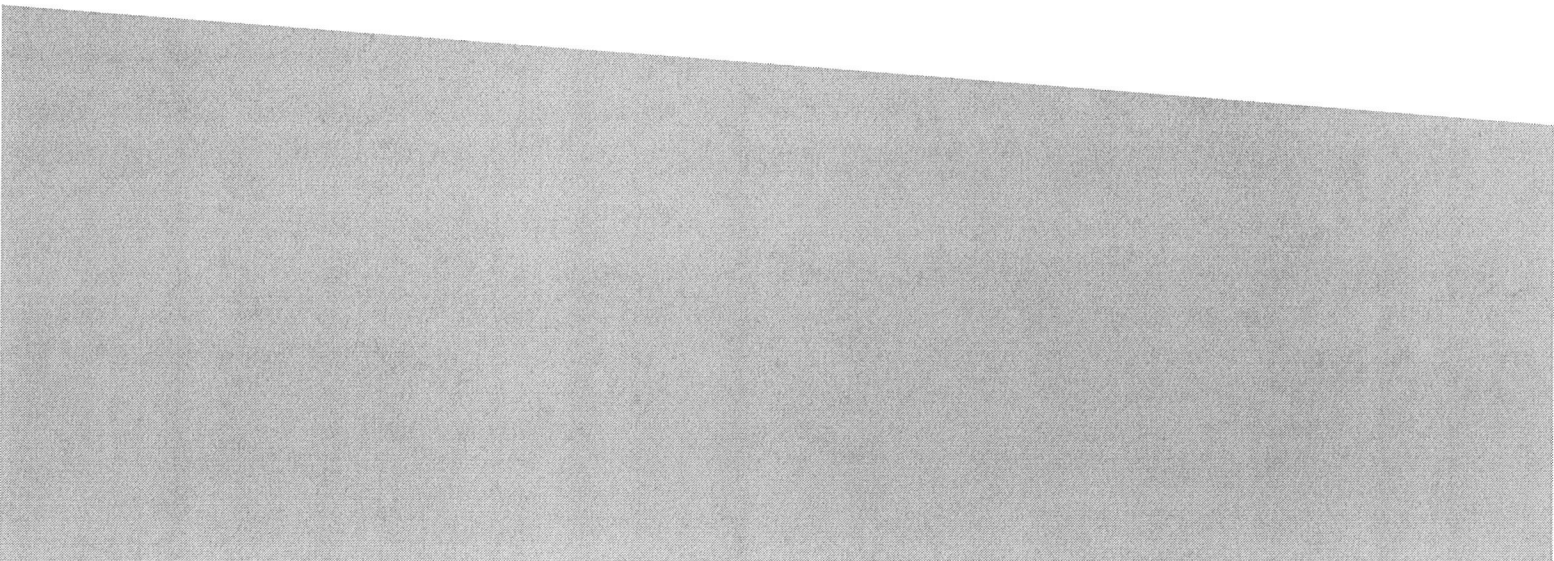
Client Name: Town of Collingwood	Site Location Raymond A. Barker Ultrafiltration Water Treatment Plant	Project No. 60609900
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Photo No. 3	Date 8/29/2019
Direction Photo Taken North	
Description Nottawasaga Bay from south-east corner of Study Area.	



Appendix **B**

Plant Species List



Appendix B. Plant List

BOTANICAL NAME		COMMON NAME	COEFFICIENT OF CONSERVATISM	WETNESS INDEX	WEEDINESS INDEX	PROVINCIAL STATUS	OMNR STATUS	COSEWIC STATUS (2016-08-19)	SARA STATUS (2016-08-19)	GLOBAL STATUS	LOCAL STATUS SIMCOE	STUDY AREA
GYMNOSPERMS		CONIFERS										
Cupressaceae		Cedar Family										
<i>Juniperus</i>	<i>virginiana</i>	Eastern Red Cedar	4	3		S5				G5	X	p
<i>Thuja</i>	<i>occidentalis</i>	Eastern White Cedar	4	-3		S5				G5	X	x,p
Pinaceae		Pine Family										
<i>Picea</i>	<i>abies</i>	Norway Spruce		5	-1	SNA				G5		p
<i>Picea</i>	<i>glauca</i>	White Spruce	6	3		S5				G5	X	p
<i>Picea</i>	<i>pungens</i>	Blue Spruce		3		SNA				G5		p
<i>Pinus</i>	<i>strobus</i>	Eastern White Pine	4	3		S5				G5	X	p
DICOTYLEDONS		DICOTS										
Aceraceae		Maple Family										
<i>Acer</i>	<i>negundo</i>	Manitoba Maple	0	-2		S5				G5		x
<i>Acer</i>	<i>platanoides</i>	Norway Maple		5	-3	SNA				GNR		p
<i>Acer X</i>	<i>freemanii</i>	Freeman's Maple	6	-5		SNA				GNR		p
Apiaceae		Carrot or Parsley Family										
<i>Daucus</i>	<i>carota</i>	Wild Carrot		5	-2	SNA				GNR		x
Asclepiadaceae		Milkweed Family										
<i>Asclepias</i>	<i>syriaca</i>	Common Milkweed	0	5		S5				G5		x
Asteraceae		Composite or Aster Family										
<i>Achillea</i>	<i>millefolium</i>	Common Yarrow		3	-1	SNA				G5		x
<i>Ambrosia</i>	<i>artemisiifolia</i>	Common Ragweed	0	3		S5				G5		x
<i>Arctium</i>	<i>minus</i>	Common Burdock		5	-2	SNA				GNR		x
<i>Centaurea</i>	<i>jacea</i>	Brown Knapweed		5	-1	SNA				GNR		x
<i>Cichorium</i>	<i>intybus</i>	Chicory		5	-1	SNA				GNR		x
<i>Solidago</i>	<i>altissima</i>	Tall Goldenrod	1	3		S5				GNR		x
<i>Solidago</i>	<i>canadensis</i>	Canada Goldenrod	1	3		S5				G5		x
<i>Taraxacum</i>	<i>officinale</i>	Common Dandelion				SNA				G5		
<i>Tragopogon</i>	<i>pratensis ssp. pratensis</i>	Yellow Goat's-beard		5	-1	SNA				GNR		x
Betulaceae		Birch Family										
<i>Betula</i>	<i>papyrifera</i>	Paper Birch	3	2		S5				G5		x,p
Boraginaceae		Borage Family										
<i>Echium</i>	<i>vulgare</i>	Viper's Bugloss		5	-2	SNA				GNR		x
Caprifoliaceae		Honeysuckle Family										
<i>Lonicera</i>	<i>tatarica</i>	Tartarian Honeysuckle		3	-3	SNA				GNR		x
Cornaceae		Dogwood Family										
<i>Cornus</i>	<i>sericea</i>	Red-osier Dogwood	2	-3		S5				G5		x
Fabaceae		Pea Family										
<i>Lotus</i>	<i>corniculatus</i>	Bird's-foot Trefoil		1	-2	SNA				GNR		x
<i>Melilotus</i>	<i>alba</i>	White Sweet-clover		3	-3	SNA				G5		x
<i>Trifolium</i>	<i>repens</i>	White Clover		2	-1	SNA				GNR		x
<i>Vicia</i>	<i>cracca</i>	Bird Vetch		5	-1	SNA				GNR		x
Fagaceae		Beech Family										
<i>Quercus</i>	<i>rubra</i>	Red Oak	6	3		S5				G5	X	p
Guttiferae		St. John's-wort Family										
<i>Hypericum</i>	<i>perforatum</i>	Common St. John's-wort		5	-3	SNA				GNR		x
Lythraceae		Loosestrife Family										
<i>Lythrum</i>	<i>salicaria</i>	Purple Loosestrife		-5	-3	SNA				G5		x

Appendix B. Plant List

BOTANICAL NAME		COMMON NAME	COEFFICIENT OF CONSERVATISM	WETNESS INDEX	WEEDINESS INDEX	PROVINCIAL STATUS	OMNR STATUS	COSEWIC STATUS (2016-08-19)	SARA STATUS (2016-08-19)	GLOBAL STATUS	LOCAL STATUS SIMCOE	STUDY AREA
Oleaceae		Olive Family										
<i>Fraxinus</i>	<i>pennsylvanica</i>	Green Ash	3	-3		S4				G5		x
<i>Syringa</i>	<i>vulgaris</i>	Common Lilac		5	-2	SNA				GNR		x
Onagraceae		Evening-primrose Family										
<i>Oenothera</i>	<i>biennis</i>	Common Evening-primrose	0	3		S5				G5		x
Plantaginaceae		Plantain Family										
<i>Plantago</i>	<i>major</i>	Common Plantain		-1	-1	S5				G5		x
Polygonaceae		Smartweed Family										
<i>Rumex</i>	<i>crispus</i>	Curly-leaf Dock		-1	-2	SNA				GNR	X	x
Rhamnaceae		Buckthorn Family										
<i>Rhamnus</i>	<i>cathartica</i>	Common Buckthorn		3	-3	SNA				GNR		
Rosaceae		Rose Family										
<i>Sorbus</i>	<i>aucuparia</i>	European Mountain-ash		5	-2	SNA				G5		p
Salicaceae		Willow Family										
<i>Populus</i>	<i>alba</i>	White Poplar		5	-3	SNA				G5	X	x
<i>Salix</i>	<i>discolor</i>	Pussy Willow	3	-3		S5				G5	X	x
<i>Salix X</i>	<i>rubens</i>	Reddish Willow		-4	-3	SE4				HYB	X	x
<i>Salix X</i>	<i>sepulcralis</i>	Hybrid Willow				SNA				GNA		p
Scrophulariaceae		Figwort Family										
<i>Linaria</i>	<i>vulgaris</i>	Butter-and-eggs		5	-1	SNA				GNR		x
<i>Verbascum</i>	<i>thapsus</i>	Common Mullein		5	-2	SNA				GNR		x
Simaroubaceae		Ailanthus Family										
<i>Ailanthus</i>	<i>altissima</i>	Tree-of-heaven		5	-1	SNA				GNR		x
Ulmaceae		Elm Family										
<i>Ulmus</i>	<i>pumila</i>	Siberian Elm		5	-1	SNA				GNR	X	x
Vitaceae		Grape Family										
<i>Vitis</i>	<i>riparia</i>	Riverbank Grape	0	-2		S5				G5		x
Poaceae		Grass Family										
<i>Phalaris</i>	<i>arundinacea</i>	Reed Canary Grass	0	-4		S5				G5	X	x
<i>Poa</i>	<i>pratensis ssp. pratensis</i>	Kentucky Blue Grass	0	1		S5				G5T	X	x
Typhaceae		Cattail Family										
<i>Typha</i>	<i>latifolia</i>	Broad-leaved Cattail	3	-5		S5				G5	X	x
FLORISTIC SUMMARY & ASSESSMENT												
Species Diversity												
Total Species:		47										
Native Species:		20	43%									
Exotic Species		27	57%									
Regionally Significant Species		0										
S1-S3 Species		0										
S4 Species		1										
S5 Species		19										
Co-efficient of Conservatism and Floral Quality Index												
Co-efficient of Conservatism (CC) (average)		2.30										
CC 0 to 3	lowest sensitivity	14	70%									

Appendix B. Plant List

BOTANICAL NAME		COMMON NAME	COEFFICIENT OF CONSERVATISM	WETNESS INDEX	WEEDINESS INDEX	PROVINCIAL STATUS	OMNR STATUS	COSEWIC STATUS (2016-08-19)	SARA STATUS (2016-08-19)	GLOBAL STATUS	LOCAL STATUS SIMCOE	STUDY AREA
CC 4 to 6	<i>moderate sensitivity</i>	6	30%									
CC 7 to 8	<i>high sensitivity</i>	0	0%									
CC 9 to 10	<i>highest sensitivity</i>	0	0%									
Floral Quality Index (FQI)		10.29										
Presence of Weedy & Invasive Species												
<i>mean weediness</i>		-1.89										
<i>weediness = -1</i>	<i>low potential invasiveness</i>	11	41%									
<i>weediness = -2</i>	<i>moderate potential invasiveness</i>	8	30%									
<i>weediness = -3</i>	<i>high potential invasiveness</i>	8	30%									
Presence of Wetland Species												
<i>average wetness value</i>		1.96										
<i>upland</i>		18	38%									
<i>facultative upland</i>		15	32%									
<i>facultative</i>		4	9%									
<i>facultative wetland</i>		8	17%									
<i>obligate wetland</i>		3	6%									

Appendix **C**

Wildlife Species List

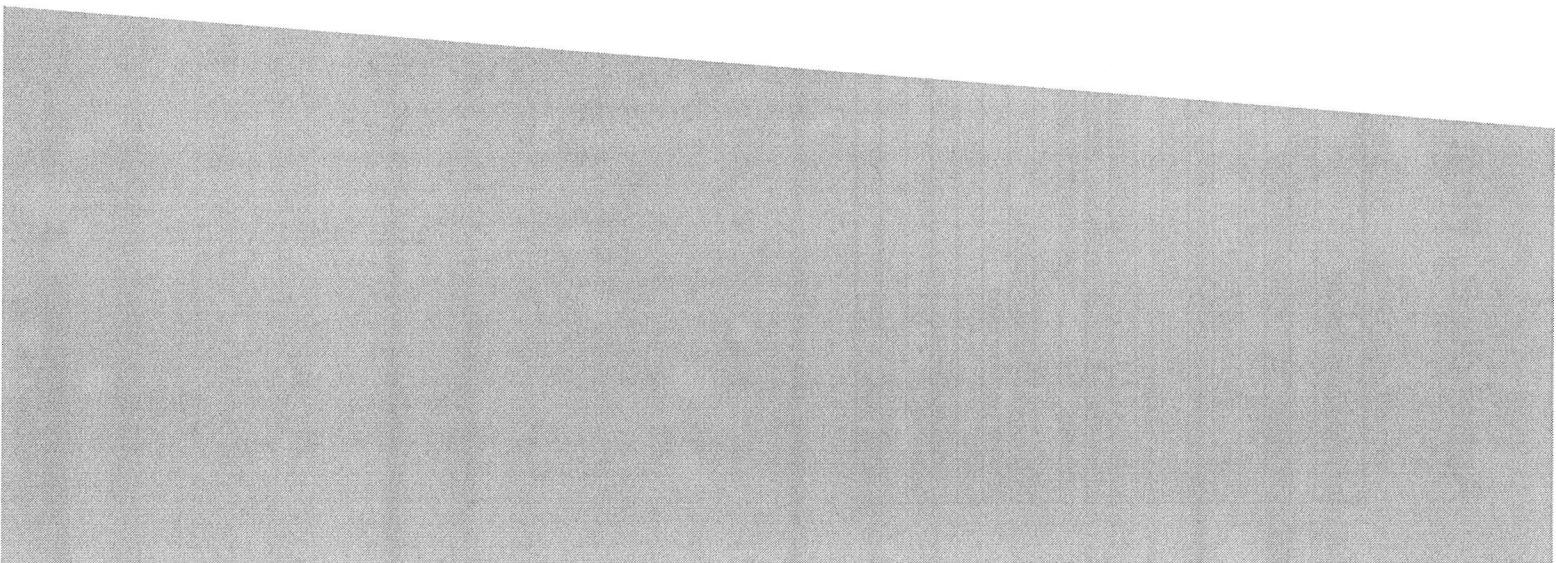


Table 1: Ontario Breeding Bird Atlas (OBBA) Records for the Vicinity of the Study Area (BSC et al., 2006)

Common Name	Scientific Name	S-Rank	COSEWIC Status	ESA Status	Area-sensitive Species	OBBA Breeding Evidence
Loons (GAVIIDAE)						
Common Loon	<i>Gavia immer</i>	S5B,S5N	-	-	A	H
Grebes (PODICIPEDIDAE)						
Pied-billed Grebe	<i>Podilymbus podiceps</i>	S4B,S4N	-	-	-	P
Bitterns, Herons & Allies (ARDEIDAE)						
Great Blue Heron	<i>Ardea herodias</i>	S4	-	-	-	NY
Green Heron	<i>Butorides virescens</i>	S4B	-	-	-	A
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>	S3B,S3N	-	-	-	H
Ducks, Geese, & Swans (ANATIDAE)						
Trumpeter Swan	<i>Cygnus buccinator</i>	S4	-	-	-	FY
Canada Goose	<i>Branta canadensis</i>	S5	-	-	-	AE
Mallard	<i>Anas platyrhynchos</i>	S5	-	-	-	FY
Blue-winged Teal	<i>Anas discors</i>	S4	-	-	-	P
Northern Shoveler	<i>Anas clypeata</i>	S4	-	-	-	P
American Wigeon	<i>Anas americana</i>	S4	-	-	-	P
Ring-necked Duck	<i>Aythya collaris</i>	S5	-	-	-	H
Hooded Merganser	<i>Lophodytes cucullatus</i>	S5B,S5N	-	-	-	P
Common Merganser	<i>Mergus merganser</i>	S5B,S5N	-	-	A	FY
Red-breasted Merganser	<i>Mergus serrator</i>	S4B,S5N	-	-	A	D
Vultures (CATHARTIDAE)						
Turkey Vulture	<i>Cathartes aura</i>	S5B	-	-	-	D
Eagles & Hawks (ACCIPITRIDAE)						
Northern Harrier	<i>Circus cyaneus</i>	S4B	-	-	A	H
Sharp-shinned Hawk	<i>Accipiter striatus</i>	S5	-	-	A	A
Cooper's Hawk	<i>Accipiter cooperi</i>	S4	-	-	A	H
Northern Goshawk	<i>Accipiter gentilis</i>	S4	-	-	A	H
Red-shouldered Hawk	<i>Buteo lineatus</i>	S4B	-	-	A	H
Red-tailed Hawk	<i>Buteo jamaicensis</i>	S5	-	-	A	P
Partridges, Grouse & Turkeys (PHASIANIDAE)						
Wild Turkey	<i>Meleagris gallopavo</i>	S5	-	-	-	FY
Ruffed Grouse	<i>Bonasa umbellus</i>	S4	-	-	-	T
Plovers and Lapwings (CHARADRIIDAE)						
Killdeer	<i>Charadrius vociferus</i>	S5B,S5N	-	-	-	DD
Sandpipers, Phalaropes, and Allies (SCOLOPACIDAE)						
Spotted Sandpiper	<i>Actitis macularia</i>	S5	-	-	-	A
Upland Sandpiper	<i>Bartramia longicauda</i>	S4B	-	-	A	D

Common Name	Scientific Name	S-Rank	COSEWIC Status	ESA Status	Area-sensitive Species	OBBA Breeding Evidence
Wilson's Snipe	<i>Gallinago gallinago</i>	S5	-	-	-	S
American Woodcock	<i>Scolopax minor</i>	S4B	-	-	-	D
Gulls & Terns (LARIDAE)						
Ring-billed Gull	<i>Larus delawarensis</i>	S5B,S4N	-	-	-	NY
Herring Gull	<i>Larus argentatus</i>	S5B,S5N	-	-	-	NY
Common Tern	<i>Sterna hirundo</i>	S4B	-	-	-	P
Pigeons & Doves (COLUMBIDAE)						
Rock Dove	<i>Columba livia</i>	SNA	-	-	-	NY
Mourning Dove	<i>Zenaida macroura</i>	S5	-	-	-	NE
Cuckoos (CUCULIDAE)						
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	S5B	-	-	-	S
Typical Owls (STRIGIDAE)						
Great Horned Owl	<i>Bubo virginianus</i>	S4	-	-	-	D
Barred Owl	<i>Strix varia</i>	S5	-	-	A	H
Eastern Screech-Owl	<i>Otus asio</i>	S4	-	-	-	H
Nightjars (CAPRIMULGIDAE)						
Common Nighthawk	<i>Chordeiles minor</i>	S4B	THR	SC	-	S
Eastern Whip-poor-will	<i>Caprimulgus vociferus</i>	S4B	THR	THR	A	T
Swifts (APODIDAE)						
Chimney Swift	<i>Chaetura pelagica</i>	S4B,S4N	THR	THR	-	T
Hummingbirds (TROCHILIDAE)						
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	S5B	-	-	-	D
Kingfishers (ALCEDINIDAE)						
Belted Kingfisher	<i>Ceryle alcyon</i>	S4B	-	-	-	AE
Woodpeckers & Allies (PICIDAE)						
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	S4B	THR	SC	-	N
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	S5B	-	-	A	S
Downy Woodpecker	<i>Picoides pubescens</i>	S5	-	-	-	AE
Hairy Woodpecker	<i>Picoides villosus</i>	S5	-	-	A	H
Northern Flicker	<i>Colaptes auratus</i>	S4B	-	-	-	N
Pileated Woodpecker	<i>Dryocopus pileatus</i>	S5	-	-	A	FY
Falcons (FALCONIDAE)						
American Kestrel	<i>Falco sparverius</i>	S4	-	-	-	T
Flycatchers (TYRANNIDAE)						
Eastern Wood-Pewee	<i>Contopus virens</i>	S4B	SC	SC	-	T
Alder Flycatcher	<i>Empidonax alnorum</i>	S5B	-	-	-	H
Least Flycatcher	<i>Empidonax minimus</i>	S4B	-	-	A	T
Eastern Phoebe	<i>Sayornis phoebe</i>	S5B	-	-	-	CF
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	S4B	-	-	-	AE
Eastern Kingbird	<i>Tyrannus tyrannus</i>	S4B	-	-	-	AE

Common Name	Scientific Name	S-Rank	COSEWIC Status	ESA Status	Area-sensitive Species	OBBA Breeding Evidence
Swallows (HIRUNDINIDAE)						
Tree Swallow	<i>Tachycineta bicolor</i>	S4B	-	-	-	NY
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	S4B	-	-	-	H
Bank Swallow	<i>Riparia riparia</i>	S4B	THR	THR	-	AE
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	S4B	-	-	-	NY
Barn Swallow	<i>Hirundo rustica</i>	S4B	THR	THR	-	AE
Purple Martin	<i>Progne subis</i>	S3S4B	-	-	-	NY
Jays & Crows (CORVIDAE)						
Blue Jay	<i>Cyanocitta cristata</i>	S5	-	-	-	CF
American Crow	<i>Corvus brachyrhynchos</i>	S5B	-	-	-	AE
Chickadees & Titmice (PARIDAE)						
Black-capped Chickadee	<i>Poecile atricapillus</i>	S5	-	-	-	CF
Red-breasted Nuthatch	<i>Sitta canadensis</i>	S5	-	-	A	P
White-breasted Nuthatch	<i>Sitta carolinensis</i>	S5	-	-	A	NY
Wrens (TROGLODYTIDAE)						
House Wren	<i>Troglodytes aedon</i>	S5B	-	-	-	NY
Winter Wren	<i>Troglodytes troglodytes</i>	S5B	-	-	A	S
Thrushes (TURDIDAE)						
Eastern Bluebird	<i>Sialia sialis</i>	S5B	-	-	-	FY
Hermit Thrush	<i>Catharus guttatus</i>	S5B	-	-	A	H
Wood Thrush	<i>Hylocichla mustelina</i>	S4B	THR	SC	-	S
Veery	<i>Catharus fuscescens</i>	S4B	-	-	A	T
American Robin	<i>Turdus migratorius</i>	S5B	-	-	-	NY
Mockingbirds, Thrashers & Allies (MIMIDAE)						
Gray Catbird	<i>Dumetella carolinensis</i>	S4B	-	-	-	CF
Brown Thrasher	<i>Toxostoma rufum</i>	S4B	-	-	-	A
Waxwings (BOMBYCILLIDAE)						
Cedar Waxwing	<i>Bombycilla cedrorum</i>	S5B	-	-	-	NB
Starlings (STURNIDAE)						
European Starling	<i>Sturnus vulgaris</i>	SNA	-	-	-	AE
Vireos (VIREONIDAE)						
Warbling Vireo	<i>Vireo gilvus</i>	S5B	-	-	-	AE
Red-eyed Vireo	<i>Vireo olivaceus</i>	S5B	-	-	-	NU
Wood-Warblers (PARULIDAE)						
Nashville Warbler	<i>Vermivora ruficapilla</i>	S5B	-	-	-	S
Yellow Warbler	<i>Dendroica petechia</i>	S5B	-	-	-	AE
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	S5B	-	-	-	S
Magnolia Warbler	<i>Dendroica magnolia</i>	S5B	-	-	A	H
Yellow-rumped Warbler	<i>Dendroica coronata</i>	S5B	-	-	-	D

Common Name	Scientific Name	S-Rank	COSEWIC Status	ESA Status	Area-sensitive Species	OBBA Breeding Evidence
Blackburnian Warbler	<i>Dendroica fusca</i>	S5B	-	-	A	H
Black-and-white Warbler	<i>Mniotilta varia</i>	S5B	-	-	A	S
American Redstart	<i>Setophaga ruticilla</i>	S5B	-	-	-	T
Ovenbird	<i>Seiurus aurocapillus</i>	S4B	-	-	A	T
Northern Waterthrush	<i>Seiurus noveboracensis</i>	S5B	-	-	-	S
Mourning Warbler	<i>Oporornis philadelphia</i>	S4B	-	-	-	T
Common Yellowthroat	<i>Geothlypis trichas</i>	S5B	-	-	-	T
Cardinals, Grosbeaks & Allies (CARDINALIDAE)						
Scarlet Tanager	<i>Piranga olivacea</i>	S4B	-	-	A	S
Northern Cardinal	<i>Cardinalis cardinalis</i>	S5	-	-	-	NE
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	S4B	-	-	-	T
Indigo Bunting	<i>Passerina cyanea</i>	S4B	-	-	-	T
New World Sparrows & Allies (EMBERIZIDAE)						
Eastern Towhee	<i>Pipilo erythrophthalmus</i>	S4B	-	-	-	S
Chipping Sparrow	<i>Spizella passerina</i>	S5B	-	-	-	NY
Field Sparrow	<i>Spizella pusilla</i>	S4B	-	-	-	S
Vesper Sparrow	<i>Pooecetes gramineus</i>	S4B	-	-	-	P
Savannah Sparrow	<i>Passerculus sandwichensis</i>	S4B	-	-	A	D
Song Sparrow	<i>Melospiza melodia</i>	S5B	-	-	-	NY
Swamp Sparrow	<i>Melospiza georgiana</i>	S5B	-	-	-	T
White-throated Sparrow	<i>Zonotrichia albicollis</i>	S5B	-	-	-	T
Blackbirds & Allies (ICTERIDAE)						
Bobolink	<i>Dolichonyx oryzivorus</i>	S4B	THR	THR	A	P
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	S4	-	-	-	NE
Eastern Meadowlark	<i>Sturnella magna</i>	S4B	THR	THR	A	T
Common Grackle	<i>Quiscalus quiscula</i>	S5B	-	-	-	NY
Brown-headed Cowbird	<i>Molothrus ater</i>	S4B	-	-	-	FY
Baltimore Oriole	<i>Icterus galbula</i>	S4B	-	-	-	NU
Finches & Allies (FRINGILLIDAE)						
House Finch	<i>Carpodacus mexicanus</i>	SNA	-	-	-	NE
Purple Finch	<i>Carpodacus purpureus</i>	S4B	-	-	-	NB
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	S4B	SC	SC	-	H
Pine Siskin	<i>Cardeulis pinus</i>	S4B	-	-	-	P
American Goldfinch	<i>Cardeulis tristis</i>	S5B	-	-	-	CF
Old World Sparrows (PASSERIDAE)						
House Sparrow	<i>Passer domesticus</i>	SNA	-	-	-	AE

Table 2: Ontario Reptile and Amphibian Atlas Records for the Vicinity of the Study Area (Ontario Nature, 2019)

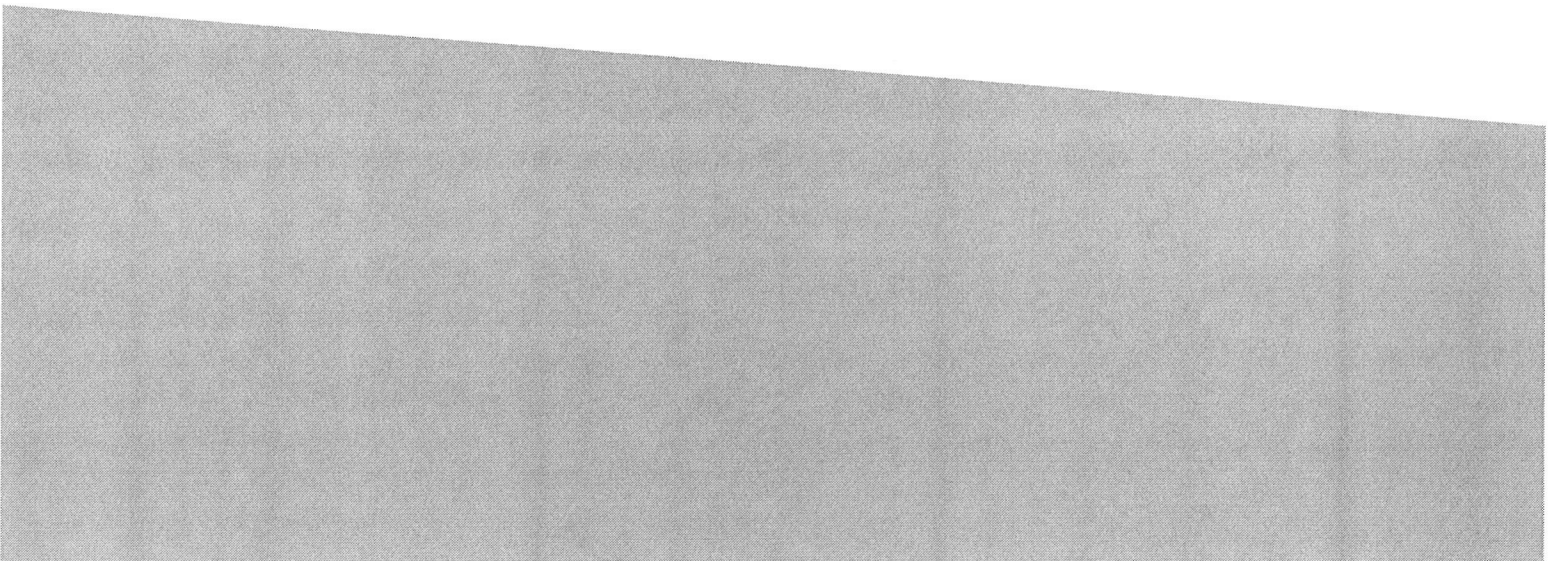
Common Name	Scientific Name	S-rank	COSEWIC Status	ESA Status	# of Records	Latest Year
American Bullfrog	<i>Lithobates catesbeianus</i>	S4	-	-	1	2017
American Toad	<i>Anaxyrus americanus</i>	S5	-	-	244	2017
Eastern Gartersnake	<i>Thamnophis sirtalis sirtalis</i>	S5	-	-	1	1960
Gray Treefrog	<i>Hyla versicolor</i>	S5	-	-	23	2002
Green Frog	<i>Lithobates clamitans</i>	S5	-	-	113	2018
Massasauga	<i>Sistrurus catenatus</i> pop. 1	S3	THR	THR	7	1994
Midland Painted Turtle	<i>Chrysemys picta marginata</i>	S4	SC	-	4	2017
Milksnake	<i>Lampropeltis triangulum</i>	S4	SC	NAR	2	2014
Mink Frog	<i>Lithobates septentrionalis</i>	S5	-	-	3	1999
Northern Leopard Frog	<i>Lithobates pipiens</i>	S5	NAR	NAR	18	2017
Snapping Turtle	<i>Chelydra serpentina</i>	S4	SC	SC	13	2018
Spring Peeper	<i>Pseudacris crucifer</i>	S5	-	-	98	2015
Western Chorus Frog - Great Lakes - St. Lawrence - Canadian Shield population	<i>Pseudacris maculata</i> pop. 1	S3	THR	NAR	4	2012
Wood Frog	<i>Lithobates sylvaticus</i>	S5	-	-	2	2013

Table 3: Ontario Butterfly Atlas Records for the Vicinity of the Study Area (Macnaughton et al., 2019)

Common Name	Scientific Name	S-Rank	COSEWIC Status	ESA Status	# of Records	Latest Year
Silver-spotted Skipper	<i>Epargyreus clarus</i>	S4	-	-	1	1991
Wild Indigo Duskywing	<i>Erynnis baptisiae</i>	S4	-	-	2	2014
European Skipper	<i>Thymelicus lineola</i>	SNA	-	-	2	1991
Leonard's Skipper	<i>Hesperia leonardus</i>	S4	-	-	1	2005
Indian Skipper	<i>Hesperia sassacus</i>	S4	-	-	2	1991
Crossline Skipper	<i>Polites origenes</i>	S4	-	-	1	2005
Black Swallowtail	<i>Papilio polyxenes</i>	S5	-	-	1	1991
Eastern Tiger Swallowtail	<i>Papilio glaucus</i>	S5	-	-	2	1991
Canadian Tiger Swallowtail	<i>Papilio canadensis</i>	S5	-	-	1	2013
Cabbage White	<i>Pieris rapae</i>	SNA	-	-	4	2014
Clouded Sulphur	<i>Colias philodice</i>	S5	-	-	2	2014
Orange Sulphur	<i>Colias eurytheme</i>	S5	-	-	1	2014
Eastern Tailed Blue	<i>Cupido comyntas</i>	S5	-	-	2	2014
Azure sp.	<i>Celastrina</i> sp.	-	-	-	1	2012
Silvery Blue	<i>Glaucopsyche lygdamus</i>	S5	-	-	2	1991
Great Spangled Fritillary	<i>Speyeria cybele</i>	S5	-	-	1	1959
Pearl Crescent	<i>Phyciodes tharos</i>	S4	-	-	1	2013
Northern Crescent	<i>Phyciodes cocyta</i>	S5	-	-	1	1991
Mourning Cloak	<i>Nymphalis antiopa</i>	S5	-	-	2	2017
Common Buckeye	<i>Junonia coenia</i>	SNA	-	-	1	2012
White Admiral	<i>Limenitis arthemis arthemis</i>	S5	-	-	2	2013
Viceroy	<i>Limenitis archippus</i>	S5	-	-	2	2013
Eyed Brown	<i>Lethe eurydice</i>	S5	-	-	1	2013
Common Ringlet	<i>Coenonympha tullia</i>	S5	-	-	5	2014
Monarch	<i>Danaus plexippus</i>	S2N,S4B	END	SC	8	2018

Appendix **D**

Species at Risk and Species of Conservation Concern Habitat Assessment



Species	Preferred Habitat ^{1, 2}	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Probability of Occurrence
Species at Risk (SAR)					
Endangered					
Lake Sturgeon (Great Lakes-Upper St. Lawrence River population) <i>Acipenser fulvescens</i>	The Lake Sturgeon lives almost exclusively in freshwater lakes and rivers with soft bottoms of mud, sand or gravel. They are usually found at depths of five to 20 meters. They spawn in relatively shallow, fast-flowing water (usually below waterfalls, rapids, or dams) with gravel and boulders at the bottom. However, they will spawn in deeper water where habitat is available. They also are known to spawn on open shoals in large rivers with strong currents. This species can be associated with the following ELC communities: OAO. Large lakes/streams > 20m deep with soft mud, sand or gravel bottoms required.	NHIC	Yes - sufficient depth and substrate may be found within the 120 m study area in Georgian Bay.	No - species not observed; however, targeted surveys were not completed. Yes - sufficient depth and substrate may be found within the 120 m study area in Georgian Bay.	Moderate – The Nottawasaga River is known Lake Sturgeon spawning and outlets into Nottawasaga Bay, approximately 16 km from the Study Area in the Town of Wasaga Beach. As the species are known to occur in Nottawasaga Bay, suitable general use habitat may be present within the outer limits of the study area in Nottawasaga Bay.
Little Brown Myotis <i>Myotis lucifugus</i>	Bats are nocturnal. During the day they roost in trees and buildings. They often select attics, abandoned buildings and barns for summer colonies where they can raise their young. Bats can squeeze through very tiny spaces (as small as six millimeters across) and this is how they access many roosting areas. Little brown bats hibernate from October or November to March or April, most often in caves or abandoned mines that are humid and remain above freezing. This species can typically be associated with any community where suitable roosting (i.e. cavity trees, houses, abandoned buildings, barns, etc.) habitat is available.	BCI	Yes - suitable buildings may occur within the study area.	No - species not observed; however, targeted surveys were not completed. No - no potential access points were observed on property buildings during field investigations.	Low – species unlikely occurs within the study area given lack of suitable habitat.
Eastern Small-footed Myotis <i>Myotis leibii</i>	In the spring and summer, eastern small-footed bats will roost in a variety of habitats, including in or under rocks, in rock outcrops, in buildings, under bridges, or in caves, mines, or hollow trees. These bats often change their roosting locations every day. At night, they hunt for insects to eat, including beetles, mosquitos, moths, and flies. In the winter, these bats hibernate, most often in caves and abandoned mines. They seem to choose colder and drier sites than similar bats and will return to the same spot each year.	BCI	Yes - suitable buildings may occur within the study area.	No - species not observed; however, targeted surveys were not completed. No - no potential access points were observed on property buildings during field investigations.	Low – species unlikely occurs within the study area given lack of suitable habitat.
Northern Myotis <i>Myotis septentrionalis</i>	Northern long-eared bats are associated with boreal forests, choosing to roost under loose bark and in the cavities of trees. These bats hibernate from October or November to March or April, most often in caves or abandoned mines. This species can typically be associated with the following ELC communities: FOC, FOM, FOD, SWC, SWM and SWD where suitable roosting (i.e. cavity trees and trees with loose bark) habitat is available.	BCI	No - no forested communities are present within the study area.	No - species not observed; however, targeted surveys were not completed. No - no forested communities were identified within the study area.	Low – species unlikely occurs within the study area given lack of suitable habitat.
Tri-colored Bat <i>Perimyotis subflavus</i>	In Ontario, the Tri-colored Bat lives in forested habitats, forming day roosts and maternity colonies in older forest within foliage or in high tree cavities, occasionally also in barns or other structures. This species forages over water and along streams in forests. At the close of the summer season, this species congregates at a location to swarm, usually near caves, mines or underground locations where they will winter; it has a strong fidelity to its winter hibernation sites. This bat overwinters in caves, typically individually instead of as a group.	BCI	Yes - suitable buildings may occur within the study area.	No - species not observed; however, targeted surveys were not completed. No - no potential access points were observed on property buildings during field investigations.	Low – species unlikely occurs within the study area given lack of suitable habitat.
Threatened					
Bank Swallow <i>Riparia riparia</i>	Bank Swallows nest in burrows in natural and human-made settings where there are vertical faces in silt and sand deposits. Many nests are on banks of rivers and lakes, but they are also found in active sand and gravel pits or former ones where the banks remain suitable. The birds breed in colonies ranging from several to a few thousand pairs.	OBBA	Yes - suitable banks may occur along the Nottawasaga Bay shoreline.	No - species not observed; however, breeding bird surveys were not completed. No - no suitable banks were observed during field investigations.	Low – species unlikely occurs within the study area given lack of suitable habitat.

Species	Preferred Habitat ^{1, 2}	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Probability of Occurrence
Barn Swallow <i>Hirundo rustica</i>	Barn Swallows often live in close association with humans, building their cup-shaped mud nests almost exclusively on human-made structures such as open barns, under bridges and in culverts. The species is attracted to open structures that include ledges where they can build their nests, which are often re-used from year to year. They prefer unpainted, rough-cut wood, since the mud does not adhere as well to smooth surfaces. This species can typically be associated with the following ELC communities: TPO, CUM1, MAM, MAS, OAO, SAS1, SAM1, SAF1; containing or adjacent structures that are suitable for nesting.	OBBA	Yes - structures suitable for nesting may occur within the study area.	No - species not observed; however, breeding bird surveys were not completed. Yes - building on the property provide marginally suitable nesting habitat.	Moderate – species may occur within the study area given presence of potentially suitable habitat.
Bobolink <i>Dolichonyx oryzivorus</i>	Historically, Bobolinks lived in North American tallgrass prairie and other open meadows. With the clearing of native prairies, Bobolinks moved to living in hayfields. Bobolinks often build their small nests on the ground in dense grasses. Both parents usually tend to their young, sometimes with a third Bobolink helping. This species can typically be associated with the following ELC communities: TPO, TPS, CUM1 and MAM2.	OBBA	No - grasslands or open meadows, if present, are too small to provide suitable breeding habitat.	No - species not observed; however, breeding bird surveys were not completed. No - no grassland or meadows observed during field investigations.	Low – species unlikely occurs within the study area given lack of suitable habitat.
Chimney swift <i>Chaetura pelagica</i>	Before European settlement Chimney Swifts mainly nested on cave walls and in hollow trees or tree cavities in old growth forests. Today, they are more likely to be found in and around urban settlements where they nest and roost (rest or sleep) in chimneys and other manmade structures. They also tend to stay close to water as this is where flying insects they eat, congregate. Foraging habitat for this species can be associated with the following ELC codes: TPO, CUM1, MAM, MAS, OAO, SAS1, SAM1, SAF1 containing or adjacent structures with suitable nesting habitat (i.e. chimneys).	OBBA	Yes - suitable chimneys may occur within the study area.	No - species not observed; however, breeding bird surveys were not completed. No - building within the property do not contain suitable chimneys.	Low – species unlikely occurs within the study area given lack of suitable habitat.
Eastern Meadowlark <i>Sturnella magna</i>	Eastern Meadowlarks breed primarily in moderately tall grasslands, such as pastures and hayfields, but are also found in alfalfa fields, weedy borders of croplands, roadsides, orchards, airports, shrubby overgrown fields, or other open areas. Small trees, shrubs or fence posts are used as elevated song perches. This species can typically be associated with the following ELC communities: TPO, TPS, CUM1, CUS, and MAM2 with elevated song perches.	OBBA	No - grasslands or open meadows, if present, are too small to provide suitable breeding habitat.	No - species not observed; however, breeding bird surveys were not completed. No - no grassland or meadows observed during field investigations.	Low – species unlikely occurs within the study area given lack of suitable habitat.
Eastern Whip-poor-will <i>Antrostomus vociferus</i>	The Eastern Whip-poor-will is usually found in areas with a mix of open and forested areas, such as savannahs, open woodlands or openings in more mature, deciduous, coniferous and mixed forests. It forages in these open areas and uses forested areas for roosting (resting and sleeping) and nesting. It lays its eggs directly on the forest floor, where its coloring means it will easily remain undetected by visual predators. This species can typically be associated with the following ELC communities: TPS, TPW, CUW, FOD, FOC and FOM where open areas are present.	OBBA	No - no forests or woodlands are present within the study area.	No - species not observed; however, targeted surveys were not completed. No - no forests or woodlands were identified within the study area.	Low – species unlikely occurs within the study area given lack of suitable habitat.
Massasauga (Great Lakes - St. Lawrence population) <i>Sistrurus catenatus</i>	Massasaugas live in different types of habitats throughout Ontario, including tall grass prairie, bogs, marshes, shorelines, forests and alvars. Within all of these habitats, Massasaugas require open areas to warm themselves in the sun. Pregnant females are most often found in open, dry habitats such as rock barrens or forest clearings where they can more easily maintain the body temperature required for the development of their offspring. Non-pregnant females and males forage and mate in lowland habitats such as grasslands, wetlands, bogs and the shorelines of lakes and rivers. Massasaugas hibernate underground in crevices in bedrock, sphagnum swamps, tree root cavities and animal burrows where they can get below the frost line but stay above the water table. This species can be associated with the following ELC communities: TP, BO, MA, FO, AL, RB, and CUM with open areas.	ORAA	No - occurrence record is considered historical (1994).	No - occurrence record is considered historical (1994).	Low – species unlikely occurs within the study area as occurrence record is considered historical (1994).

Species	Preferred Habitat ^{1, 2}	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Probability of Occurrence
Species of Conservation Concern					
Special Concern					
Common Nighthawk <i>Chordeiles minor</i>	Traditional Common Nighthawk habitat consists of open areas with little to no ground vegetation, such as logged or burned-over areas, forest clearings, rock barrens, peat bogs, lakeshores, and mine tailings. Although the species also nests in cultivated fields, orchards, urban parks, mine tailings and along gravel roads and railways, they tend to occupy natural sites. This species can typically be associated with the following ELC communities: SD, BB, RB, CUM, BO, FOM, FOC and FOD with openings with little vegetation.	OBBA	Yes - open areas with little to no ground vegetation, suitable for nesting, may occur within the study area.	No - species not observed; however, targeted surveys were not completed. No - gravel pedestrian path and parking lot are likely too disturbed to provide suitable nesting habitat.	Low – species unlikely occurs within the study area given lack of suitable habitat.
Eastern Wood-Pewee <i>Contopus virens</i>	The Eastern Wood-Pewee can be found in every type of wooded community in eastern North America. The size of the forest does not appear to be an important factor in habitat selection as this species has been found in both small fragmented forests and larger forest tracks. ³ It is most abundant in intermediate-age mature forest stands with little understory vegetation. This species can typically be associated with the following ELC communities: FOC, FOM, FOD, SWD, SWM and CUW.	OBBA	No - no forests or woodlands are present within the study area.	No - species not observed; however, targeted surveys were not completed. No - no forests or woodlands were identified within the study area.	Low – species unlikely occurs within the study area given lack of suitable habitat.
Evening Grosbeak <i>Coccothraustes vespertinus</i>	During the breeding season, the Evening Grosbeak is generally found in open, mature mixed-wood forests dominated by fir species, White Spruce and/or Trembling Aspen. Its abundance is strongly linked to the cycle of its primary prey, the Spruce Budworm. Outside the breeding season, the species depends mostly on seed crops from tree species in the boreal forest such as firs and spruces. It is also attracted to ornamental trees that have seeds or fruit and may visit bird feeders. This species can typically be associated with the following ELC communities: FOC and FOM.	OBBA	No - no forests are present within the study area.	No - species not observed; however, breeding bird surveys were not completed. No - no forests were observed during field investigations.	Low – species unlikely occurs within the study area given lack of suitable habitat.
Red-headed Woodpecker <i>Melanerpes erythrocephalus</i>	The Red-headed Woodpecker lives in open woodland and woodland edges, and is often found in parks, golf courses and cemeteries. These areas typically have many dead trees, which the bird uses for nesting and perching. This woodpecker regularly winters in the United States, moving to locations where it can find sufficient acorns and beechnuts to eat. A few of these birds will stay the winter in woodlands in southern Ontario if there are adequate supplies of nuts. This species can typically be associated with the following ELC communities: TPS, TPW, CUW, FOD1, FOD2, FOD4-1, FOD6, FOD7, and FOD9 that are open and have an abundance of dead trees.	OBBA	No - no forests or woodlands are present within the study area.	No - species not observed; however, targeted surveys were not completed. No - no forests or woodlands were identified within the study area.	Low – species unlikely occurs within the study area given lack of suitable habitat.
Wood Thrush <i>Hylocichla mustelina</i>	The Wood Thrush can typically be found in the interior and along the edges of well-developed upland deciduous and mixed forests. Key elements of these forests include trees that are greater than 16 m in height, high variety of deciduous tree species, moderate subcanopy and shrub density, shade, fairly open forest floor, moist soils and decaying leaf litter. Wood Thrush is more likely to occur in larger forests but may also nest in 1 ha fragments and semi-wooded residential areas and parks. Smaller habitat fragments have lower fecundity when compared to larger fragments. ⁴ This species can typically be associated with the following ELC communities: FOD and FOM that are greater than 1 ha in size.	OBBA	No - no forests are present within the study area.	No - species not observed; however, breeding bird surveys were not completed. No - no forests were observed during field investigations.	Low – species unlikely occurs within the study area given lack of suitable habitat.
Monarch <i>Danaus plexippus</i>	Throughout their life cycle, Monarchs use three different types of habitat. Only the caterpillars feed on milkweed plants and are confined to meadows and open areas where milkweed grows. Adult butterflies can be found in more diverse habitats where they feed on nectar from a variety of wildflowers. Monarchs spend the winter in Oyamel Fir forests found in central Mexico. This species can typically be associated with the following ELC communities: AI, TP and CUM where milkweed plants are present.	OBA	Yes - cultural meadow may occur within the study area.	Yes - species observed incidentally during field investigations. Yes - although no cultural meadows were identified, isolated common milkweed plants occur within the study area.	High – presence of this species and common milkweed were confirmed within the study area.

Species	Preferred Habitat ^{1, 2}	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Probability of Occurrence
Snapping turtle <i>Chelydra serpentina</i>	<p>Snapping Turtles spend most of their lives in water. They prefer shallow waters so they can hide under the soft mud and leaf litter, with only their noses exposed to the surface to breathe. During the nesting season, from early to mid-summer, females travel overland in search of a suitable nesting site, usually gravelly or sandy areas along streams. Snapping Turtles often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits.</p> <p>This species can typically be associated with the following ELC communities: OAO, SA near gravelly or sandy areas.</p>	ORAA	Yes - Nottawasaga Bay may provide suitable habitat.	<p>No - species not observed; however, targeted surveys were not completed.</p> <p>Yes - Nottawasaga Bay and shoreline may provide suitable habitat.</p>	Moderate – this species may occur within the study area given presence of potentially suitable habitat.
Provincially Rare (S1 to S3)					
Western Chorus Frog (Great Lakes / St. Lawrence - Canadian Shield population) <i>Pseudacris triseriata</i>	<p>The Western Chorus Frog is primarily a lowland terrestrial species. In marshes or wooded wetland areas, it is found on the ground or in low shrubs and grass. It is a poor climber. Like all other frogs, the Western Chorus Frog requires both terrestrial and aquatic habitats in close proximity. For breeding and tadpole development, it requires seasonally dry temporary ponds devoid of predators, particularly fish. The Western Chorus Frog is very rarely found in permanent ponds. Although it uses aquatic habitat during the breeding season, the Western Chorus Frog is a poor swimmer. The species hibernates in its terrestrial habitat, under rocks, dead trees or leaves, or in loose soil or animal burrows, even though these sites are sometimes flooded.</p>	ORAA	Yes - wetlands may occur within the study area.	<p>No - species not observed; however, amphibian call surveys were not completed.</p> <p>Yes - suitable shallow marsh inclusion along Ontario Street.</p>	Moderate – this species may occur within the study area given presence of potentially suitable habitat.
Purple Martin <i>Progne subis</i>	<p>Historically inhabited forest edge and riparian areas or open wetlands containing snags with woodpecker holes but are now found wherever birdhouses may be installed.⁵</p>	OBBA	Yes - birdhouses may be present within the study area.	<p>No - species not observed; however, breeding bird surveys were not completed.</p> <p>No - no birdhouses observed during field investigations.</p>	Low – species unlikely occurs within the study area given lack of suitable habitat.
Black-crowned Night Heron <i>Nycticorax nycticorax</i>	<p>Form nesting colonies typically on islands, in swamps, or over water. Foraging habitat includes swamps, streams, rivers, margins of pools, ponds, lakes, lagoons, tidal mudflats, salt marsh, freshwater marshes, man-made ditches, canals, ponds, reservoirs, and wet agricultural fields.⁶</p>	OBBA	No - wetlands within the study area, if present, are too small to support nesting colonies.	<p>No - species not observed; however, breeding bird surveys were not completed.</p> <p>No - study area is too disturbed and lacks suitable vegetation to support nesting colonies.</p>	Low – species unlikely occurs within the study area given lack of suitable habitat.

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5 - Brown, C.R. and S. Tarof, 2013. Purple Martin (*Progne subis*), version 2.0. In *The Birds of North America* (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. <https://doi.org/10.2173/bna.287>

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Appendix F

**Town of Collingwood
Raymond A. Barker Water Treatment Plant
Class Environmental Assessment
STAGE 1 ARCHAEOLOGICAL ASSESSMENT**

AECOM Canada Ltd.

November 4, 2019

Ministry of Heritage, Sport, Tourism, Culture
Industries

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Jul 7, 2020

Samantha Markham (P438)
AECOM
410 - 250 York London ON N6A 6K2

**RE: Review and Entry into the Ontario Public Register of Archaeological Reports:
Archaeological Assessment Report Entitled, "Stage 1 Archaeological Assessment
Collingwood WTP Class EA Part of Lot 44, Concession 7, Geographic Township of
Nottawasaga, Simcoe County, Now the Town of Collingwood, Ontario ", Dated Nov
4, 2019, Filed with MTCS Toronto Office on Nov 26, 2019, MTCS Project Information
Form Number P438-0186-2019, MTCS File Number 0011307**

Dear Ms. Markham:

This office has reviewed the above-mentioned report, which has been submitted to this ministry as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c 0.18.¹ This review has been carried out in order to determine whether the licensed professional consultant archaeologist has met the terms and conditions of their licence, that the licensee assessed the property and documented archaeological resources using a process that accords with the 2011 *Standards and Guidelines for Consultant Archaeologists* set by the ministry, and that the archaeological fieldwork and report recommendations are consistent with the conservation, protection and preservation of the cultural heritage of Ontario.

The report documents the assessment/mitigation of the study area as depicted in Figure 6 of the above titled report and recommends the following:

AECOM's Stage 1 archaeological assessment for the Collingwood WTP EA determined that the potential for the recovery of archaeological resources has been removed as a result of extensive, deep land alterations associated with the construction of the Raymond A. Barker Ultrafiltration WTP and underground utilities. Based on these findings, no further archaeological work is required.

Based on the information contained in the report, the ministry is satisfied that the fieldwork and reporting for the archaeological assessment are consistent with the ministry's 2011 *Standards and Guidelines for Consultant Archaeologists* and the terms and conditions for archaeological licences. This report has been entered into the Ontario Public Register of Archaeological Reports. Please note that the ministry makes no representation or warranty as to the completeness, accuracy or quality of reports in the register.

Should you require any further information regarding this matter, please feel free to contact me.

Sincerely,

Heather Kerr
Archaeology Review Officer

cc. Archaeology Licensing Officer
Brian Sahely, AECOM Canada Ltd.
TBD TBD, Ministry of the Environment, Conservation, and Parks

¹*In no way will the ministry be liable for any harm, damages, costs, expenses, losses, claims or actions that may result: (a) if the Report(s) or its recommendations are discovered to be inaccurate, incomplete, misleading or fraudulent; or (b) from the issuance of this letter. Further measures may need to be taken in the event that additional artifacts or archaeological sites are identified or the Report(s) is otherwise found to be inaccurate, incomplete, misleading or fraudulent.*

Town of Collingwood

**Stage 1 Archaeological Assessment
Collingwood WTP Class EA
Part of Lot 44, Concession 7, Geographic
Township of Nottawasaga, Simcoe County,
Now the Town of Collingwood, Ontario**

Prepared by:

AECOM

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License: P438

PIF Number: P438-0186-2019

November 4, 2019
Original Report

Project Number: 60609900

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0	Yes	Ontario Ministry of Tourism, Culture, and Sport
0	Yes	AECOM Canada Ltd.

Revision History

Revision #	Date	Revised By:	Revision Description

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The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("AECOM") for the benefit of the Client ("Client") in accordance with the agreement between AECOM and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

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- represents AECOM's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.

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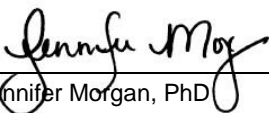
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This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

Quality Information

Report Prepared By: 
Jennifer Morgan, PhD
Bioarchaeology Specialist

Report Reviewed By: 
Adria Grant, MA, CAHP
Ontario Department Manager
Impact Assessment and Permitting (IAP)

Executive Summary

AECOM Canada Ltd. (AECOM) was retained by the Town of Collingwood to conduct a Stage 1 archaeological assessment for the Collingwood Waste Water Treatment Plant (WTP) Environmental Assessment (EA) in the Town of Collingwood, Ontario. The study area is located on part of Lot 44, Concession 7, in the Geographic Township of Nottawasaga, in the County of Simcoe, now the Town of Collingwood, Ontario (Figures 1 and 2).

The Stage 1 archaeological assessment was conducted as part of a Municipal Class Environmental Assessment study during the design stage of the project and was triggered by the requirements of the *Environmental Assessment Act* in accordance with subsection 11(1) (Ontario Government 1990a). This project is subject to the requirements of the *Ontario Heritage Act* (Government of Ontario 1990b) and the *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011).

AECOM's Stage 1 archaeological assessment for the Collingwood WTP EA determined that the potential for the recovery of archaeological resources has been removed as a result of extensive, deep land alterations associated with the construction of the Raymond A. Barker Ultrafiltration WTP and underground utilities. **Based on these findings, no further archaeological work is required.**

The MTCS is asked to accept this report into the Ontario Public Register of Archaeological Reports thereby concurring with the recommendations presented herein. As no further archaeological assessment is required, archaeological concerns for the Collingwood WTP EA in the Town of Collingwood, Ontario have been fully addressed.

Please note that this archaeological assessment report has been written to meet the requirements of the MTCS's *Standards and Guidelines for Consultant Archaeologists* (Ontario Government 2011); however, properties that are subject to archaeological assessment are not considered cleared for ground disturbance activities until the associated report has been reviewed and accepted by the MTCS. In order to maintain compliance with the MTCS and the *Ontario Heritage Act* (1990), no ground disturbing activities are to occur until the proponent and approval authority receive a formal letter from the MTCS stating that the recommendations provided herein are compliant and that the report has been accepted into the MTCS' register of archaeological reports.

Project Personnel

Project Manager	Brian Sahely, M.A.Sc., P.Eng
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Licensed Archaeologist	Samantha Markham. MES (P438)
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Table 1: Cultural Chronology for Southern Ontario 2

1. Project Context

1.1 Development Context

AECOM Canada Ltd. (AECOM) was retained by the Town of Collingwood to conduct a Stage 1 archaeological assessment for the Collingwood Waste Water Treatment Plant (WTP) Environmental Assessment (EA) in the Town of Collingwood, Ontario. The study area is located on part of Lot 44, Concession 7, in the Geographic Township of Nottawasaga, in the County of Simcoe, now the Town of Collingwood, Ontario (Figures 1 and 2).

The Stage 1 archaeological assessment was conducted as part of a Municipal Class Environmental Assessment study during the design stage of the project and was triggered by the requirements of the *Environmental Assessment Act* in accordance with subsection 11(1) (Ontario Government 1990a). This project is subject to the requirements of the *Ontario Heritage Act* (Government of Ontario 1990b) and the *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011).

This EA is being completed as part of the expansion of the Raymond A. Barker Ultrafiltration WTP. The plant capacity will be increased through the addition of a new low lift pumping station, a UV building, and other process upgrades. All archaeological consulting activities were conducted under PIF number P438-0186-2019 issued to Professional Archaeologist Samantha Markham in accordance with the Ministry of Tourism Culture, and Sport's (MTCS) *Standards and Guidelines for Consultant Archaeologists* (Ontario Government 2011). Permission to enter the property to conduct fieldwork, including the collection of artifacts when present, was provided by the Town of Collingwood.

1.1.1 Objectives

The objective of the Stage 1 background study is to document the archaeological and land use history and current conditions within the study area. This information will be used to support recommendations regarding cultural heritage values or interests, as well as assessment and mitigation strategies. The results of Stage 1 archaeological assessment presented in this report are drawn in part from:

- Recent and historical maps of the study area;
- Reports of previous archaeological assessments within 50 m of the study area;
- The MTCS Archaeological Sites Database (ASDB) for a listing of registered archaeological sites within a 1 km radius of the study area;
- A visual inspection of the existing conditions of the study area and surroundings; and,
- Archaeological management plans or other archaeological potential mapping, where available.

The Stage 1 archaeological assessment has been conducted to meet the requirements of the MTCS *Standards and Guidelines for Consultant Archaeologists* (Ontario Government 2011).

1.2 Historical Context

Years of archaeological research and assessments in southern Ontario have resulted in a well-developed understanding of the historic use of land in Simcoe County, from the earliest First Nation people to the more recent Euro-Canadian settlers and farmers. Table 1 provides a breakdown of the cultural and temporal history of past occupations in southern Ontario.

Table 1: Cultural Chronology for Southern Ontario

Archaeological Period	Time Period	Characteristics
Early Paleo	9000-8400 BC	<ul style="list-style-type: none"> Fluted Points Arctic tundra and spruce parkland, caribou hunters
Late Paleo	8400-8000 BC	<ul style="list-style-type: none"> Holcombe, Hi-Lo and Lanceolate Points Slight reduction in territory size
Early Archaic	8000-6000 BC	<ul style="list-style-type: none"> Notched and Bifurcate base Points Growing populations
Middle Archaic	6000-2500 BC	<ul style="list-style-type: none"> Stemmed and Brewerton Points, Laurentian Development Increasing regionalization
Late Archaic	2000-1800 BC	<ul style="list-style-type: none"> Narrow Point Environment similar to present
	1800-1500 BC	<ul style="list-style-type: none"> Broad Point Large lithic tools
	1500-1100 BC	<ul style="list-style-type: none"> Small Point Introduction of bow
Terminal Archaic	1100-950 BC	<ul style="list-style-type: none"> Hind Points, Glacial Kame Complex Earliest true cemeteries
Early Woodland	950-400 BC	<ul style="list-style-type: none"> Meadowood Points Introduction of pottery
Middle Woodland	400 BC – AD 500	<ul style="list-style-type: none"> Dentate/Pseudo-scallop Ceramics Increased sedentism
	AD 550-900	<ul style="list-style-type: none"> Princess Point Introduction of corn horticulture
Late Woodland	AD 900-1300	<ul style="list-style-type: none"> Agricultural villages
	AD 1300-1400	<ul style="list-style-type: none"> Increased longhouse sizes
	AD 1400-1650	<ul style="list-style-type: none"> Warring nations and displacement
Contact Period	AD 1600-1875	<ul style="list-style-type: none"> Early written records and treaties
Historic	AD 1749-present	<ul style="list-style-type: none"> European settlement (French and English)

Notes: Taken from Ellis and Ferris (1990)

The following sections provide a detailed summary of the archaeological cultures that have settled in the vicinity of the study area. As Chapman and Putnam (1984) illustrate, the modern physiography of southern Ontario is largely a product of events of the last major glacial stage and the landscape is a complex mosaic of features and deposits produced during the last series of glacial retreats and advances prior to the withdrawal of the continental glaciers from the area. Southwestern Ontario was finally ice free by 12,500 years ago. With continuing ice retreat and lake regressions the land area of southern Ontario progressively increased while barriers to the influx of plants, animals, and people steadily diminished (Karrow and Warner 1990). The land within this area of southern Ontario has been

extensively utilized by pre-contact First Nation people who began occupying southwestern Ontario as the glaciers receded from the land.

1.2.1 Pre-Contact First Nation Settlement

The Paleo Period

In this area the first human settlement can be traced back to 11,000 BC; these earliest well-documented groups are referred to as Paleo which literally means old or ancient. During the Paleo period people were non-agriculturalists who depended on hunting and gathering of wild food, they moved their encampments on a regular basis to be in the locations where these resources naturally became available, and the size of the groups occupying any particular location would vary depending on the nature and size of the available food resources (Ellis and Deller 1990). The picture that has emerged for the early and late Paleo is of groups at low population densities who were residentially mobile and made use of large territories during annual cycles of resource exploitation.

The Archaic Period

The next major cultural period following the Paleo is termed the Archaic, which is broken temporally into the Early, Middle, and Late Archaic periods. There is much debate on how the term Archaic is employed; general practice bases the designation off assemblage content as there are marked differences in artifact suites from the preceding Paleo and subsequent Woodland periods. As Ellis *et al.* (1990) note, from an artifact and site characteristic perspective the Archaic is simply used to refer to non-Paleo manifestations that pre-date the introduction of ceramics. Ellis *et al.* (1990) stress that Archaic groups can be distinguished from earlier groups based on site characteristics and artifact content.

Early Archaic sites have been reported throughout much of southwestern Ontario and extend as far north as the Lake Huron Basin region and as far east as Rice Lake (Deller *et al.* 1986). A lack of excavated assemblages from southern Ontario has limited understandings and inferences regarding the nature of stone tool kits in the Early Archaic and tool forms other than points are poorly known in Ontario; however, at least three major temporal horizons can be recognized and can be distinguished based on projectile point form (Ellis *et al.* 1990). These horizons are referred to as Side-Notched (*ca.* 8,000-7,700 BC), Corner-Notched (*ca.* 7,700-6,900 BC), and Bifurcated (*ca.* 6,900-6,000 BC) (Ellis *et al.* 1990). Additional details on each of these horizons and the temporal changes to tool types can be found in Ellis *et al.* (1990).

The Middle Archaic period (6,000-2,500 BC), like the Early Archaic, is relatively unknown in southern Ontario. Ellis *et al.* (1990) suggest that artifact traits that have come to be considered as characteristic of the Archaic period as a whole, first appear in the Middle Archaic. These traits include fully ground and polished stone tools, specific tool types including banner stones and net-sinkers, and the use of local and/or non-chert type materials for lithic tool manufacture (Ellis *et al.* 1990).

The Late Archaic begins around approximately 2,000 BC and ends with the appearance of ceramics and the Meadowood Phase at roughly 950 BC. Much more is known about this period than the Early and Middle Archaic and a number of Late Archaic sites are known. Sites appear to be more common than earlier periods, suggesting some degree of population increase. True cemeteries appear and have allowed for the analysis of band size, biological relationships, social organization, and health. Narrow and Small point traditions appear as well as tool recycling wherein points were modified into drills, knives, end scrapers, and other tools (Ellis *et al.* 1990). Other tools including serrated flakes used for sawing or shredding, spokeshaves, and retouched flakes manufactured into perforators, gravers, micro-perforators, or piercers. Tools on coarse-grained rocks such as sandstone and quartz become common and include hammerstones, net-sinkers, anvils, and cobble spalls. Depending on preservation,

several Late Archaic sites include bone and/or antler artifacts which likely represent fishing toolkits and ornamentation. These artifacts include bone harpoons, barbs or hooks, notched projectile points, and awls. Bone ornaments recovered have included tubular bone beads and drilled mammal canine pendants (Ellis *et al.* 1990).

Throughout the Early to Late Archaic periods the natural environment warmed and vegetation changed from closed conifer-dominated vegetation cover, to the mixed coniferous and deciduous forest in the north and deciduous vegetation in the south we see in Ontario today (Ellis *et al.* 1990). During the Archaic period there are indications of increasing populations and decreasing size of territories exploited during annual rounds; fewer moves of residential camps throughout the year and longer occupations at seasonal campsites; continuous use of certain locations on a seasonal basis over many years; increasing attention to ritual associated with the deceased; and, long range exchange and trade systems for the purpose of obtaining valued and geographically localized resources (Ellis *et al.* 1990).

The Woodland Period

The Early Woodland period is distinguished from the Late Archaic period primarily by the addition of ceramic technology, which provides a useful demarcation point for archaeologists but is expected to have made less difference in the lives of the Early Woodland peoples. The settlement and subsistence patterns of Early Woodland people shows much continuity with the earlier Archaic with seasonal camps occupied to exploit specific natural resources (Spence *et al.* 1990). During the Middle Woodland well-defined territories containing several key environmental zones were exploited over the yearly subsistence cycle. Large sites with structures and substantial middens appear in the Middle Woodland associated with spring macro-band occupations focussed on utilizing fish resources and created by consistent returns to the same site (Spence *et al.* 1990). Groups would come together into large macro-bands during the spring-summer at lakeshore or marshland areas to take advantage of spawning fish; in the fall inland sand plains and river valleys were occupied for deer and nut harvesting and groups split into small micro-bands for winter survival (Spence *et al.* 1990). This is a departure from earlier Woodland times when macro-band aggregation is thought to have taken place in the winter (Ellis *et al.* 1988; Granger 1978).

The period between the Middle and Late Woodland period was both technically and socially transitional for the ethnically diverse populations of southern Ontario and these developments laid the basis for the emergence of settled villages and agriculturally based lifestyles (Fox 1990). The Late Woodland period began with some groups shifting settlement and subsistence patterns, involving an increasing reliance on corn horticulture. Corn may have been introduced into southwestern Ontario from the American Midwest as early as 600 AD. However, it did not become a dietary staple until at least three to four hundred years later. The first agricultural villages in southwestern Ontario date to the 10th century A.D. Unlike the riverine base camps of the Middle Woodland period, Late Woodland sites are located in the uplands, on well-drained sandy soils.

In the Late Woodland period, between 900-1300 AD, villages tended to be small settlements with nearby camps and hamlets that served as temporary spaces for hunting game and gathering resources outside of the villages. At this time, small village sites were characterized by the presence of longhouses with villages being occupied considerably longer than later in the Woodland period. Villages tended to be moved when nearby soils had been depleted by farming and conveniently collected firewood grew scarce. The Jesuits reported that the Huron moved their villages once every 10-15 years as they relied less heavily on corn than did later groups, and since their villages were much smaller, there was less demand on nearby resources. Small amounts of corn appear to have been a dietary component at this time; however, archaeological evidence suggests that its role was not as a dietary staple at this time but was possibly supplemental in nature.

Between 1300 and 1400 AD, village sizes grew significantly, resulting in the development of complex community political systems. This period also marks the emergence of fully developed horticulture, including the cultivation of corn, beans, and squash. Additionally, changes in ceramic styles may reflect increasing levels of inter-community communication and integration. This is supported by Michi Saagiig (Mississauga Anishinaabeg) oral histories,

which speak to the coming of the corn growers and the symbiotic relationships that Algonkian speaking groups had with the Huron-Wendat in particular.

By the beginning of the fourteenth century, larger fortified village sites were often cleared to accommodate the cultivation of corn, beans, and squash as a result of an increasing reliance on horticulture. Longhouses also continued to grow in size until 1450 AD when a decrease in house length is observed. This decrease in house length may be partially attributed to large scale drops in population size associated with the introduction of European diseases.

1.2.2 Post-Contact Period Settlement

The post-contact Indigenous occupation of southern Ontario was heavily influenced by the dispersal of Iroquoian speaking peoples, including the Six Nations of the Iroquois – Mohawk, Cayuga, Oneida, Seneca, Onondaga, and Tuscarora. This was followed by the return of Algonkian speaking groups from northern Ontario, including the Michi Saagig, who had temporarily retreated to their wintering grounds in the mid-1600s to avoid warfare and disease as a result of colonial settlement. Algonkian speaking Ojibwe (Chippewa), Odawa (Ottawa), and Pottawatomi, known as the Three Fires Confederacy, remained in their traditional territory that covered a vast area of southern Ontario as well as eastern Michigan.

As European settlers encroached on their territory the nature of First Nation population distribution, settlement size and material culture changed. Despite these changes it is possible to correlate historically recorded villages with archaeological manifestations and the similarity of those sites to more ancient sites reveals an antiquity to documented cultural expressions that confirms a long historical continuity to systems of Indigenous ideology and thought (Ferris 2009).

It is important to note that, when discussing the historical documentation of the movement of Indigenous people, what has been documented by early European explorers and settlers represents only a very small snap-shot in time. Documentation of where Indigenous groups were residing during European exploration and settlement is restricted to only a very short period of time and does not reflect previous and subsequent movements of these groups. This brief history does not reflect the full picture of the pre- or post-contact period occupation of Indigenous groups or cultures. As such, relying on historic documentation in regards to Indigenous occupation and movement across the landscape can lead to misinterpretation. For example, noting the movement of Indigenous groups into an area may incorrectly suggest to the reader that these groups had not occupied the area previously; however, this is not the case. It is clear from Indigenous oral histories and the archaeological record that pre-contact Indigenous populations were extremely mobile and not tied to any one specific area. Over the vast period of time prior to the arrival of Europeans, Indigenous groups, language families, and cultures were fluid across the landscape.

The study area falls within the boundaries of Treaty 18, also known as the Lake Simcoe-Nottawasaga Purchase. Treaty 18 was signed on October 17, 1818 by representatives of the Crown and the Chippewas of Lake Huron and Simcoe. The main condition of this treaty was that 1,200 pounds of goods were to be given to the Chippewas of Lakes Hurons and Simcoe every year, indefinitely, for the surrender of 1,592,000 ac. This annuity ceased after the signing of the Williams Treaties in 1923 (King 2018) (Figure 3).

1.2.3 Euro-Canadian Settlement

The 1871 (Hoggs 1871) and 1881 (H. Belden 1881) historic maps of Simcoe County were reviewed to determine the presence of 19th century settlement features within the study area, as these elevate the potential for the presence of 19th century archaeological resources. It should be noted that not all features of interest, particularly farmhouses and smaller homesteads, were mapped systematically as this would have been beyond the intended scope of the Ontario historical atlas series. In addition, given that atlases were funded by subscription, preference with regard to the level of detail included was given to subscribers. As such, the absence of structures or other features on historic atlas maps does not preclude the presence of historic features at the time the area was surveyed.

By 1871, the land within the Township of Nottawasaga had been surveyed, with most lots severed and sold off, and nearly all of the land occupied by early settlers. The expansion of the Town of Collingwood was significant in 1871, with the Town plot spread across multiple lots and concessions; however, Lot 44, Concession 7, is not listed to any landowner and only a small portion of the west part of the lot, well outside of the study area, had been surveyed as part of the Town plot. Although no historic structures are illustrated on Lot 44, the Northern Railroad of Canada was constructed through the west side of the lot to access a shipping area on the shore of Georgian Bay (Figure 4). At the time of the 1881 survey of the Township of Nottawasaga, Collingwood had expanded with the town plot extending to include the entirety of Lot 44, Concession 7. Town roads, which are still in use today, were constructed at this time, including parts of Raglan Street (Figure 5). Other than town roads, no structures are illustrated on the map.

A fish hatchery was once located on Raglan Street within the boundaries of the study area. The hatchery was built in 1912 by the Dominion of Canada government and was later taken over by the Ontario Government. The hatchery was constructed to address declining fish stocks in the area as a result of a government report issued in 1894 (Collingwood Museum nd). The hatchery was closed in 1957 and the Raymond A. Barker WTP now stands in its place.

1.3 Archaeological Context

1.3.1 Natural Environment

The single most important environmental feature necessary for extended human occupation is potable water. As such, proximity to water is regarded as a useful index for the determination of potential for the presence of archaeological resources. The study area is located on the south shore of Georgian Bay and approximately 400 m northwest of the Nottawasaga River. These water sources served as important pre- and post-contact transportation routes as well as sources of potable water and lake resources.

The study area falls within the Simcoe Lowlands geographic region of southern Ontario, which is positioned between Georgian Bay and Lake Simcoe. This region includes the Lake Simcoe basins and the Nottawasaga River and is characterized by imperfectly drained sand, silt, and clay soils. Extensive marshes and swamps also provide an abundance of organic mud. Dominant tree species in the once dense forests included elm, ash, maple, and cedar (Chapman and Putnam 1984). In addition to forest resources, the study area is located near Collingwood, or Fossil Hill, chert outcrops. These bedrock outcrops were used throughout the pre-contact period and was the preferred raw material used by Paleo populations for tool manufacture.

The modern physiography of southern Ontario is largely a product of events of the last major glacial stage, the Wisconsinan and Late Wisconsinan time (ca. 25,000-10,000 BP) (Ellis and Ferris 1990). The study area would have been completely inundated by Glacial Lakes Algonquin and Lake Nipissing with settlement occurring in the area after the glacial lakes receded (Chapman and Putnam 1984:34).

The availability of food and raw material resources made this area an ideal environment for both temporary and permanent settlement throughout the pre-and post-contact periods and attracted Euro-Canadian settlers in the early 19th century. During the 19th and 20th century, rapid deforestation resulted in significant land clearance across Simcoe County and, over time, the once diverse forest life and wide range of tree species and natural resources would have also been depleted as agricultural and modern residential and commercial development continued. As a result of continuing urban development, this part of southern Ontario is almost completely deforested today.

1.3.2 Previous Archaeological Work

To inform the current Stage 1 archaeological assessment and further establish the archaeological context of the study area, a search of the Ontario Public Register of Archaeological Reports was conducted by AECOM to determine if any previous archaeological work has been completed within the current study area or within 50 m of the study area boundaries. No reports documenting previous archaeological work within the study area or within 50 m were found.

To the best of our knowledge, there are no other reports concerning archaeological work conducted within or in close proximity (i.e. within 50 m) of the study area; however, it should be noted that the MTCS does not maintain a database of all properties that have had past archaeological investigations and searches of the MTCS' public register do not always result in a complete listing of all archaeological work conducted in a given area. In consequence, in some cases the only way a consulting archaeologist will know that a past assessment has been conducted is if they have personal knowledge of it, or if the assessment resulted in the discovery and registration of one or more archaeological sites.

1.3.3 Known Archaeological Sites

AECOM conducted a data search of the ASDB to determine if any known archaeological sites are located within the study area, as well as within 1 km of the current study area boundaries. The results of this search indicated that there are no known archaeological sites registered within 1 km of the study area. It is pertinent to note that a lack of registered archaeological sites does not preclude the presence of archaeological sites within a given study area, but, rather, that minimal archaeological work has been completed in the immediate vicinity.

1.3.4 Existing Conditions

The Collingwood WTP EA study area is located at the existing Raymond A. Barker Ultrafiltration WTP at 10 Raglan Street in the Town of Collingwood, Ontario. It is generally bounded by Raglan Street to the west, public pathways to the north and south, and Nottawasaga Bay to the east. The study area is currently comprised of the existing WTP and associated access roads.

2. Property Inspection

To assist in the evaluation of the Collingwood WTP EA study area, a property inspection was conducted by licensed archaeologist Cody McNea (R414) on August 29, 2019 under PIF # P438-0186-2019 issued to professional archaeologist Samantha Markham (P438). The property inspection was conducted to meet the requirements of *Section 1.2* of the *Standards and Guidelines for Consultant Archaeologists* (Ontario Government 2011) and, in accordance with *Section 1.2, Standard 1*, the entire Study Area and its periphery was subject to systematic inspection to identify the presence or absence of any features of archaeological potential.

The weather on August 26, 2019 was sunny and clear with a high temperature of 26°C. The weather conditions permitted excellent visibility and photographs were taken of the visible landscape features (Photos 1-9). Photograph locations and directions, as well as the results of the Stage 1 AA property inspection are provided on Figure 6 of this report. To meet the requirements of *Standard 4, Section 1.2*, an attempt was made to document additional features of archaeological potential not visible on the mapping. No additional features of archaeological potential were identified during the site inspection.

The entirety of the study area has been significantly previously disturbed. This is evidenced by the presence of existing building footprints, grading associated with landscaping conducted around the buildings, and underground utilities.

3. Analysis and Conclusions

3.1 Determination of Archaeological Potential

Archaeological potential is established by determining the likelihood that archaeological resources may be present on a subject property. Criteria commonly used by the MTCS to determine areas of archaeological potential are listed in Section 1.3.1 of the *Standards and Guidelines for Consultant Archaeologists* (Ontario Government 2011). Distance to modern or ancient water sources is generally accepted as the most important element for past human settlement patterns and when considered alone may result in a determination of archaeological potential. In addition, any combination of two or more of the listed criteria indicates archaeological potential.

Based on a review of the historical, environmental, and archaeological context of the study area, it has been determined that there may be potential for the recovery of pre- and post-contact First Nation and 19th century Euro-Canadian archaeological resources within the study area based on the presence of the following features:

- Distance to various types of water sources (Georgian/Nottawasaga Bay, Nottawasaga River);
- Soil texture and drainage (imperfectly drained);
- Resource areas including food or medicinal plants, scarce raw materials;
- Areas of early Euro- Canadian industry, settlement, and early transportation routes; and,
- Properties listed on municipal register of properties designated under the *Ontario Heritage Act* (Government of Ontario 1990b).

Certain features indicate that archaeological potential has been removed, such as land that has been subject to extensive and intensive deep land alterations that have severely damaged the integrity of any archaeological resources. This includes landscaping that involves grading below the topsoil level, building footprints, quarrying and sewage and infrastructure development (Ontario Government 2011).

Through a visual inspection of the study area, it was determined that the study area has been significantly previously disturbed as a result of the construction of the Raymond A. Barker Ultrafiltration WTP and its associated infrastructure, including underground utilities, and grading as a result of landscaping around the building footprints.

3.2 Conclusions

AECOM's Stage 1 background study for the Collingwood WTP EA has determined that, although there are features that support the potential for the recovery of archaeological resources, the study area has been significantly previously disturbed. As such, archaeological potential within the study area boundaries has been removed as a result of the construction of the Raymond A. Barker Ultrafiltration WTP.

4. Recommendations

AECOM's Stage 1 archaeological assessment for the Collingwood WTP EA determined that the potential for the recovery of archaeological resources has been removed as a result of extensive, deep land alterations associated with the construction of the Raymond A. Barker Ultrafiltration WTP and underground utilities. **Based on these findings, no further archaeological work is required.**

The MTCS is asked to accept this report into the Ontario Public Register of Archaeological Reports thereby concurring with the recommendations presented herein. As no further archaeological assessment is required, archaeological concerns for the Collingwood WTP EA in the Town of Collingwood, Ontario have been fully addressed.

Please note that this archaeological assessment report has been written to meet the requirements of the MTCS's *Standards and Guidelines for Consultant Archaeologists* (Ontario Government 2011); however, properties that are subject to archaeological assessment are not considered cleared for ground disturbance activities until the associated report has been reviewed and accepted by the MTCS. In order to maintain compliance with the MTCS and the *Ontario Heritage Act* (1990), no ground disturbing activities are to occur until the proponent and approval authority receive a formal letter from the MTCS stating that the recommendations provided herein are compliant and that the report has been accepted into the MTCS' register of archaeological reports.

5. Advice on Compliance with Legislation

This report is submitted to the Ontario Minister of Tourism, Culture and Sport as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Tourism, Culture and Sport, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the *Ontario Heritage Act*.

Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48(1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48(1) of the *Ontario Heritage Act*.

Archaeological sites recommended for further archaeological fieldwork or protection remain subject to section 48 (1) of the *Ontario Heritage Act* and may not be altered, or have artifacts removed from them, except by a person holding an archaeological license.

The *Funeral, Burial and Cremation Services Act*, 2002, S.O. 2002, c.33 (when proclaimed in force in 2012) require that any person discovering human remains must notify the police or coroner and the Registrar of Burial Sites, War Graves, Abandoned Cemeteries, and Cemetery Closures.

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7. Images



Photo 1: Visually confirmed disturbance (utilities), facing south



Photo 2: Visually confirmed disturbance (building footprint, underground utilities), facing north east



Photo 3: Visually confirmed disturbance (underground utilities, artificial landscaping), facing east



Photo 4: Visually confirmed disturbance (building footprint, underground utilities), facing south



Photo 5: Visually confirmed disturbance (building footprint, access road construction), facing east



Photo 6: Visually confirmed disturbance (building footprint) facing west



Photo 7: Visually confirmed disturbance (underground utilities), facing north east



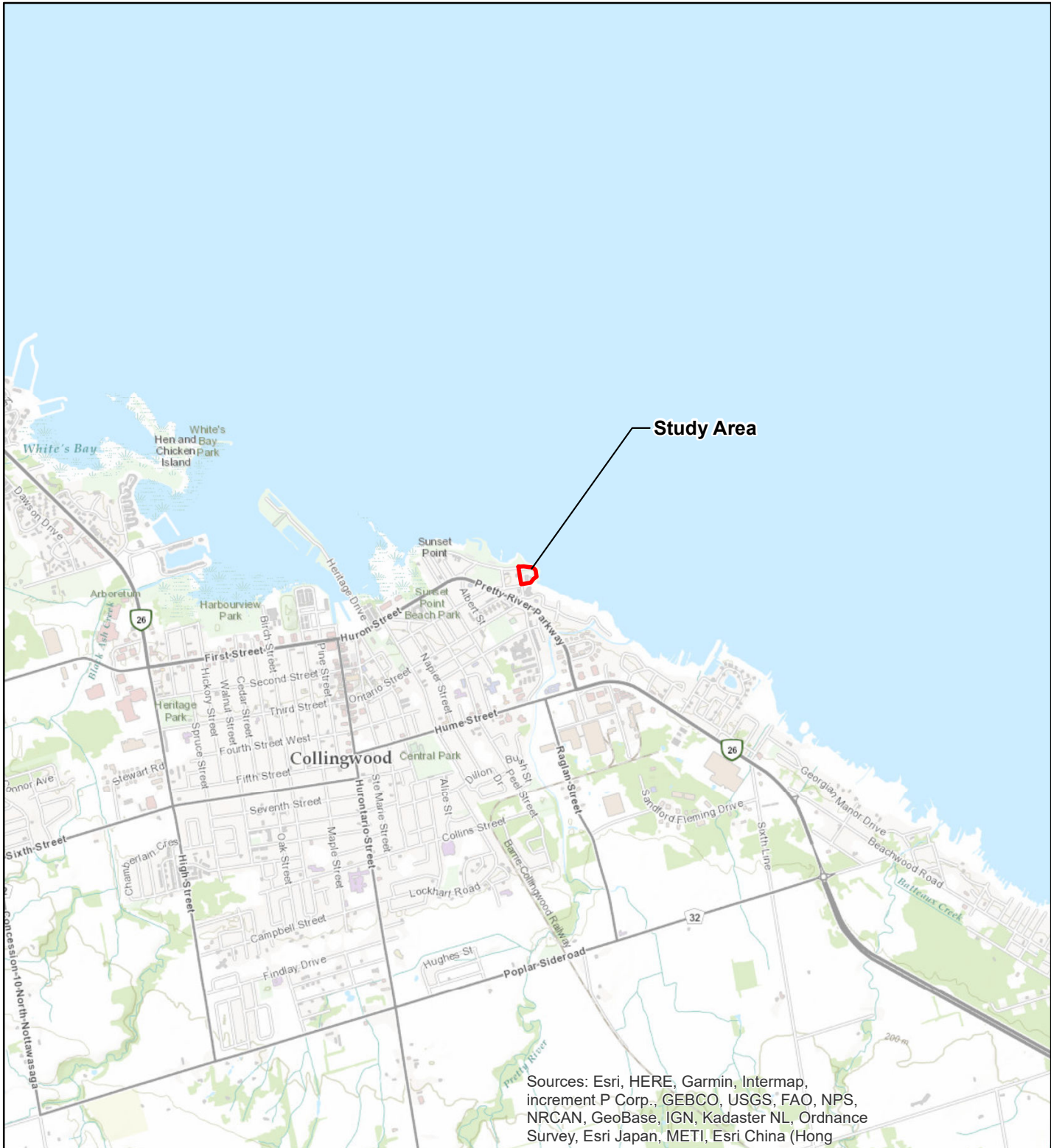
Photo 8: Visually confirmed disturbance (artificial landscaping), facing north east



Photo 9: Visually confirmed disturbance, building footprint and infrastructure), facing north


8. Figures

All figures pertaining to the Stage 1 archaeological assessment for the Collingwood WTP Class EA in the Town of Collingwood, Ontario are provided on the following pages.

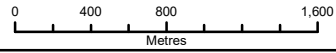


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Legend

 Study Area



Stage 1 Archaeological Assessment Collingwood WTP Class EA Amendment Town of Collingwood, Ontario		
Location of Study Area		
September 2019	1:40,000	Datum: NAD 83 UTM17 Source: LIO 2018
PH: 60609900	V#:	
AECOM		Figure 1
		
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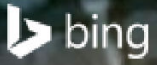


Georgian Bay (baie Georgienne)

Saint Lawrence St

Radlan St

Simcoe St



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Study Area



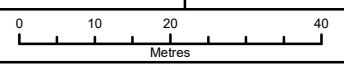
Stage 1 Archaeological Assessment
Collingwood WTP Class EA Amendment
Town of Collingwood, Ontario

Study Area in Detail

September 2019	1:1,000	Datum: NAD 83 UTM17 Source: LIO 2018
PH: 60609900	V#:	

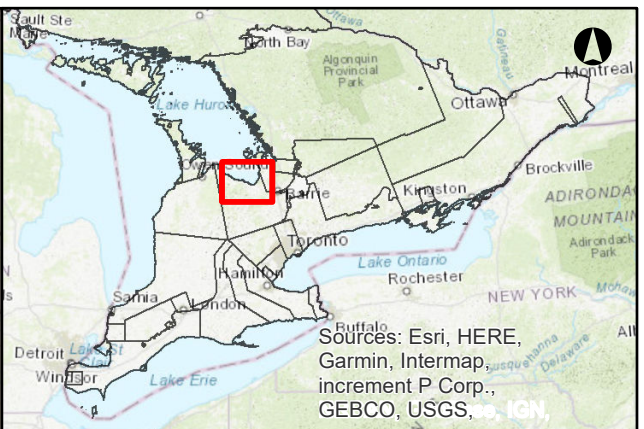
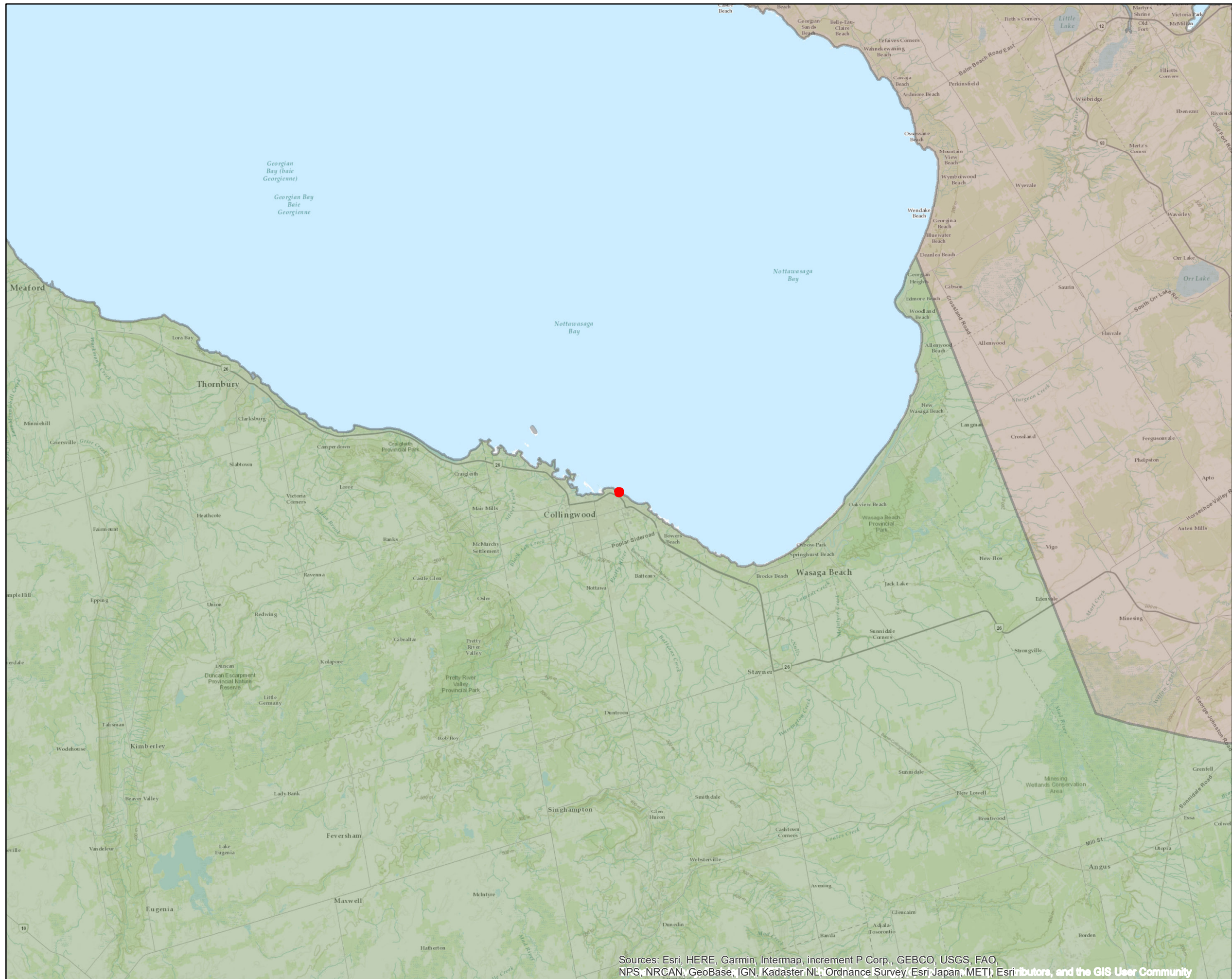


Figure 2






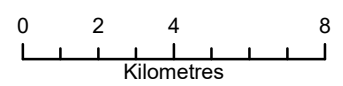
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Map Source: Microsoft (2019) DigitalGlobe (2019) CNES (2019) Distribution Airbus DS
 PH: 60609900 V#: 1:1,000
 Date: September 2019
 Figure 2: Study Area in Detail



Legend

-  Study Area
- Treaty**
-  Lake Simcoe Purchase, Treaty 16, 1815
-  Nottawasaga Purchase, Treaty 18, October 17, 1818



**Stage 1 Archaeological Assessment
Collingwood WTP Class EA Amendment
Town of Collingwood, Ontario**

Ontario Treaties Map

September 2019	1:200,000	Datum: NAD83 UTM17 Source: www.ontario.ca/page/map-ontario-treaties-and-reserves#17
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P#: 60609900	V#:
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Figure 3

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri Contributors, and the GIS User Community

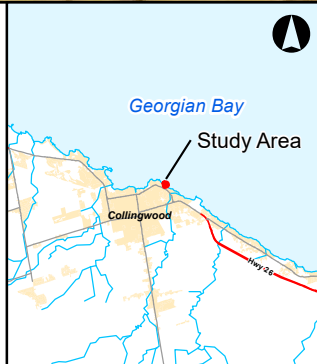
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Map location: \client\p1501\data\work\PROJECT\9100069900\Collingwood WTP Class EA Amendment\9060-Work\626529\GIS\Graphics\Design\1_Reports\ASST1\Fig3_TreatiesPurchases.mxd Date saved: 2019/09/10 12:14 PM User Name: gahb



Legend

 Study Area



Stage 1 Archaeological Assessment
Collingwood WTP Class EA Amendment
Town of Collingwood, Ontario

Portion of the 1871 Map of Simcoe County

September 2019

1:25,000

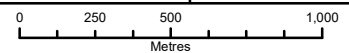
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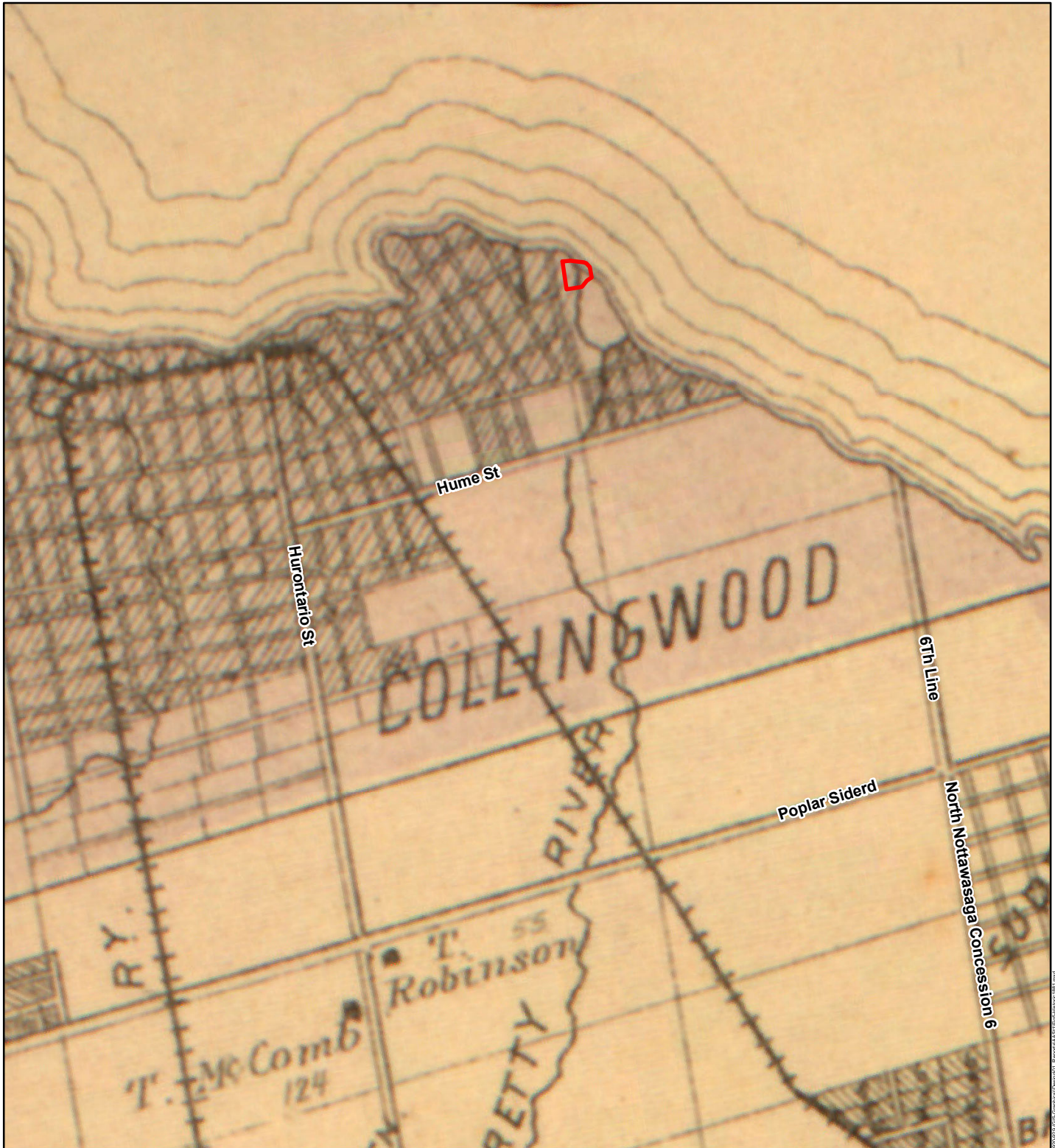
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Figure 4

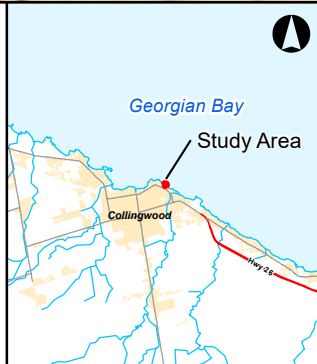


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 Study Area



Stage 1 Archaeological Assessment
Collingwood WTP Class EA Amendment
Town of Collingwood, Ontario

Portion of the 1881 Map of Simcoe County

September 2019

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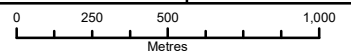
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Supplement to Illustrated Atlas of the
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Figure 5

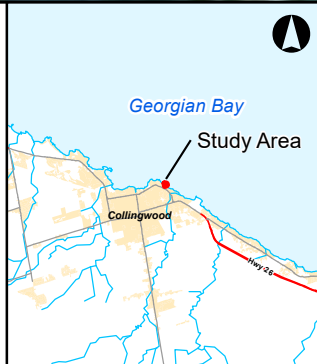


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-  Photo Location and Direction
-  Study Area
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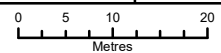
Stage 1 Archaeological Assessment
Collingwood WTP Class EA Amendment
Town of Collingwood, Ontario

Results of the Stage 1 Property Inspection

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Figure 6



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Appendix G

**Town of Collingwood
Raymond A. Barker Water Treatment Plant
ALTERNATIVES SELECTION**

Technical Memorandum

Rev. 7

AECOM Canada Ltd.

April 8, 2020

Town of Collingwood
Raymond A. Barker Water Treatment Plant

Alternatives Selection Technical Memorandum Rev. 7

Prepared by:

AECOM

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Project No.: 60609900

Date:

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905 886 7022 tel

905 886 9494 fax

Project No.: 60609900

Date:

April 8, 2020

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("AECOM") for the benefit of the Client ("Client") in accordance with the agreement between AECOM and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
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April 8, 2020

Mr. Ken Kaden
Project Coordinator Environmental Services
Town of Collingwood
43 Stewart Road
Collingwood, ON, L9Y4M7

Dear Mr. Kaden:

Project No: 60609900

RE: Raymond A. Barker WTP – Alternatives Selection Technical Memorandum Rev. 7

We are pleased to submit the *Alternatives Selection Technical Memorandum Rev. 7 for the Raymond A. Barker WTP*.

Should you have any comments, please do not hesitate to contact the undersigned.

Sincerely,
AECOM Canada Ltd.

Draft

Brian Sahely, M.A.Sc., P.Eng.
Senior Process Engineer/Project Manager
brian.sahely@aecom.com

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Revision Log

Draft #	Revised By	Date	Issue / Revision Description
1	BS	November 11, 2019	Issued for Review
2 (Rev. 1)	BS	November 25, 2019	Issued for Review for Updated Alternatives Description
3 (Rev. 2)	BS	January 19, 2020	Issued for Review for Technical and Cost Scoring
3 (Rev. 2)	BS	February 2, 2020	Issued to Ainley only for preparation of EA boards
4	BS	February 25, 2020	Issued with tender estimate (conceptual drawing still missing)
5	BS	March 11, 2020	Issued with updated costs
6	BS	March 24, 2020	Issued with existing vs. optional concept renderings
7	BS	March 24, 2020	Issues with updated high lift pumping strategies given receipt of Municipal and Regional System Analysis (Appendix B)

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Appendices

- Appendix A: Detailed Technical Evaluation Scoring and Results
Appendix B: Distribution System Analysis

1. Introduction

1.1 Background

The Town of Collingwood Master Servicing Plan (MSP) has identified the need to expand the existing 31.14 ML/d Raymond A. Barker Water Treatment Plant which currently has insufficient capacity to accommodate future water demands for the Town of Collingwood and its contractual commitments to supply treated water to other municipalities.

A Class Environmental Assessment (EA) previously filed in September 2004 has now expired. It is no longer valid due to significant updates in planning, technology and consultation requirements. Therefore, instead of an Amendment/Addendum to the 2004 Environmental Study Report (ESR), an Updated Phase 3 & 4 ESR will be prepared, referencing the MSP (including March 2019 PIC) to satisfy Phases 1 & 2.

The MSP determined the need to increase the ultimate plant capacity identified in the 2004 Class EA (75 MLD) to 101 MLD for current full build-out projections and commitments to other municipalities. When doing so, the MSP showed various capacity requirements at different phases. For example, the plant capacity required for the year 2038 is 51,871 m³/d – note that this year was selected as the maximum plant net rated capacity to maintain the required intake raw water instantaneous flowrate below that allowed in the current Permit-to-Take-Water.

Prior to reviewing alternatives for meeting the ultimate and phase 1 capacity, the following four (4) Technical Memorandum were completed by AECOM in November 2019:

- **Natural Environment Assessment** – The assessment indicated that there are no designated natural heritage features or areas (e.g., significant wetlands, etc.) or ecological communities within the study area. Potential impacts to noted species at risk or their habitat are considered low provided implementation of avoidance and mitigation measures are followed.
- **Stage 1 Archaeological Assessment** – The assessment indicated that the potential for the recovery of archaeological resources has been removed as a result of extensive, deep land alterations associated with previous construction on the site.
- **Condition Assessment** – An architectural and structural condition assessment was conducted for the Raymond A. Barker Water Treatment Plant. The condition survey methodology was limited to visual inspection of exposed components from ground level. Therefore, this assessment is a preliminary condition survey, not a detailed condition survey. Interior and exterior areas of the plant buildings assessed included the surge chamber, raw water building, generator building, industrial building, and main plant building. Recommendations are presented along with an opinion of costs for immediate and future recommended upgrades.
- **Plant Performance/Capacity Assessment** – The conclusion of the performance assessment is that there are no new treatment processes that need to be added to the Raymond A. Barker WTP to improve the treated water quality to meet the proposed performance targets in Table 3. The report recommended that the expansion of the plant focus on capacity limitations. The capacity assessment presented a detailed catalogue of the existing capacity of each unit treatment of the WTP with a summary provided in Table 1.

Table 1 Equivalent Net Plant Capacity Assessment of Existing Unit Processes

Process	Equivalent Net Plant Capacity (m ³ /d)	Comments
Intake	100,917	Note that a higher Nottawasaga Lake level than 175.6m and a higher intake C factor than 110 will result in a higher intake net capacity.
Membrane System	27,656	Sum of 23,113 m ³ /d (ZW500 system) and 4,543 m ³ /d (ZW1000 system) at 2°C and 30 days CIP frequency and design fluxes as shown in this report. This is based on current flux standards and can be increased if needed. This capacity assumes no substantial fibre breakages that will require membrane modules to be isolated, resulting in a reduction of plant capacity.
Chlorine Contact Chambers	21,423	Based on providing 0.5-log inactivation of <i>Giardia</i> cysts at 0.5°C, pH of 8.1 and 1.66 mg/L average free chlorine residual. The free chlorine residual can be increased as needed to achieve sufficient disinfection.
Clearwell	45,600	Based on providing 15 minutes high lift equalization volume.
Municipal HLPs	28,850	Firm capacity of pumps shown. Note that the Municipal HLPs cannot be reviewed on their own given that the plant feeds both the Municipal HLPs and the Regional HLPs.
Regional HLPs	22,890	Firm capacity of pumps shown. Note that the Regional HLPs cannot be reviewed on their own given that the plant feeds both the Municipal HLPs and the Regional HLPs.
Chlorinator	103,013	Limited by CT chamber chlorinator.
V-notch & Rotameter	43,758	For chlorination in the CT chamber.
Chlorine Gas Storage	30,941	Based on 2 chlorine gas containers providing 30 days average day design flow and dosage.

The next step of this project is to review various alternatives for meeting the plant capacity for Phase 1 and ultimate flows as presented in Table 4.

1.2 Objectives of this Memorandum

The objective of this report is to present alternatives for achieving the plant capacity for Phase 1 and ultimate flows; and, recommend preferred alternatives based on a cost-benefit evaluation. A conceptual design and opinion of costs of the preferred upgrades for Phase 1 and ultimate flows are also provided.

1.3 Memorandum Outline

The outline of this memorandum is shown in Table 2.

Table 2 Memorandum Outline

Section No.	Description
1	Presents the project background, objectives and provides an outline of this report.
2	Presents the evaluation approach.
3	Presents the project objectives.
4	Presents the preliminary screening criteria.
5	Identifies and screens various alternatives to meet phase 1 and ultimate flows.
6	Presents the alternatives for further evaluation.
7	Completes the technical evaluation of short-listed alternatives.
8	Completes the cost evaluation of short-listed alternatives.
9	Presents the Cost-Benefit analysis results.
10	Presents a sensitivity analysis on the Cost-Benefit analysis.
11	Presents the preferred alternatives given the Cost-Benefit analysis and sensitivity analysis.
12	Presents a conceptual design of the phase 1 and ultimate upgrades.
13	Presents an opinion of cost of the phase 1 and ultimate upgrades based on 2020 dollars.

2. Evaluation Approach

2.1 Overview of the Evaluation Approach

The evaluation methodology is essential to guiding the decision-making process. A well-structured and comprehensive evaluation methodology provides the basis for decision making that is sound, defensible, traceable and in this case, consistent with the project objectives for the plant expansion.

An overview of the steps that will be undertaken to identify the preferred alternative is outlined in Figure 1 below and described in subsequent sections of this memorandum.

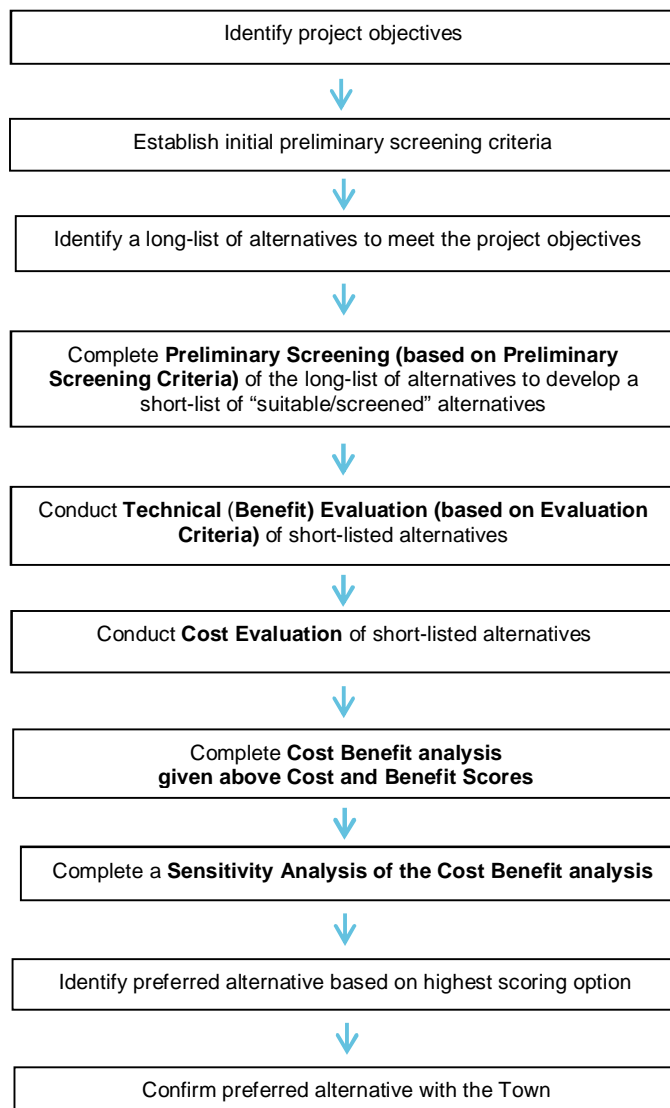


Figure 1 Overview of Evaluation Approach

2.2 Evaluation Process

Experience in other projects of similar nature has shown that development of a systematic, step-wise method for making decisions at the start of the project helps to focus and clarify decision-making. The purpose of the preliminary screening is to identify a short-list of alternatives, from the initial long-list of options that are considered feasible for this project and eliminate those that are not feasible given the operational requirements of this project. This first step in the evaluation process helps to avoid the need to carry unrealistic alternatives when completing the detailed evaluation of the short-listed alternatives.

The short-listed alternatives will then be subjected to a detailed evaluation using a weighting and ranking system that enables a systematic, rational, and reproducible comparison and identification of the preferred alternative.

As the selection of the preferred alternative will need to strike a balance between cost and non-cost factors, the proposed methodology for the detailed evaluation step is four-fold:

- Construct a decision model that includes consideration of all factors or criteria not directly related to cost. Each of these factors/criteria will receive a weighting that is directly related to its importance within the project; the higher the weighting, the more important the factor/criteria. Each short-listed alternative will receive a score ranging from 0 – 10 (with increments in 0.5) points for each factor/criterion that will be based on the level of technical benefit it provides. The scoring will also be determined based on the relative technical benefit the short-listed alternative offers in comparison to the others.
- In parallel, generate conceptual level capital and operations and maintenance (O&M) costs for each short-listed alternative, which in turn will be used to develop Life Cycle Costs.
- Perform a Cost-Benefit Analysis using the abovementioned technical benefit scoring and costs. In order for the Town to select the preferred alternative of value rather than strictly by cost, the overall analysis scoring will be based on 70% technical and 30% cost. It is recommended that the short-listed alternative that scores the highest Cost-Benefit Analysis be the preferred alternative.
- Perform sensitivity analyses on both the decision model and the cost estimates to check that the results will not vary if changes in scoring or costs are made. This verifies that any decisions made using this process are robust and defensible. The revised Cost-Benefit Analysis that will be performed as part of the sensitivity analyses will be based on a 50% technical and 50% cost weighting, which equals to a Benefit/Cost Evaluation Philosophy.

3. Project Objectives

3.1 Project Objectives

Project objectives have been established in order to represent the driving factors behind this project as well as those elements that are expected to have an important influence in the decision-making process. The success of the evaluation methodology can be measured by the extent to which the outcome of the evaluation process is able to achieve these goals/objectives at the end of the process. Consequently, with this philosophy, the following project objectives have been developed:

- The preferred design concept proposed for the expansion of the Raymond A. Barker WTP will be able to provide a safe and secure water supply that meets or exceeds the proposed water quality (Table 3) for the plant in a fiscally and technically responsible manner.
- The preferred design concept for the expansions will be, to the greatest extent possible, compatible with the existing treatment systems and will therefore result in limited modifications to the existing processes. In addition, if modifications or upgrades to the existing processes are required, the benefit of these modifications/upgrades should offset the costs associated with their implementation.
- The preferred design concept will be capable of providing the required water demands listed in Table 4.
- Construction and implementation of the preferred design concept will allow the Town to continue to meet water production and projected water demands and interfering to a minimum with the current operation of the plant and the uninterrupted supply of water.
- The preferred design concept will allow the Town to operate the facility in a manner that is consistent with the availability of staff resources and in a way that is simple and fiscally responsible by balancing capital and operating costs.
- The preferred design concept will address in a responsible and practical manner all issues and concerns identified by the different stakeholder groups identified throughout the process.

3.2 Water Quality Treatment Criteria and Water Demand Projections

The water quality treatment criteria are found in Table 3.

Table 3 Water Quality Treatment Criteria for the Raymond A. Barker WTP

Parameter	Ontario Requirement	Proposed Performance Target
Ontario Drinking Water Quality Standards (ODWQS)		
<i>Cryptosporidium</i>	2-log reduction	4-log reduction
<i>Giardia</i>	3-log reduction (incl. 0.5-log inactivation from disinfection)	4-log reduction (incl. 0.5-log inactivation from disinfection)
Viruses	4-log reduction (incl. 2-log inactivation from disinfection)	4-log reduction (incl. 2-log inactivation from disinfection)
HAA5 (µg/L)	80 based on a running annual average of quarterly samples measured at a point that is likely to have an elevated potential for formation of THMs and HAAs	60 LRAA
Total THMs (µg/L)	100 based on a running annual average of quarterly samples measured at a point reflecting the maximum residence time in the distribution system (LRAA)	80 LRAA
Turbidity (NTU)	< 0.1 NTU, 99% of time	< 0.1 NTU, 99% of time < 0.3 NTU, 100% of time
Distribution Free Chlorine Residual (mg/L)	0.05 to 4.0 mg/L free chlorine residual	0.05 to 3.0 mg/L free chlorine residual (target of 1.50 mg/L average leaving the plant)
Ontario Drinking Water Quality Objectives and Guidelines (ODWQOG)		
Corrosive/water stability	-	Non-corrosive and stable water
Taste & Odour	Inoffensive	Inoffensive

Water demand projections are found in Table 4. For the purpose of this report, the flowrates in this table will be used in all calculations. The instantaneous factors for the CT chambers instantaneous flows and the raw water instantaneous flows are shown to be different to that from the *Plant Performance/Capacity Assessment TM* given that the preferred membrane system will most likely not be a constant bleed system. During detailed design, depending on the preferred membrane system(s) selection and design, the instantaneous factors need to be verified. With the CT chambers instantaneous flows significantly impacting the size of the UV units and CT chambers, it was deemed critical to assume the higher instantaneous flows for this report given that 30% of the Cost-Benefit Score for any alternative comparison is allocated to a 20-year life cycle cost of the alternatives.

The average day demands for the total net treated water is approximately 40,179 m³/d for Phase 1 (2038 flows) and 81,244 m³/d for ultimate flows. This equates to an MDD/ADD ratio of 1.291 for Phase 1 and 1.244 for the ultimate flow.

Table 4 Water Demand Projections for the Raymond A. Barker WTP

Phase #	Intake	Industrial Well	WTP			
	Intake Raw Water Inst. ⁶ Flows (m ³ /d)	Industrial Flows ⁵ (m ³ /d)	CT Chambers Inst. Flows ⁴ (m ³ /d)	Total Net Treated Water Flows ³ (m ³ /d)	Municipal Pipeline Flows ² (m ³ /d)	Regional Pipeline Flows ¹ (m ³ /d)
1 (approx. Year 2038)	67,876	2,000	65,876	51,871	32,757	19,114
Ultimate	130,358	2,000	128,358	101,069	51,483	49,586

Notes:

1. Includes approximately 18,250 m³/d (Phase 1) and 33,500 m³/d (Ultimate) for the Town of New Tecumseth; and, 0 m³/d (Phase 1) and 4,854 m³/d (Ultimate) for the Township of Clearview (Nottawa). 864 m³/d (Phase 1) and 11,232 m³/d (Ultimate) of Collingwood water goes through the Regional pipeline to the Davey reservoir/pumphouse to service Zone 2.
2. Includes approximately 27,621 m³/d minus 864 m³/d (Phase 1) and 46,315 m³/d minus 11,232 m³/d (Ultimate) for the Town of Collingwood; and, approximately 6,000 m³/d (Phase 1) and 16,400 m³/d (Ultimate) for the Town of Blue Mountains.
3. Sum of Municipal and Regional pipeline flows.
4. Given approximate membrane instantaneous permeate factor of 1.27 to account for membrane downtime and backwash wastewater volume.
5. Even though the original required industrial demand was 16,418 m³/d, industrial flows since 2017 never exceeded 2,000 m³/d, so this number was used as agreed by the Town. If a higher capacity is needed, then this may come from the treated water supply given the restrictions of the PTTW.
6. Assumes no additional instantaneous factors to that already accounted for in the membrane permeate factor.

4. Preliminary Screening Criteria

A preliminary screening of alternatives will initially be completed in order to eliminate those alternatives not viable for implementation at the Raymond A. Barker WTP. Preliminary screening will be accomplished by considering the preliminary screening criteria shown in Table 5.

Table 5 Preliminary Screening Criteria

Preliminary Screening Criteria	Description
Compliance	<ul style="list-style-type: none"> • Ability to continuously meet or exceed the proposed treatment objectives in Table 3
Technical Feasibility	<ul style="list-style-type: none"> • Adequate space exists for the given location. • Compatibility with existing infrastructure (potential impact on overall construction requirements). • Compatibility with existing processes (operating risk, system reliability, maintenance and monitoring requirements). • Is a common technology used in water treatment facilities in North America.
Capacity	<ul style="list-style-type: none"> • Ability to meet the required water demands listed in Table 4.
Financial	<ul style="list-style-type: none"> • Is known not to have a high financial and/or operating cost.

Alternatives that are considered suitable based on the preliminary screening will be carried forward to the evaluation process.

5. Identification and Screening of Various Alternatives to Meet Phase 1 and Ultimate Flows

5.1 Introduction

The existing treatment train at the Raymond A. Barker WTP is shown in Figure 2. This section reviews the existing treatment processes and the alternatives, if any, to achieve the Phase 1 and ultimate flows presented in Table 4.

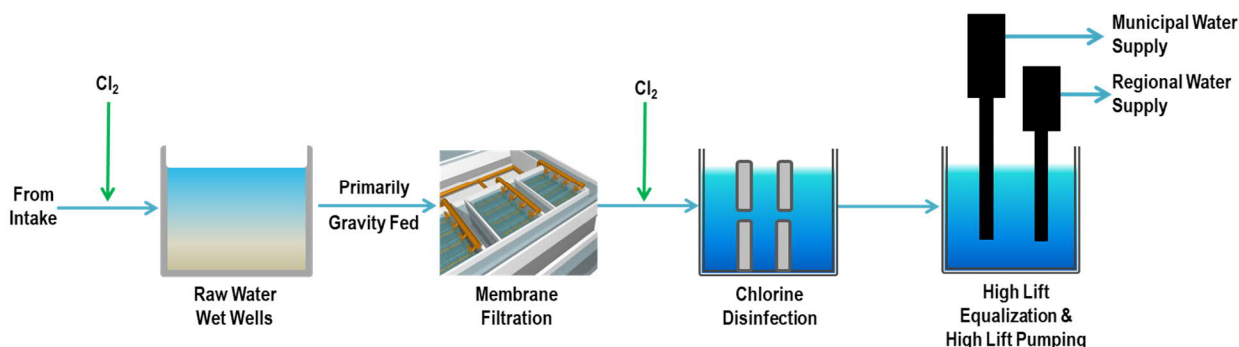


Figure 2 Existing Treatment Train

5.2 Intake

5.2.1 Current Capacity

Table 1 shows the instantaneous capacity of the intake to be 125,000 m³/d, which is slightly less than the ultimate instantaneous capacity of 130,358 m³/d (assuming a permeate membrane instantaneous factor of 1.27 per Table 4).

5.2.2 Upgrade Requirements

The current Permit-to-Take-Water (PTTW) No. 3451-8CZMJC, dated January 28, 2011, authorizes the withdrawal of water up to 68,250 m³/d ML/d (47,400 L/min). The previous PTTW No. 91-P-3037, dated January 15, 2001, allowed two Taking Rates, including a Taking Rate 2 as listed below, which does not become effective until the OWRA Section 52 approval for the water works at the higher rate has been issued as stated in that PTTW:

- **100,100 m³/d (maximum amount taken per day):** This flowrate is slightly less than the ultimate net flowrate of 101,069 m³/d, which can be applied for when needed.
- **100,094 m³/d (maximum amount taken per minute):** This flowrate is considerably less than the required ultimate instantaneous flowrate of 130,358 m³/d and will need to be applied for when needed.

Given above, Table 6 shows the intake upgrades to achieve the Phase 1 and ultimate flow requirements.

Table 6 Intake Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Process Area	Instantaneous Flowrate Requirements	Recommended Upgrades	Firm Capacity
Intake	Phase 1 67,876 m ³ /d	Do nothing	-
	Ultimate 130,358 m ³ /d	Whenever additional intake capacity is needed, the following should be reviewed further at that time: <ul style="list-style-type: none"> • The required intake capacity should be re-calculated given the actual membrane system designed and installed as this will impact the instantaneous factors used to calculate the required raw water instantaneous flowrate, i.e., intake capacity. • The Nottawasaga Bay low water level should be reviewed again since this impacts the intake capacity. • Testing should be conducted to confirm the intake C factor as this will impact the intake capacity. • An application should be made for an increase in capacity in the PTTW, both for the maximum amount taken per day and the maximum taken per minute. In the past frazil ice used to occur at the intake crib, with this event either decreasing the plant capacity or requiring the plant to shut down. With rising Bay water levels, this issue has not occurred since before 2009. During a Workshop with the Town on October 18, 2019, it was discussed that Bay water levels should continue to be monitored and that any frazil ice concerns would be addressed in the future, if needed.	-

5.3 Low Lift Pumping Station and Micro-screening

5.3.1 Current Capacity

There is currently no low lift pumping; however, there is a 15 kW (20 hp) mixer in the inlet channel 1 in the raw water wet well 1 used to increase the hydraulic grade line of the water in the raw water wet well 2. To date, this practice has been sufficient to achieve the plant target capacity.

5.3.2 Upgrade Requirements

There is currently no screening (whether traveling screens or micro-screens) to protect the membranes from fibre breakages from fine debris, including sharp objects within the raw water. Significant fibre breakages can reduce the plant capacity. The plant operations staff prefer to avoid the use of traveling or bar screens within the raw water wet wells to protect the low lift pumps (recommended per below) and membranes, with a preference to install micro-screens above grade. The installation of micro-screens and the need for additional membrane treatment capacity (all at a higher hydraulic grade line) will require low lift pumps to achieve the following instantaneous flowrates:

- Phase 1 flowrate = 65,876 m³/d, i.e., 67,876 (intake raw water instantaneous flow) – 2,000 (industrial flow)
- Ultimate flowrate = 128,358 m³/d, i.e., 130,358 (intake raw water instantaneous flow) – 2,000 (industrial flow)

Table 7 shows the low lift pumping station and micro-screening upgrades to achieve the Phase 1 and ultimate flow requirements.

Table 7 Low Lift Pumping Station and Micro-screening Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Process Area	<i>Instantaneous Flowrate Requirements</i>	Recommended Upgrades	<i>Instantaneous Firm Capacity</i>
Low Lift Pumping Station	Phase 1 65,876 m³/d	<ul style="list-style-type: none"> Construct two (2) low lift wet wells (LLWWs), between the existing raw water wet well 2 and industrial pumping station wet well to house the suction pipes of the new low lift pumps and industrial feed pumps Demolish the existing raw water building and corridor to the existing industrial pumping station; removal of all existing equipment within these infrastructures. Construct a new low lift pumping station (LLPS) with location shown in Figure 3 to house new low lift pumps, automatic strainers (micro-screens), pipes, valves, instruments, controls panels, etc. Install three (3) low lift pumps (LLPs) (2 duty, 1 standby), each pump rated at 42,786 m³/d, with space for installation of a fourth LLP rated at 42,786 m³/d Install lift header(s) and flowmeter(s) to feed the new automatic strainers prior to feeding the membrane system(s) 	85,572 m ³ /d
	Ultimate 128,358 m³/d	<ul style="list-style-type: none"> Install fourth LLP rated at 42,786 m³/d. 	128,358 m ³ /d
Micro-screening	Phase 1 65,876 m³/d	<ul style="list-style-type: none"> Install two (2) automatic strainers (1 duty, 1 standby), with the new LLPS, with each strainer rated at 65,876 m³/d, with space for installation of a third strainer rated at 65,876 m³/d 	65,876 m ³ /d
	Ultimate 128,358 m³/d	<ul style="list-style-type: none"> Install third strainer rated at 65,876 m³/d 	131,752 m ³ /d

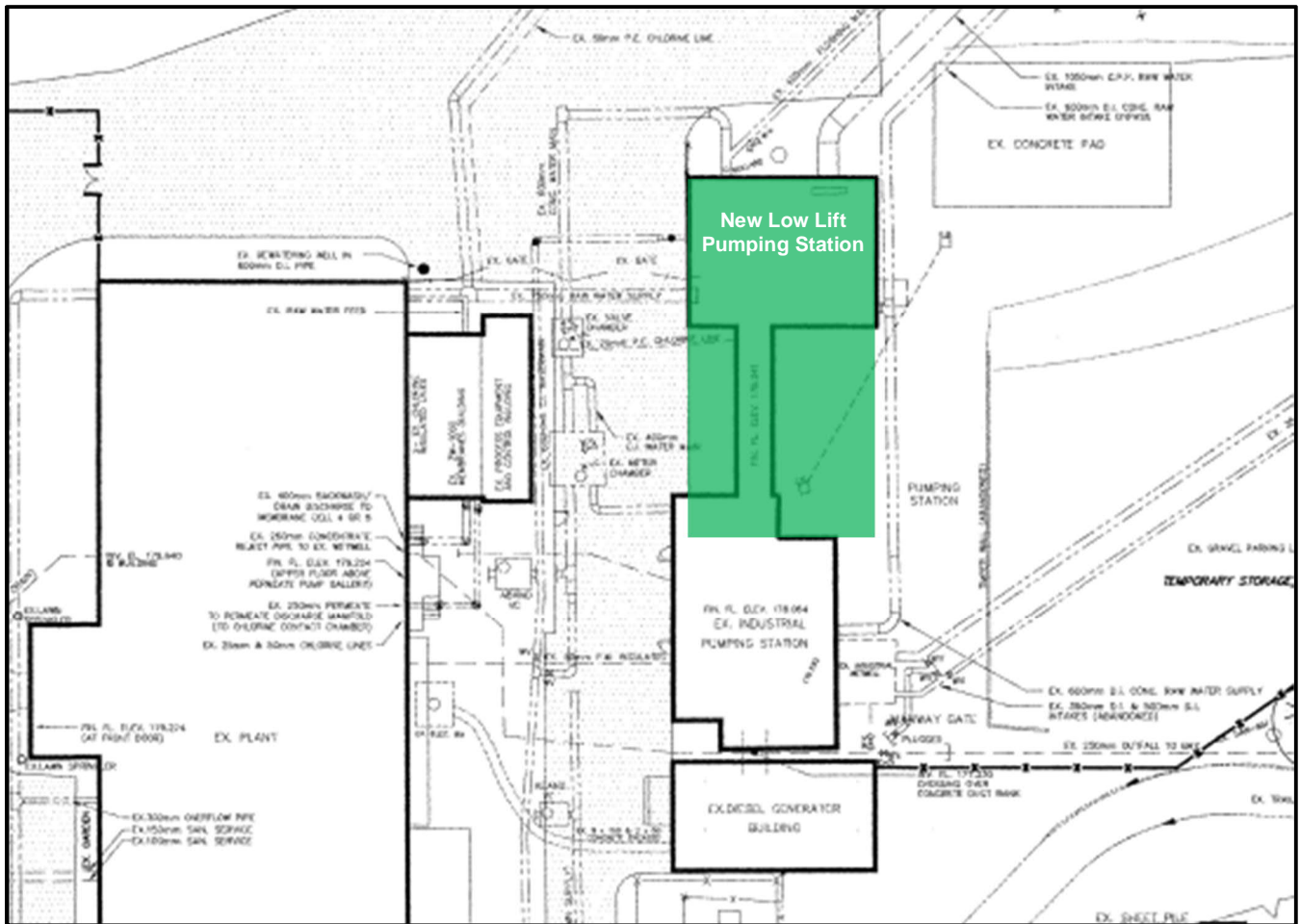


Figure 3 Proposed Location of New Low Lift Pumping Station

5.4 Industrial Pumping Station

5.4.1 Current Capacity

Table 1 shows the required industrial pumping station flowrate to be 2,000 m³/d for Phase 1 and ultimate flows. This is a considerable decrease from the original required industrial demand of 16,418 m³/d.

5.4.2 Upgrade Requirements

Table 8 shows the industrial pumping station upgrades to achieve the Phase 1 and ultimate flow requirements.

Table 8 Industrial Pumping Station Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Process Area	Instantaneous Flowrate Requirements	Recommended Upgrades	Instantaneous Firm Capacity
Industrial Pumping Station	Phase 1 2,000 m ³ /d	<ul style="list-style-type: none"> Demolish the existing industrial pumping station (with a new generator building to be constructed at this location per Section 5.14). Install two (2) industrial feed pumps (1 duty, 1 standby) within the new low lift pumping station discussed in Section 5.3, each pump rated at 2,000 m³/d, with space for installation of a third industrial feed pump in case flows greater than 2,000 m³/d are eventually required. Install industrial header(s) and flowmeter(s) to feed the new automatic strainers prior to feeding the industrial pipeline. 	2,000 m ³ /d
	Ultimate 2,000 m ³ /d	<ul style="list-style-type: none"> Install additional industrial feed pump as required at any time. 	2,000 m ³ /d
Strainers	Phase 1 2,000 m ³ /d	<ul style="list-style-type: none"> Install two (2) automatic strainers (1 duty, 1 standby), with the new industrial feed pumps, with each strainer rated at 2,000 m³/d, with space for installation of a third strainer rated at the same capacity as the third pump if installed in the future. Note that the mesh size of this strainer will be much larger than that of the strainers on the low lift discharge header(s). 	2,000 m ³ /d
	Ultimate 2,000 m ³ /d	<ul style="list-style-type: none"> Install third strainer rated at the same capacity as the third pump if installed in the future. 	2,000 m ³ /d

5.5 Membranes

5.5.1 Current Capacity

Table 1 shows the current capacity of the ZW500 and ZW1000 membrane systems at preferred operating fluxes to be 23,113 and 4,543 m³/d, respectively, for a total of 27,656 m³/d. This is less than the plant current rated capacity of 31,140 m³/d understanding that this capacity can be achieved by increasing the operating flux of the membrane systems by 13%.

The following concerns with the existing membrane systems may impact the total capacity of the membrane systems and/or the cost and/or selection of the preferred membrane alternative.

- The ZW1000 system is a temporary installation in a timber structure outside the WTP. During membrane fibre repair, the operators have to remove the timber roof in order to lift the membrane cassettes out of the steel membrane tank to conduct a fibre repair. If the temporary ZW1000 system is needed to provide additional water production, a permanent structure should be constructed to allow easy removal and maintenance of the membrane cassettes.
- The wastewater from the ZW1000 system is discharged to train E in the ZW500 system. This increases the bacteriological counts and the solids in these trains thus increasing the fouling rate of the membranes and also, the potential for an increase count of these parameters in the membrane permeate water. To alleviate concerns with this practice, the ZW500 train E currently rejects at a higher capacity. However, this discharge should be eliminated.
- For the ZW500 membrane system, there is no capability to automate the membrane integrity test (MIT) which is currently conducted manually annually. However, there are on-line turbidity meters on each membrane permeate header. To meet current standards, equipment should be installed to automate the MIT with this test occurring daily for approximately 30 minutes per test. This will decrease the production of the ZW500 membrane system thus decreasing its net capacity.
- The existing backwash and clean-in-place (CIP) tanks are filled with water from the high lift header, which results in a loud noise during the filling process. Consideration should be given to feed these tanks from the

membrane permeate pumps understanding that no chlorine residual will be within the membrane backwash supply water during the colder months when zebra mussel control is not practiced.

- During a clean-in-place process, water is heated within the CIP tank and then transferred to the membrane train undergoing the CIP process. This volume of water does not fill the entire membrane tank such that cold feed water has to be used to top up the membrane tank water level. This results in a decline in water temperature that makes the CIP process less effective than if the water within the membrane tanks was at the targeted temperature.
- There is no standby backwash or CIP tank; however, the CIP tank can act as a backup to the backwash tank with a CIP process being delayed until the backwash tank is back in service.
- After a CIP process, the chemical waste is discharged to the sanitary sewer with no neutralization of the high pH CIP chlorine waste (with sodium bisulphite) or the low pH CIP citric acid waste (with sodium hydroxide). This is typically practiced given sanitary sewer by-laws restrictions.
- There is no bisulphite system to dechlorinate any residual chlorine in the membrane reject wastewater.
- It is typical to install at least one redundant membrane train (N-1R configuration), so that when any component of a membrane train is being serviced or a lengthy clean-in-place (CIP) cycle is being conducted, the plant can always achieve its net rated capacity. The Town has requested that this redundant train for all membrane alternatives be considered within this report and reviewed again during the detailed design stage.
- It is ideal to install standby train(s) to reduce the combined permeate flowrate fluctuations under the following events:
 - When a train is undergoing daily membrane integrity tests (MIT) or a chemically enhanced backwash (CEB), a standby train will operate
 - When a train is undergoing frequent backwash cycles approximately every 30 to 60 minutes, a standby train will operate

Installing two standby trains will result in the designation (N-2S), which when combined with one redundant train will result in the designation (N-1R-2S).

The existing ZW500 membrane trains do not have daily MITs or CEBs conducted. The Town is currently accustomed to having the membrane permeate flows fluctuate during a backwash cycle. Moreover, programming can be conducted to reduce the permeate flowrate fluctuations when not operating near plant capacity such that the flowrate of the remaining membrane trains will ramp up whenever a membrane train is undergoing a backwash cycle (and MIT/CEB is practiced in the future). As a result, no standby trains will be designed on this project.

5.5.2 Upgrade Requirements

5.5.2.1 Filtration (Particulate Removal) Technologies

Overview

Source water may contain turbidity, particles, and organic material. The primary processes used to treat the water are particulate and turbidity removal, which is accomplished by using clarification and filtration techniques. Clarification is the removal of solids from the water by either sedimentation or flotation methods. Filtration is the removal of particulate matter via water flowing through a porous medium. Clarification and filtration are the most practical treatment processes for removal of suspended particles and turbidity from a drinking water supply. Particulate removal processes reviewed as part of this EA comprise:

- Conventional treatment (coagulation/flocculation/clarification followed by granular media filtration)
- Direct filtration (coagulation/flocculation followed by granular media filtration)
- Membrane filtration

A brief description of each of these processes is provided as follows:

Conventional Treatment

Conventional treatment involves the sequential combination of a number of processes which include coagulation, flocculation, clarification and granular media filtration processes (Figure 4).

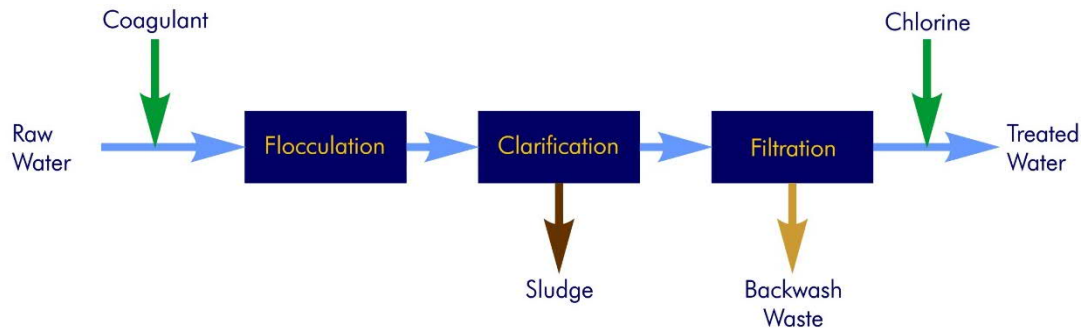


Figure 4 Typical Process Flow Diagram for Conventional Treatment

Coagulation

Coagulation refers to the chemical addition of a coagulant such as alum, ferric chloride or polyaluminium chloride to the raw water. This is a high energy mixing step that allows the quick dispersion of the coagulant into the bulk of the water, which is essential to achieve complete coagulant dispersion before the chemical reactions are complete. Coagulation involves the destabilization of colloidal material through neutralization of their inherent, natural charge, which otherwise keeps the particles in suspension due to mutual electrostatic repulsion. As such, coagulation per se is not specifically a solids removal process; however, it is an instrumental step in facilitating the solids removal in downstream processes.

Flocculation

Following particulate charge neutralization due to coagulation, particles are brought together during a slow mix step called flocculation. Gentle mixing of the coagulated water encourages the collision of small neutralized particles and promote their agglomeration into large particle masses, called “flocs”, which are more amenable for separation downstream. Similar to coagulation, flocculation is not considered a solids removal process, but one important precursor to most clarification and/or filtration processes in most water treatment plants.

Clarification

For waters higher in particulate loading, the flocculation process is then typically followed by clarification, where the heavier and larger particles either settle to the bottom of the basins or float to the surface of the water (depending on the clarification process) and are removed from the water. Clarification processes are normally able to remove the bulk of the particulate matter present in a source water and are usually placed as one of the first processes in the plant, with the aim of reducing particulate loading to downstream processes. There are a number of clarification processes available in the water treatment industry, each with specific characteristics and suited to source waters of different nature. These include:

- High rate clarification with plate (or tube) settlers (Figure 5), and
- Ballasted flocculation/clarification (Figure 6).

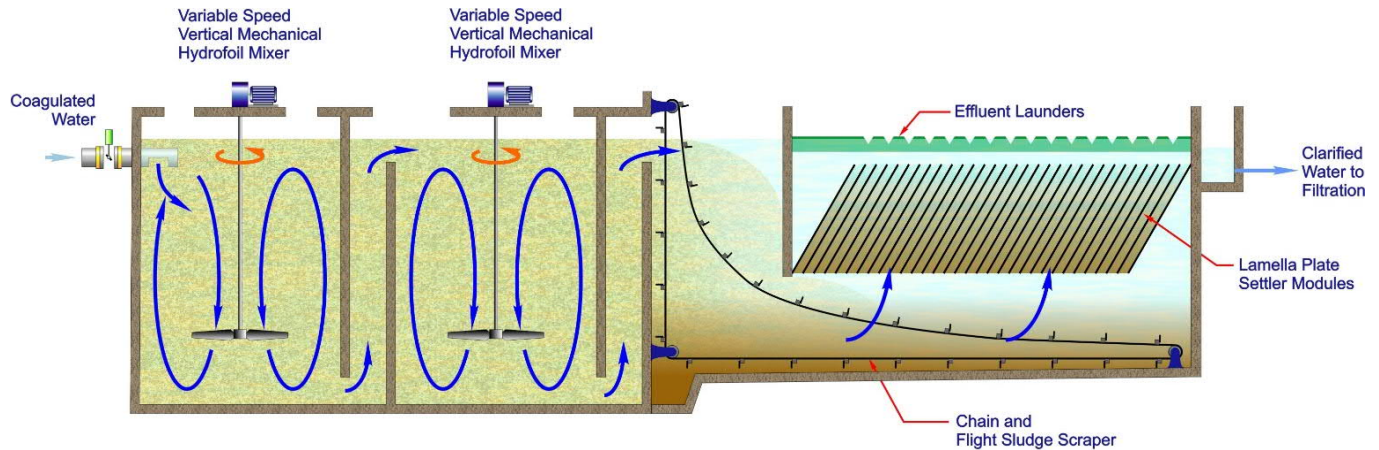


Figure 5 Schematic Diagram of High Rate Clarification (with Coagulation and Flocculation)

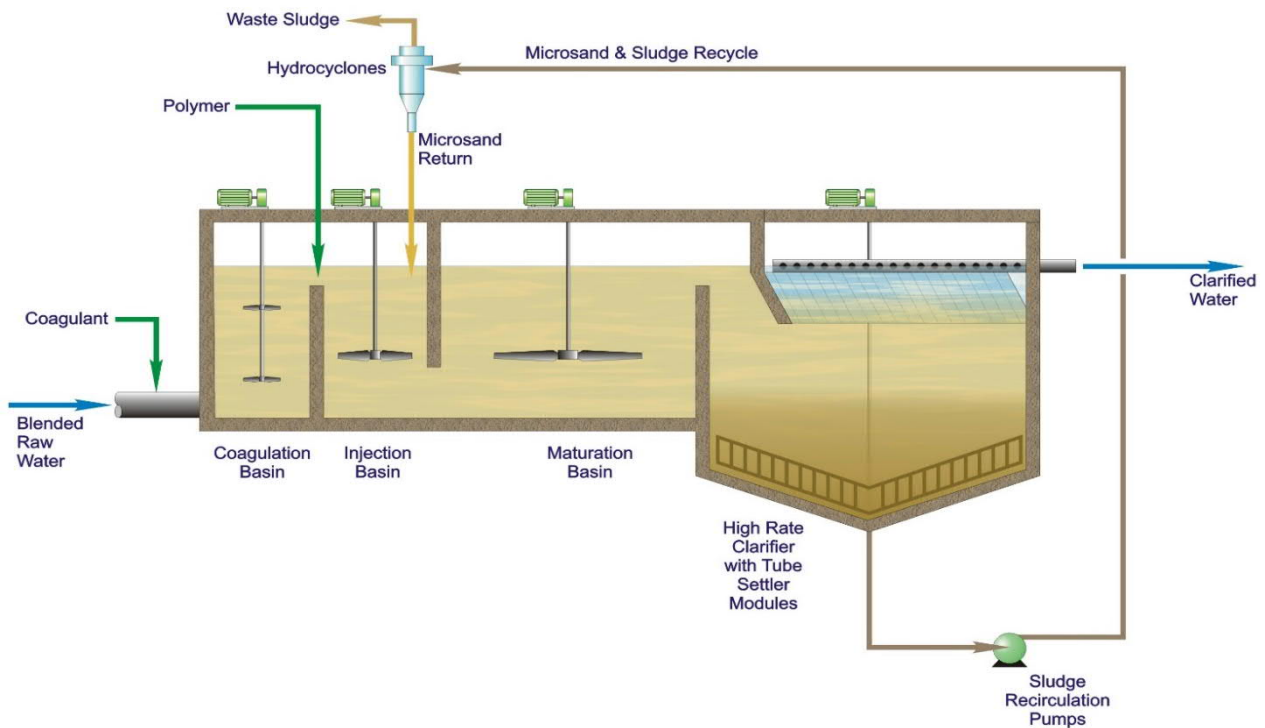


Figure 6 Schematic Diagram of Ballasted Flocculation/Clarification Process (Actiflo®)

Granular Media Filtration (Figure 7)

Granular media filtration represents by far the most common type of filtration used in water treatment and involves the placement of one or more layers of inert granular media within a concrete or fabricated metal structure. Water then flows downward through the media, either by gravity or under pressure, and the media filters the water during its passage through the bed.

The media is sized to balance the need for effective particulate removal with the gradual accumulation of head loss which occurs as particles are trapped in the bed. To facilitate this process, it is typical to place more than one layer of media of different sizes, with larger media at the top, to optimize this balance. Over time, as particles accumulate in the filter, it will need to be backwashed, typically every 24 to 96 hours depending upon the quality of water fed to the filter. The backwash procedure flushes solids out of the bed, restoring it to its clean condition.

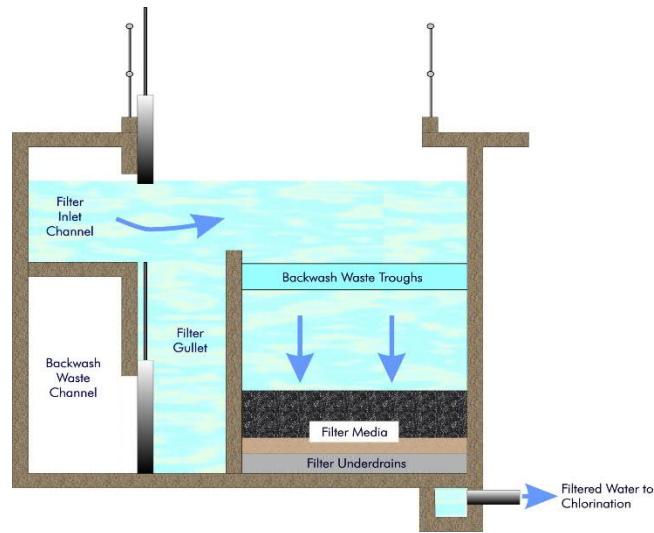


Figure 7 Schematic Diagram of Granular Media Filtration Process

Direct Filtration (coagulation/flocculation followed by granular media filtration)

Direct filtration process consists of chemical coagulation, flocculation, and granular media filtration for the effective removal of particulate and turbidity from the water. Direct filtration eliminates the use of the clarification process from the train; therefore, allowing the filter material itself to do the work of straining contaminants from the water (Figure 8). The treatment processes used in direct filtration are fundamentally the same as those previously described, with the only exception that the clarification step is removed. Filter design is also usually different, typically with deeper, coarser beds being used to increase the solids holding capacity of the bed.

Direct filtration is a relatively simple filtration process, and it is economically attractive. Since the clarification step is omitted from the train, coagulation chemicals require expert handling to achieve the desired results, so trained personnel are necessary to manage filtration systems. The system results in significant improvement of source water quality, but it is best employed on relatively high-quality source waters that contain low levels of particulate material, with constant flows and low turbidity.

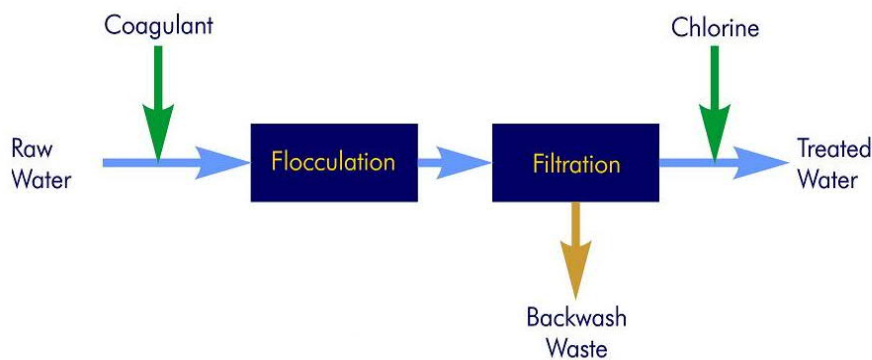


Figure 8 Typical Process Flow Diagram for Direct Filtration

Low Pressure Membrane Filtration

Low Pressure membrane filtration (henceforth termed simply membrane filtration) is a pressure or vacuum-driven physical separation process in which particulate matter is rejected by an engineered permeable membrane. The plastic filter membranes have a very small pore size capable of straining out particles without the need of chemical coagulation, flocculation or clarification processes.

Low pressure membrane filtration (LPMF) processes used for particulate removal in the drinking water industry almost exclusively are based upon the use of hollow fiber membranes, with pore sizes in the 0.01 – 0.1 micron range. Two specific types of membranes are used, microfiltration (MF) and ultrafiltration (UF), characterized by the pore size of the membranes. MF units can achieve removal of particles as small as 0.2 μm , while UF can achieve removal of particles as small as 0.01 μm . The small size of the pores provides excellent removal of particulate matter under all conditions and given that *Giardia* cysts and *Cryptosporidium* oocysts are greater than 2 μm , these types of membranes can provide essentially complete removal of these microorganisms through physical size exclusion.

In some cases, membranes are used in conjunction with a coagulant, or a sorbent (such as powdered activated carbon) to target specific contaminants, as although membranes are the best available technology for particulate removal, they are ineffective against dissolved substances. Coagulation and/or sorption can trap or capture contaminants into a particulate form, able to be removed by the membrane. In addition, membrane systems can also be constructed with clarification processes upstream, based upon the same principle as clarification upstream of granular media filtration, i.e., to reduce the loading of potential foulants to the membrane. However, for source waters like the Nottawasaga Bay, typically with low turbidity concentrations, the use of clarification processes upstream of membranes is usually not necessary for sustainable performance on these types of waters (Figure 9).

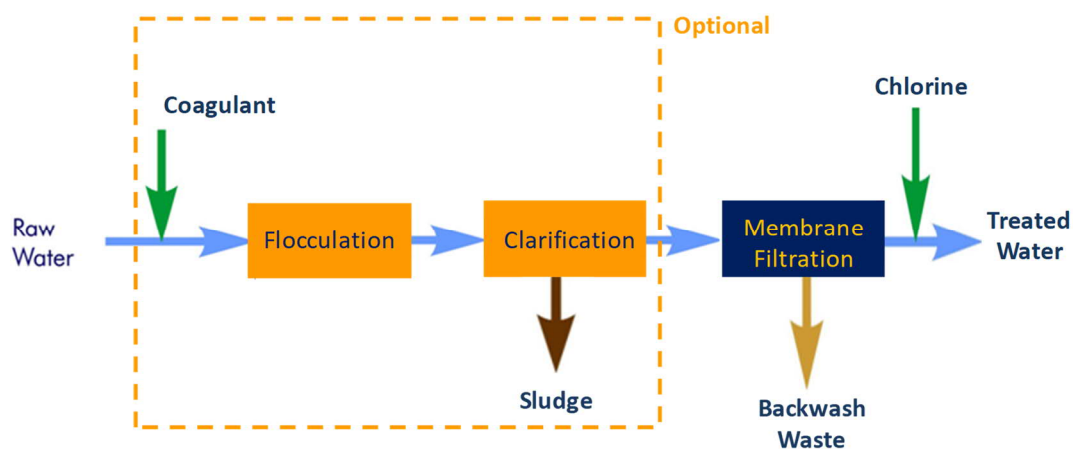


Figure 9 Typical Process Flow Diagram for Membrane Filtration

Membrane systems are proprietary designs that differ from supplier to supplier. There are two main types of membrane filtration systems:

- **Submerged type**, with membranes installed in tanks (Figure 10) are by definition outside-in membranes, as they involve the placement of bundles of membrane fibres into an open tank of water to be treated. The inside of the fibres is placed under vacuum, sucking water through the membrane fibre wall and into the inside of the fibre.
- **Pressure type**, with membranes installed on a pad (Figure 11); where membranes are housed within fabricated pressure vessels, and water is pumped through the membranes under a positive pressure. In pressure fed membranes, water can be fed to the outside of the fibres and forced through to the inside under pressure (outside-in) or fed to the inside of the fibre and forced to the outside under pressure (inside-out) depending upon the particular manufacturer.

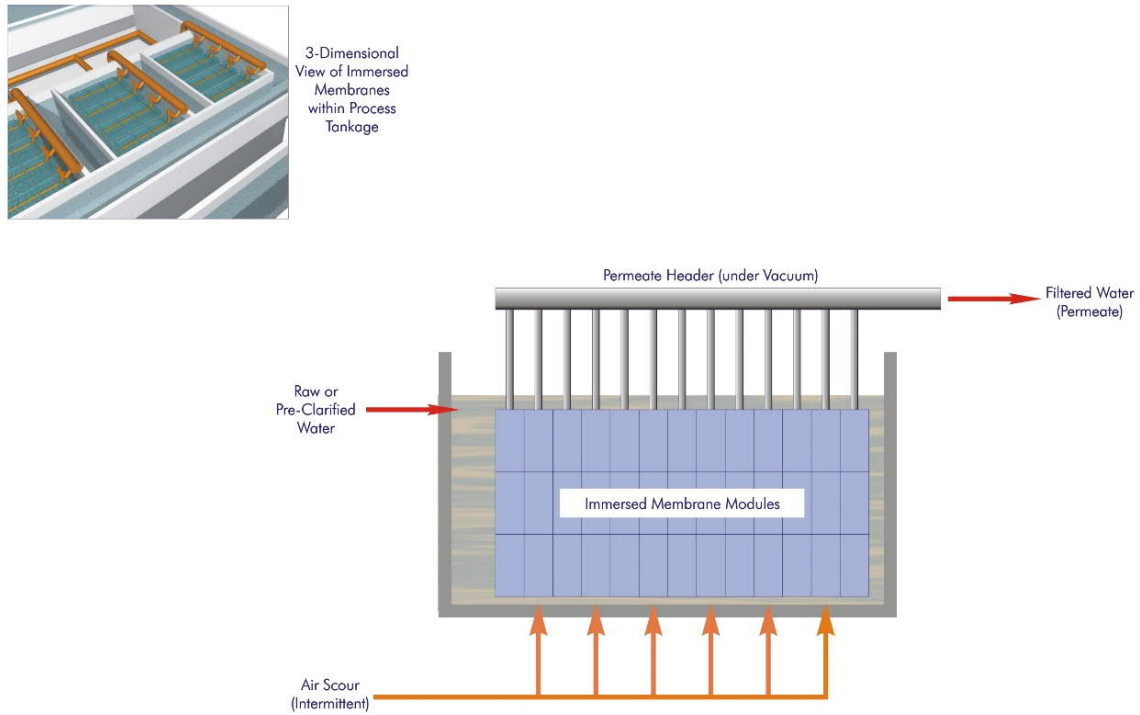


Figure 10 Schematic Diagram of Submerged Membrane Filtration

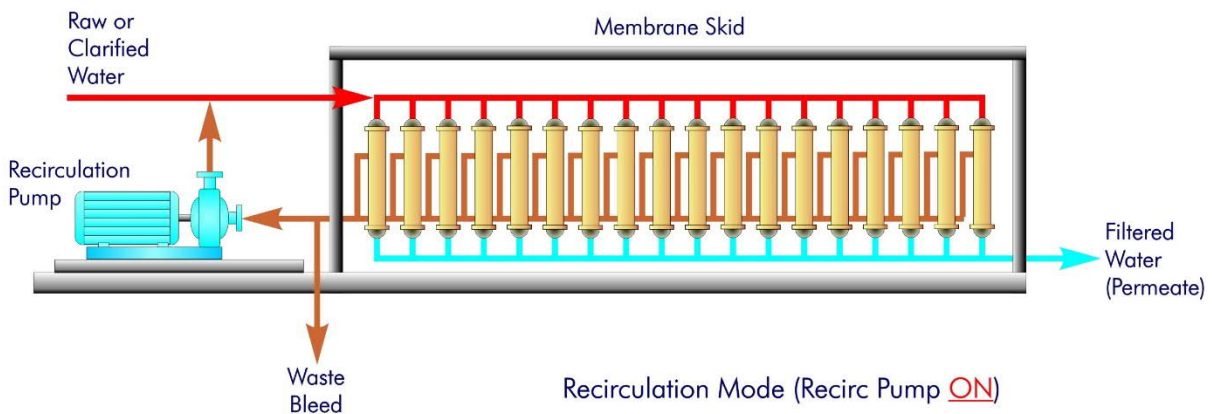


Figure 11 Schematic Diagram of Pressure Fed Membrane Filtration

Summary

Conventional and direct filtration will not be further considered for the following reasons:

- Low pressure membrane filtration will provide a higher filtration capacity on the existing site than conventional and direct filtration.
- Lower pressure membrane filtration will provide a much higher pathogen removal credit than conventional and direct filtration.
- The plant operations staff are accustomed to operating a low-pressure membrane filtration system.

Both submerged and pressure membranes will be considered for the plant expansion.

5.5.2.2 Maximum Capacity Capable from within the Existing ZW500 Membrane Building

Using ZW500d Short Modules

Prior to reviewing the membrane alternatives, it is beneficial to first understand how much capacity can the existing ZW500 membrane system achieve given preferred operating fluxes and each train filled with ZW500d short modules, similar to trains B and E. Table 9 shows this total net capacity of the ZW500d (short module) membrane system to be 29,450 m³/d, which when added to the capacity of the ZW1000 membrane system, results in a total net capacity of 33,993 m³/d with no redundant trains and a total net capacity of 28,103 m³/d with one redundant train. This capacity remains considerably less than the Phase 1 and ultimate net capacity requirement of 51,871 and 101,069 m³/d, respectively.

Table 9 ZW500 Membrane System Design Data with ZW500d Short Modules

Trains	Membrane Type	# of Cassettes/ Train	# of Modules/ Cassette	Membrane Area per Module (m ²)	Total Area/ Train (m ²)	Inst. Flux (Lmh) ³	Net Flux (Lmh) ³	Net Capacity/ Train (m ³ /d)	Total Net Capacity for All 5 Trains (m ³ /d)
A to E	ZW500d (short module)	15	20	32.52	9,755	27.6	25.16	5,890	29,450

Using ZW500d Tall Modules

There is a ZW500d tall module that has a membrane area per module of 40.88 m², which if installed results in a net capacity of 25.7% more than that of the ZW500d short module. Filling the existing ZW500 membrane tanks with ZW500d tall modules can result in a total net capacity of the ZW500 membrane system of 37,019 m³/d, and a total net capacity of 41,562 m³ when combined with the ZW1000 membrane system with no redundant trains. The total net capacity with one redundant train would be 34,158 m³/d. The following should be noted with this alternative:

- The taller module/cassette would require the height of the membrane tank walls to be increased to accommodate the taller modules.
- The capacity of the ZW500d tall module can be increased even further if partial or full tank drain is installed (versus the current constant bleed) since this new operation will allow the operating design flux to increase.
- Increasing the membrane tank walls and providing a partial/full tank drain mode of operation with the ZW500d tall modules are similar to the ZW1000 retrofit option that will be discussed later on. In comparison, the latter option could provide a much higher net capacity at lower membrane capital and operating costs.
- Increasing the instantaneous flux of a ZW500d tall module and the existing ZW1000 membrane systems by 25% may result in a total plant net capacity of 51,953 m³/d with no redundant trains and 42,698 m³/d with one redundant train, which will be less than the Phase 1 net capacity requirement of 51,871 m³/d. However, this higher flux will most likely increase the CIP frequency and decrease the membrane life span. Moreover, the Phase 1 capacity cannot be achieved with this membrane generation and the requirement for one redundant train. *As a result, this option is not further considered.*

Using Pressurized Membranes

Pressurized membranes can also be installed within the ZW500 membrane building; however, this option is estimated to produce a net capacity either similar or less than that for the ZW500d tall module discussed above (given one redundant train). Since the Phase 1 capacity cannot be achieved within the existing ZW500 membrane building, this option is not further considered for a *minor retrofit* within the existing ZW500 membrane building.

However, the installation of pressurized membranes within the existing ZW500 membrane building will be considered if a *major retrofit* of this building with membranes along with a new ancillary equipment building (Options 2.1 or 2.2 in Table 10) is the preferred option for increasing the plant capacity.

The use of pressurized membranes will also be considered for the option(s) with a new membrane building.

Using Other Submerged Membranes

The installation of other submerged membranes (e.g., ZW1000 membranes and other suppliers) within the existing ZW500 membrane building will also be considered if a *major retrofit* of this building with membranes along with a new ancillary equipment building (Options 2.1 or 2.2 in Table 10) is the preferred option for increasing the plant capacity.

The use of submerged membranes will also be considered for the option(s) with a new membrane building.

Summary

Given above, the following will be considered when reviewing membrane alternatives to achieve Phase 1 and ultimate flows:

- Installation of ZW500d short modules within the ZW500 membrane building to maximize the capacity of the existing tanks with a minor retrofit, understanding that the balance of the total plant capacity is to be achieved with a new two-story membrane building.
- Installation of other submerged or pressurized membranes within the ZW500 membrane building with a major retrofit. This option is divided in two based on the number of existing ZW500d trains remaining.
- Installation of membranes (pressurized or submerged) within a new two-story membrane building and abandoning the existing ZW500 membrane building.

For all membrane alternatives, the following design criteria will be considered:

- **90% Membrane Recovery** – This is to reduce the total suspended solids (TSS) concentration within the membrane backwash wastewater to allow for direct discharge to the Nottawasaga Bay without installation of clarification tankage/equipment.
- **Clean-in-place (CIP) Frequency of 30 Days** – This is to reduce the frequency of the CIP process that can last up to 12 hours.

5.5.2.3 Alternatives to Achieving Phase 1 and Ultimate Flows

Table 10 shows membrane alternatives to achieving the Phase 1 and ultimate net capacity requirements of 51,871 and 101,069 m³/d, respectively. The alternatives in this table are illustrated in Figure 12 to Figure 15. Each alternative considers the following options:

- Retrofit within the existing ZW500 membrane building. This includes the following:
 - Replacement of membranes.
 - Replacement of all process equipment and associated instrumentation and electrical equipment given their age.
 - Installation of process equipment to meet current standards and state of the art installations, e.g., on-line membrane integrity testing, CIP/neutralization tanks, etc.
 - Construction of a new membrane ancillary building with CIP/neutralization tanks, boiler skirts, new electrical room to house the starters and PLC, etc.
- Removal of the “temporary” ZW1000 membrane building given the concerns discussed in Section 5.5.1 and as requested by the Town during a Workshop on November 19, 2019.
- Construction of a new two-story membrane building:
 - During Phase 1, the new membrane building can be constructed for the ultimate phase with membranes installed now for Phase 1 only.
 - Either pressurized or submerged membranes can be considered within this new membrane building with the preferred membrane technology (and supplier) to be determined during detailed design after membrane pre-selection has been conducted.
 - The new membrane building can be installed either north of the existing ZW500 membrane building or east of the existing raw water building. Given the prime waterfront property, the Town prefers that the

new membrane building if selected as the preferred option be located east of the existing raw water building.

- Given that the capacity of each membrane train within this new membrane building will most likely be larger than that of a retrofitted ZW500 membrane train, the required redundant membrane train will need to be accounted for within this new membrane building.
- The need for rental of membrane trailer(s) during construction.

The following options were considered in addition to those in Table 10:

Option 4 – Hybrid of Option 1

In this option, a new membrane building is to be constructed for Phase 1 flows (and potentially higher flows). In the future, the existing ZW500 membrane building is to be retrofitted to provide the balance of flows required. This option was not further considered for the following reasons:

- Once membrane ancillary equipment is installed within the new membrane building, this equipment will be shared between all future membrane trains such that only new membrane trains need to be constructed/installed. Installing membranes within the existing ZW500 membrane building will most likely require membrane ancillary equipment to be installed within that building (or a new building) thus:
 - Adding more capital and operating costs.
 - Adding more complexity to operations given that two sets of membranes and membrane ancillary equipment will need to be operated and maintained.
- Once a new membrane building is constructed for Phase 1 flows (and potentially higher flows) and the existing ZW500 membrane building is abandoned, there is a high probability that the existing ZW500 membrane building will be repurposed for new rooms and/or storage, with no appetite later on (14+ years) to install membranes within this building.

Option 5 – Hybrid of Option 3

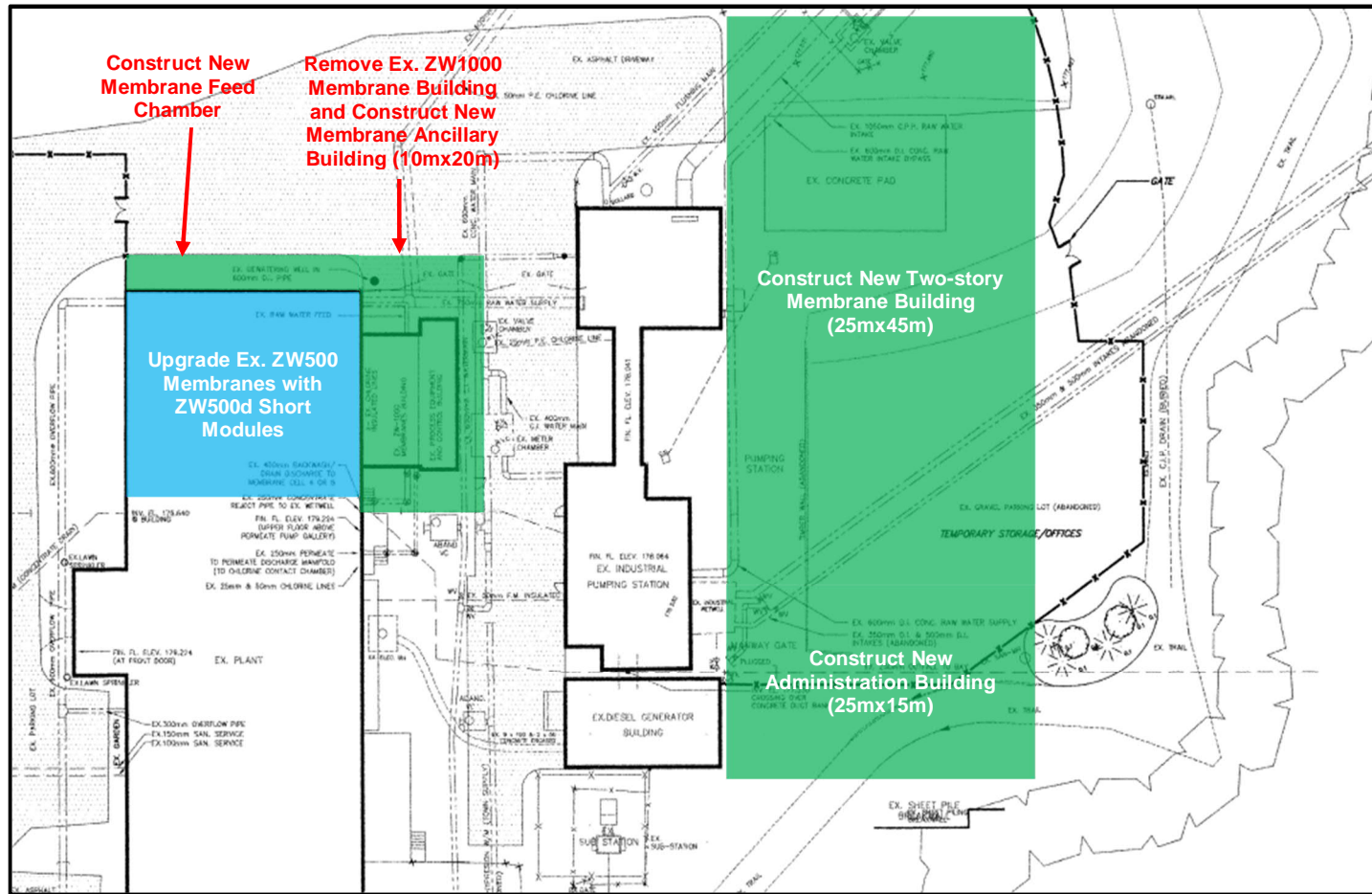
In this option, a new membrane building is to be constructed with the required number of membrane cassettes/modules installed within the new membrane building, with the existing ZW500 membrane system continuing to operate until all the membranes and process/instrumentation/electrical equipment reach their end of life. In this option, no new membrane ancillary building will be constructed, thus not making it an equal comparison to Options 1 to 3 in Table 10. As a result, this option was not further considered.

However, if Option 3 is determined to be the preferred alternative from the Cost-Benefit analysis within this report, the Town can still execute this option to reap the benefits of the remaining life of the membranes and process/instrumentation/electrical equipment.

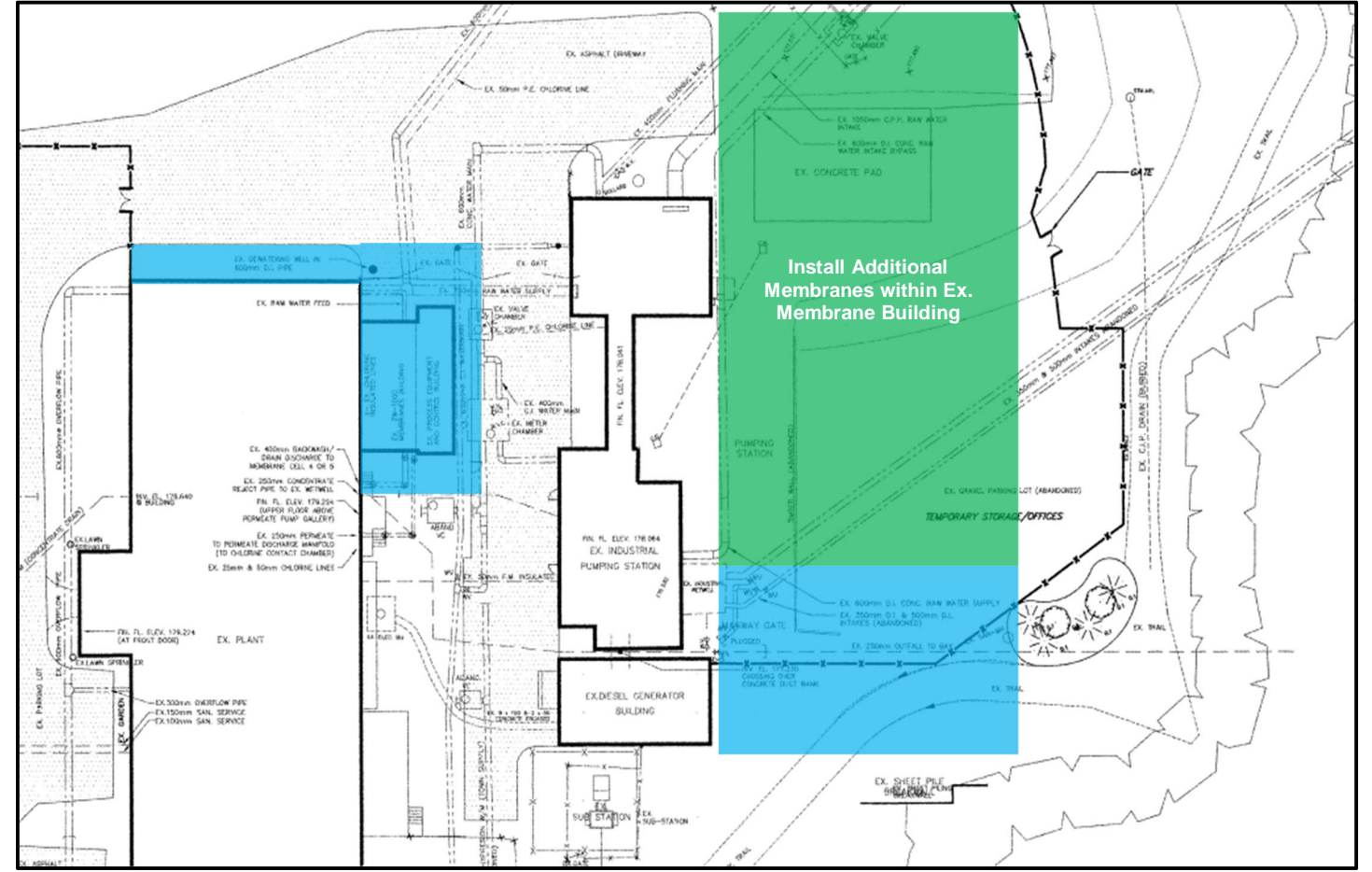
Table 10 Membrane Alternatives to Achieving the Phase 1 and Ultimate Net Capacity Requirements

Title	Option	Retrofit of Existing ZW500 Membrane Building with New Membrane Ancillary Building Specific to this Building	Removal of Ex. ZW1000 Membrane Building?	Construction of New Membrane Building and/or Administration Building	Rental of Membrane Trailer(s) During Construction?	Alternative to be Shortlisted for Further Evaluation? <i>If no, provide reasoning.</i>
Maintain Existing ZW500 Membrane Building Capacity with Minor Retrofit of ZW500d Trains and Construct New Membrane Building (Figure 12)	1A (Phase 1)	<ul style="list-style-type: none"> Upgrade membrane trains with ZW500d short modules with minor modifications to the permeate connections. Replace the membrane tank coatings. Replace all the membrane permeate pumps, blowers, instruments, etc. given their current life span. Install permanent membrane integrity testing. Construct new membrane ancillary building with CIP/neutralization tanks; boiler skids, new electrical room to house the starters and PLC, etc. Resolve the noise effect when feeding the backwash/CIP tanks if any of these tanks were to be reused. Construct new membrane feed chamber north of existing feed chamber to provide some membrane feed equalization and install overflow back to new LLWW. 	Yes	<ul style="list-style-type: none"> Construct new two-story membrane building sized for ultimate flows with membranes installed to achieve Phase 1 net capacity only. Install chemical systems for entire plant within this new building. These include sodium hypochlorite, citric acid, sodium bisulphite and sodium hydroxide. Construct a new administration building. 	No	Yes
		Net capacity provided = 29,450 m ³ /d (assuming the new membrane building will house the redundant membrane train).	-	Net capacity provided = 22,421 m ³ /d		
	1B (Ultimate)	-	-	Install new membranes within membrane building constructed as part of Phase 1.	No	
Additional net capacity provided = + 0 m ³ /d		-	Additional net capacity provided = +49,198 m ³ /d			
Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 2 Remaining ZW500d Trains (Figure 13)	2.1 A (Phase 1)	<ul style="list-style-type: none"> Complete major retrofit of existing ZW500 membrane building with new membranes maintaining two of the existing ZW500d membrane trains. Install permanent membrane integrity testing. Construct new membrane ancillary building with CIP/neutralization tanks; boiler skids; new electrical room to house the starters and PLC; wastewater equalization tanks to accept the new membrane drains/dumps as required; and, chemical feed systems including sodium hypochlorite, citric acid, sodium bisulphite and sodium hydroxide. Resolve the noise effect when feeding the backwash/CIP tanks if any of these tanks were to be reused. If submerged membranes are the preferred option, construct new membrane feed chamber north of existing feed chamber to provide some membrane feed equalization and install overflow back to new LLWW. The height of the existing feed chamber may also need to be increased. 	Yes	Construct a new administration building.	Yes	Yes
		Net capacity provided = 51,871 m ³ /d	-	-		
	2.1 B (Ultimate)	Install additional membranes to achieve ultimate capacity.	-	-	No	
Additional net capacity provided = + 49,198 m ³ /d		-	-			
Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 0 Remaining ZW500d Trains (Figure 14)	2.2 A (Phase 1)	<ul style="list-style-type: none"> Complete major retrofit of existing ZW500 membrane building with new membranes maintaining none of the existing ZW500d membrane trains. Install permanent membrane integrity testing. Construct new membrane ancillary building with CIP/neutralization tanks; boiler skids; new electrical room to house the starters and PLC; wastewater equalization tanks to accept the new membrane drains/dumps as required; and, chemical feed systems including sodium hypochlorite, citric acid, sodium bisulphite and sodium hydroxide. Resolve the noise effect when feeding the backwash/CIP tanks if any of these tanks were to be reused. If submerged membranes are the preferred option, construct new membrane feed chamber north of existing feed chamber to provide some membrane feed equalization and install overflow back to new LLWW. The height of the existing feed chamber may also need to be increased. 	Yes	Construct a new administration building.	Yes	Yes
		Net capacity provided = 51,871 m ³ /d	-	-		

	2.2 B (Ultimate)	Install additional membranes to achieve ultimate capacity. Additional net capacity provided = + 49,198 m ³ /d	-	-	No		
Repurpose Existing ZW500 Membrane Building and Construct New Membrane Building (Figure 15)	3A (Phase 1)	<ul style="list-style-type: none"> Abandon existing ZW500 trains. Repurpose the ZW500 membrane building possibly as the new administration building. 	Yes	<ul style="list-style-type: none"> Construct new two-story membrane building sized for ultimate flows with membranes installed to achieve Phase 1 net capacity only. Cost regarding tank coatings will be avoided since existing tanks will be no longer be used. Install chemical systems for entire plant within this new building. These include sodium hypochlorite, citric acid, sodium bisulphite, hydrochloric acid, and sodium hydroxide. 	No	Yes	
		Net capacity provided = 0 m ³ /d	-	Net capacity provided = 51,871 m ³ /d			
	3B (Ultimate)	-		-	Install new membranes within membrane building constructed as part of Phase 1.	No	
		Additional net capacity provided = + 0 m ³ /d		-	Additional net capacity provided = +49,198 m ³ /d		

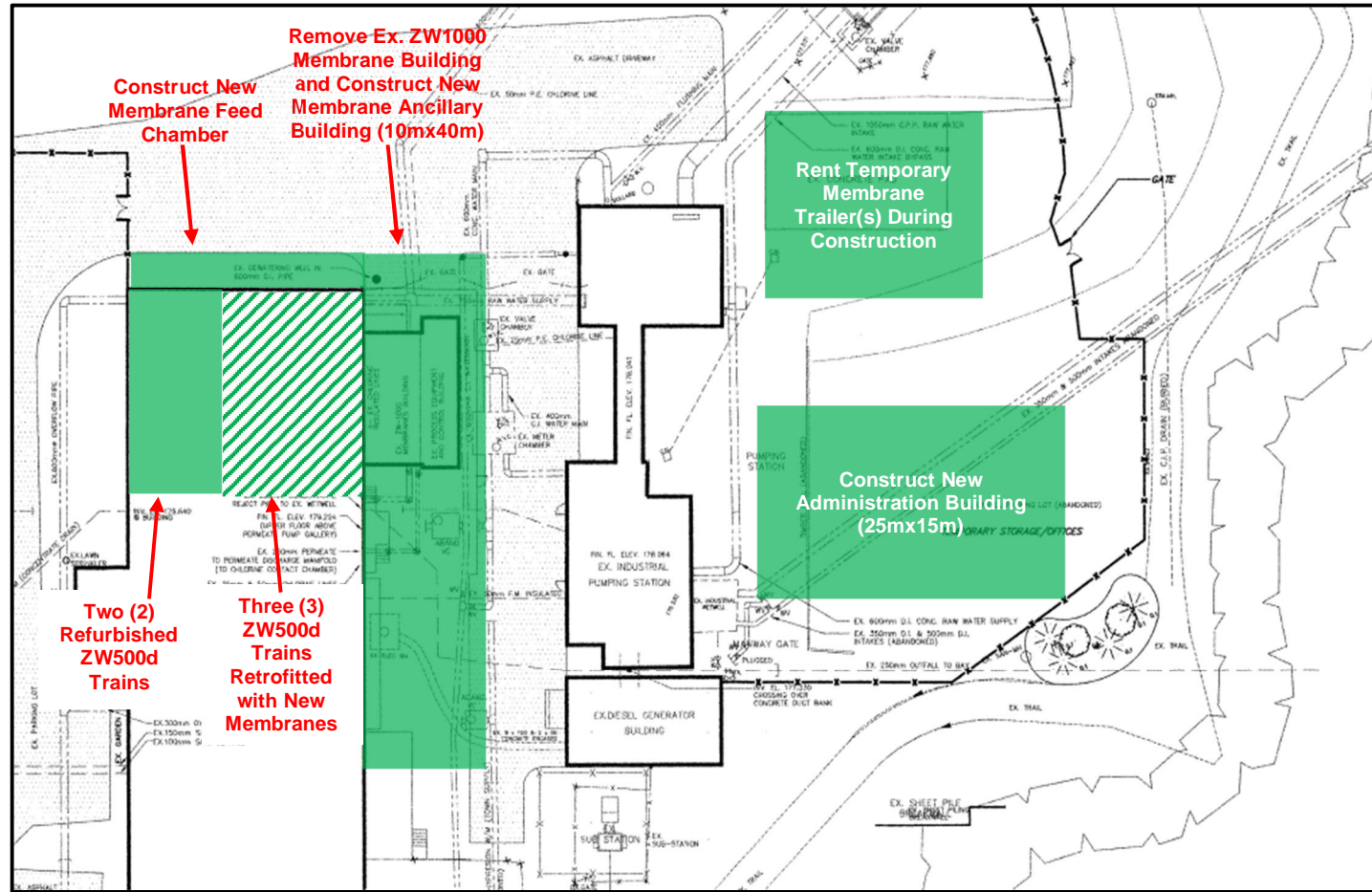


Option 1A – Phase 1 Concept

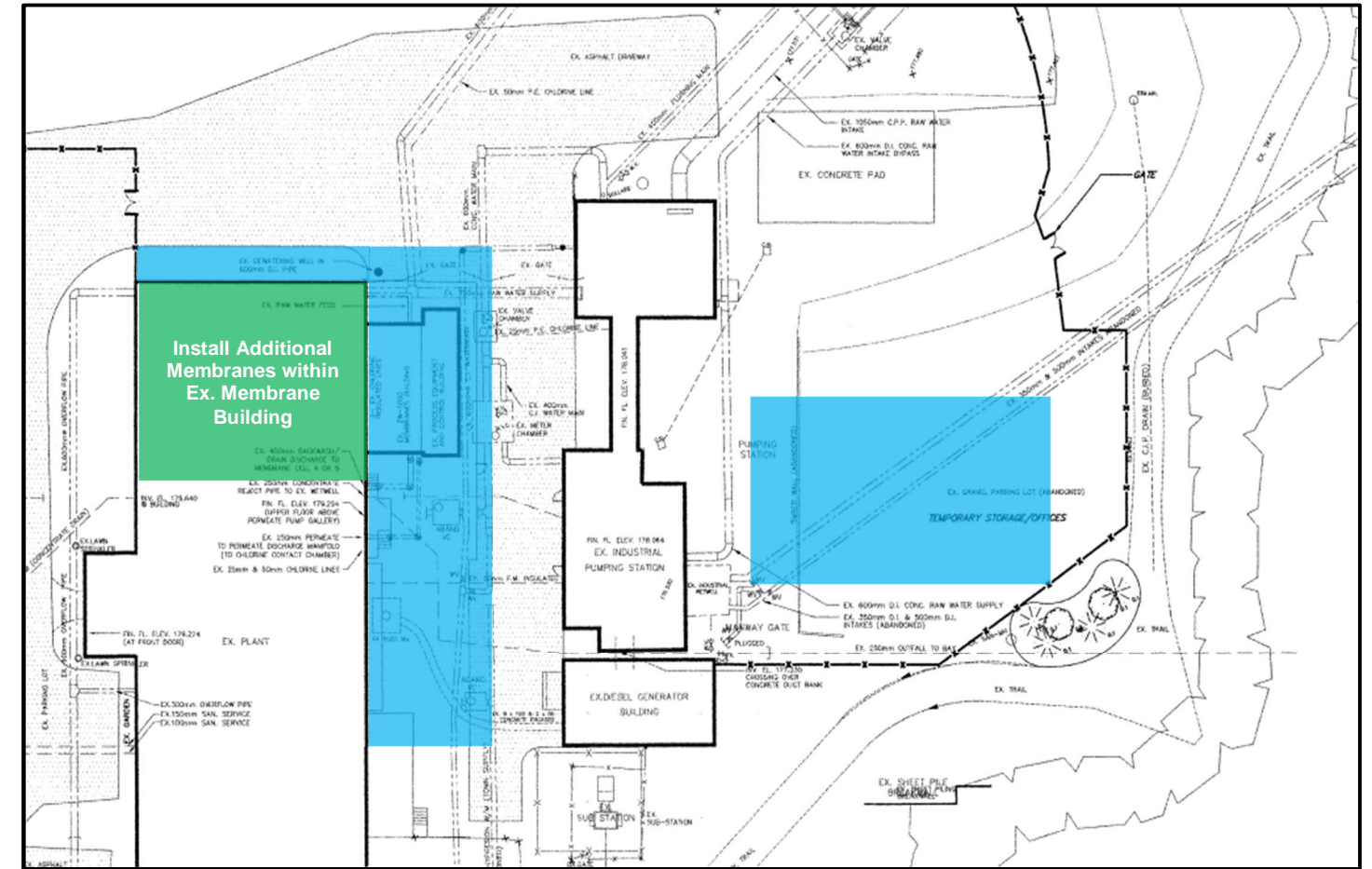


Option 1B – Ultimate Phase Concept

Figure 12 Option 1 Concept: Maintain Existing ZW500 Membrane Building Capacity with Minor Retrofit and Construct New Membrane Building (New Infrastructure Shown as Green)

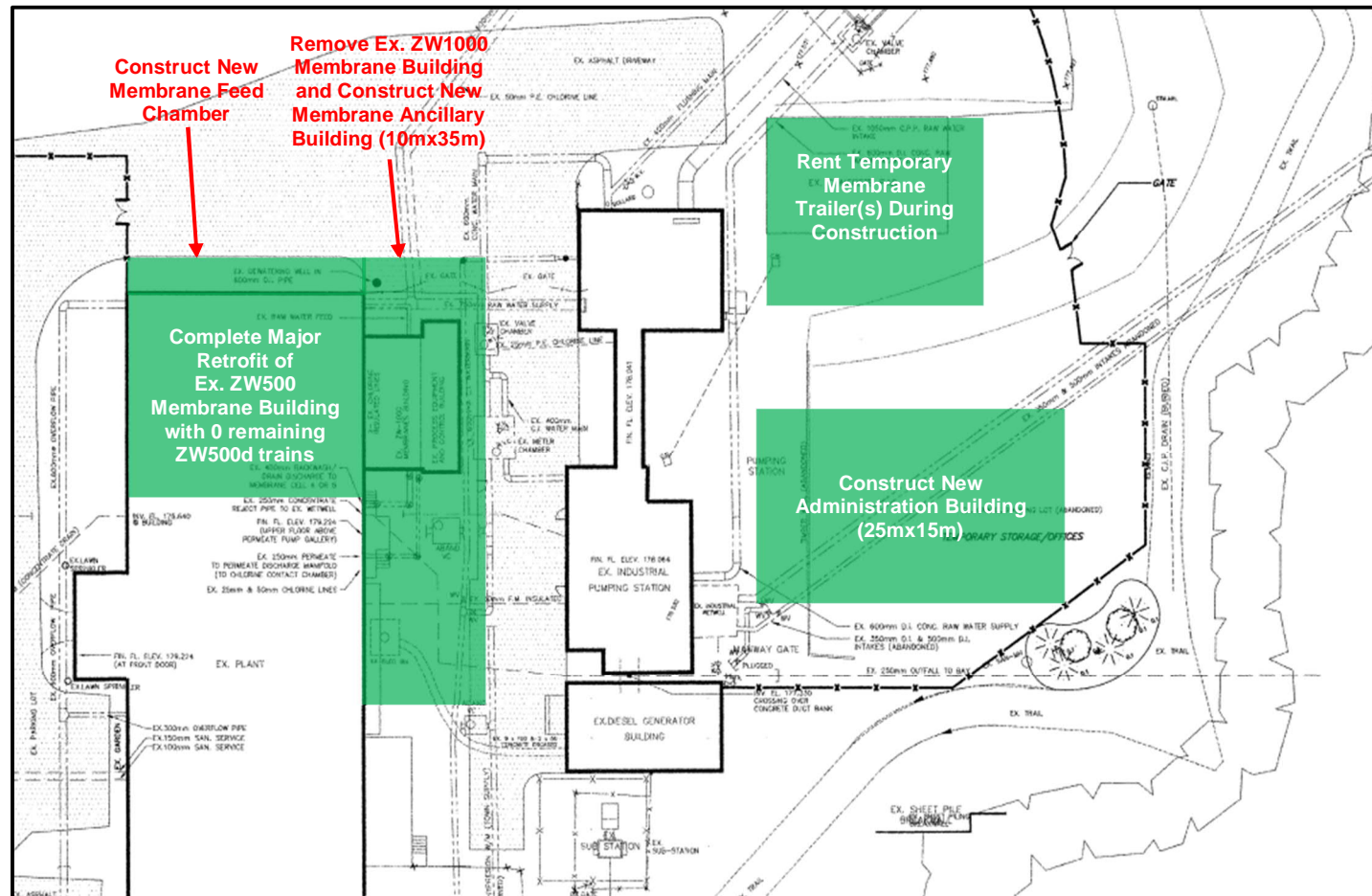


Option 2.1 A – Phase 1 Concept

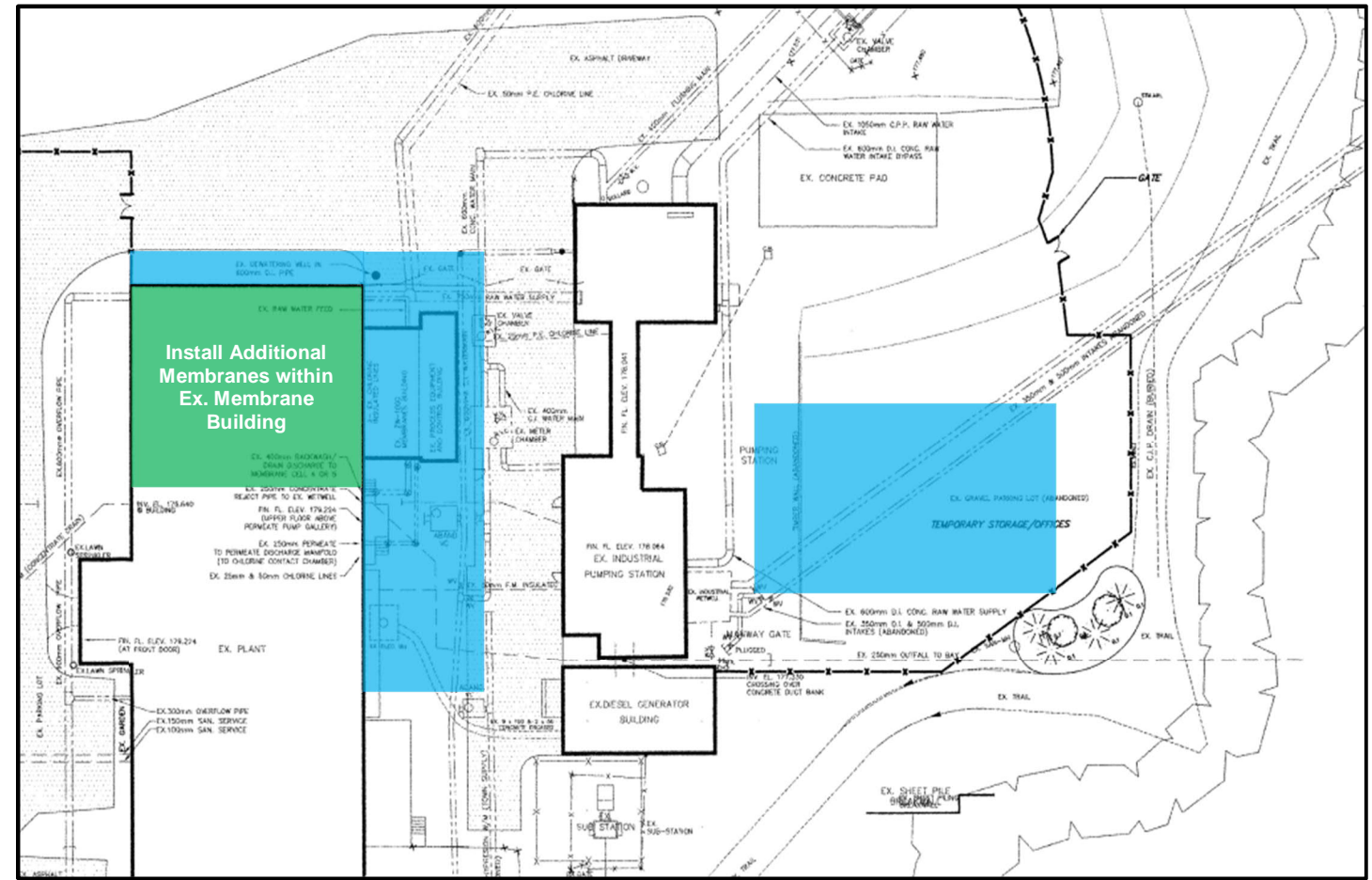


Option 2.1 B – Ultimate Phase Concept

Figure 13 Option 2.1 Concept: Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 2 Remaining ZW500d Trains (New Infrastructure Shown as Green)

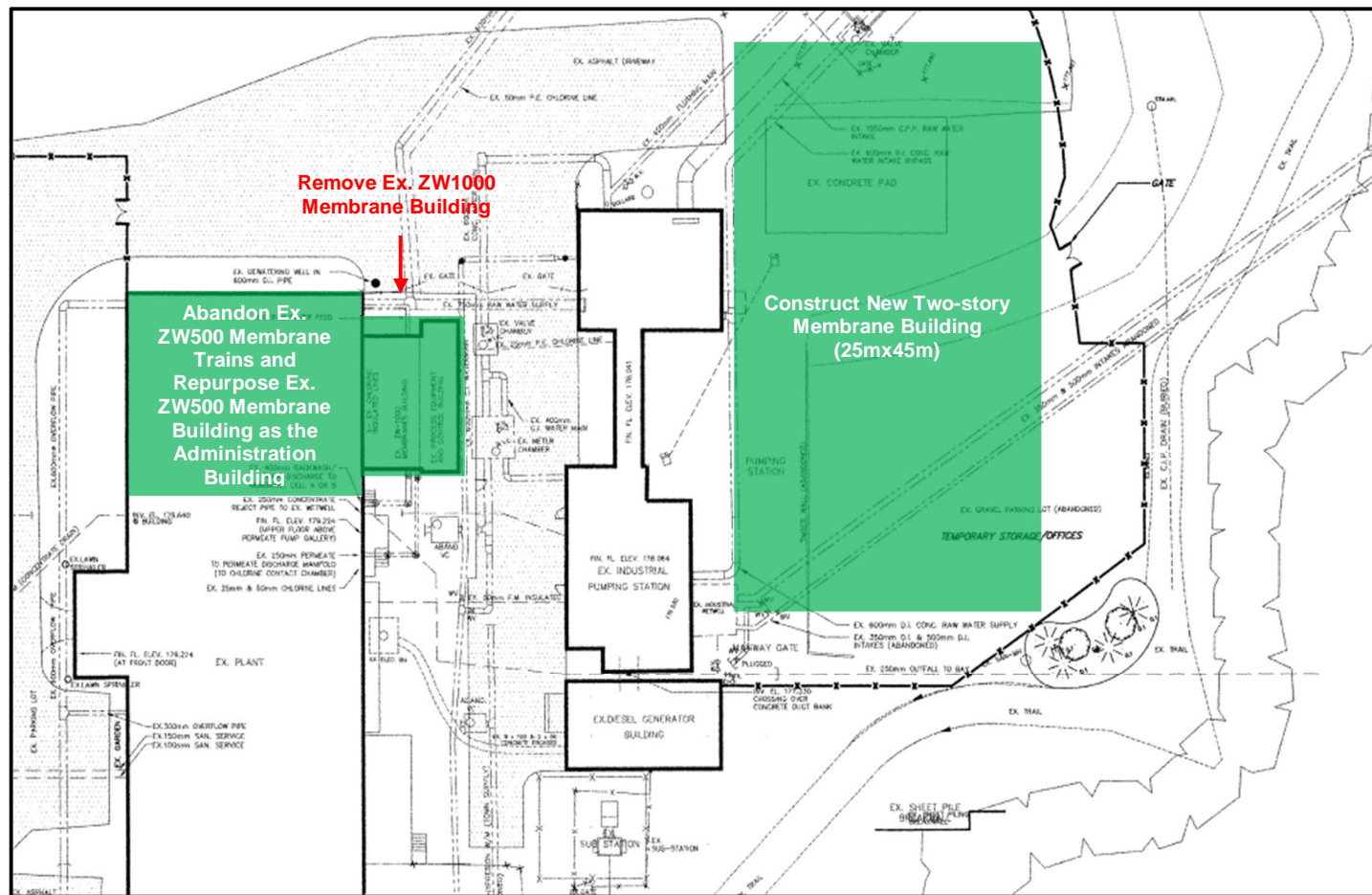


Option 2.2 A – Phase 1 Concept

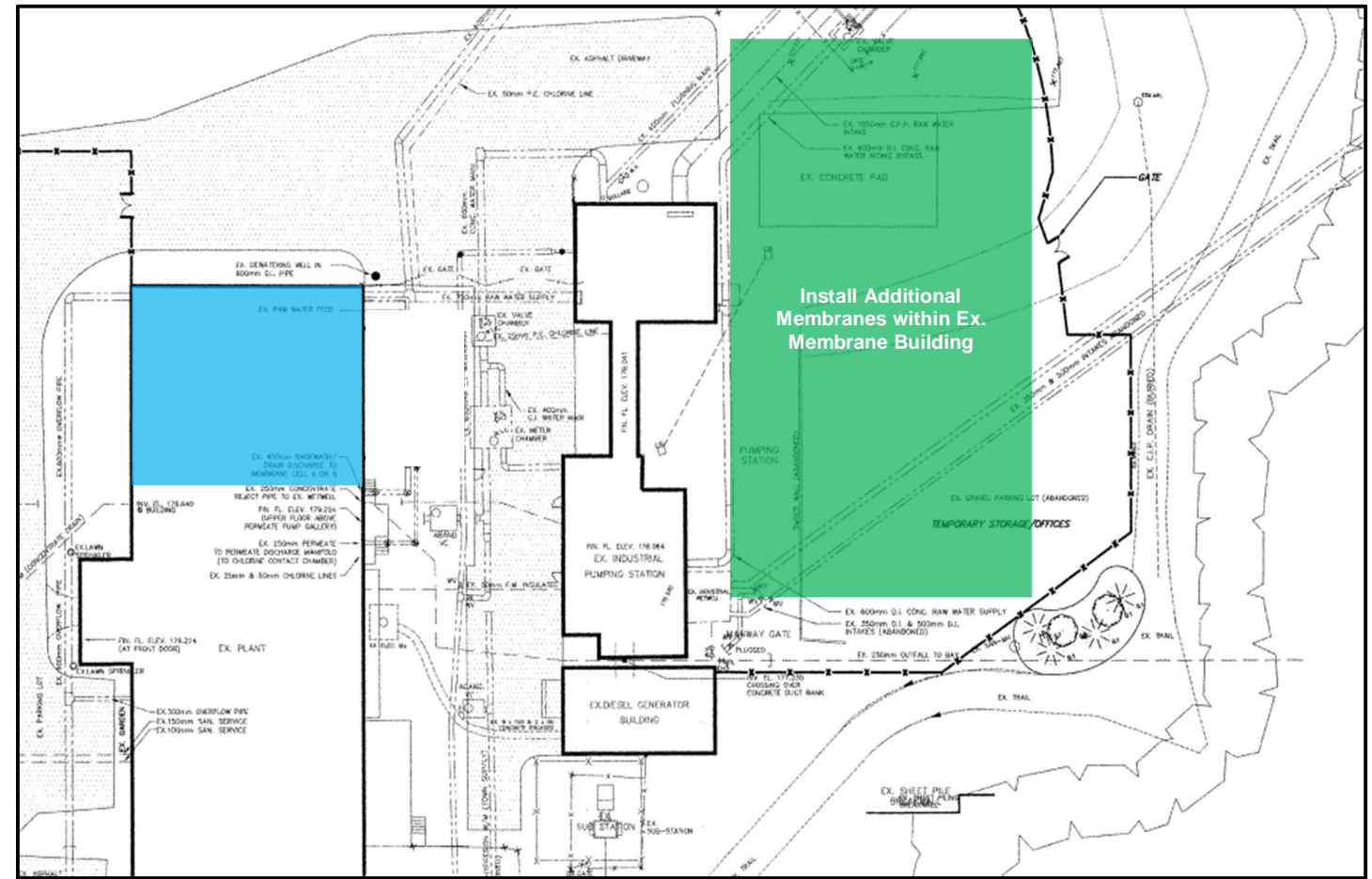


Option 2.2 B – Ultimate Phase Concept

Figure 14 Option 2.2 Concept: Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 0 Remaining ZW500d Trains (New Infrastructure Shown as Green)



Option 3A – Phase 1 Concept



Option 3B – Ultimate Phase Concept

Figure 15 Option 3 Concept: Repurpose Existing ZW500 Membrane Building and Construct New Membrane Building (New Infrastructure Shown as Green)

5.5.2.4 Shortlisted Alternatives

Table 10 shows all four (4) membrane alternatives to be shortlisted for further evaluation as there is no reasoning to eliminate any of these alternatives at this stage.

5.6 Disinfection

5.6.1 Current Capacity

Table 1 shows the current net capacity of the CT chambers as 21,423 m³/d to achieve 0.5-log *Giardia* inactivation at 0.5°C, a pH of 8.1, and an average free chlorine residual of 1.66 mg/L. This is less than the plant current rated capacity of 31,140 m³/d understanding that this disinfection capacity can be achieved by increasing the free chlorine residual (if required) given the water temperature and pH at the time of the calculations being conducted.

5.6.2 Upgrade Requirements

5.6.2.1 Disinfection Technologies

Overview

The following disinfection technologies were considered as part of this EA:

- Chlorination
- Ultraviolet (UV) Irradiation
- Ozonation
- Chlorine Dioxide Disinfection

A brief description of each of these processes is provided as follows:

Chlorination

Chlorine has been used as an effective disinfectant in drinking water for many years and is currently being used at the Raymond A. Barker WTP. It is by far the most common disinfectant, by virtue of its low cost, ease of use, and relative effectiveness.

Chlorine is a powerful oxidant that works quickly on bacteria and viruses, although it is not particularly effective against *Giardia* and it is almost completely ineffective against *Cryptosporidium*. Chlorine is fed to the water in some form, usually either as gaseous chlorine (Figure 16) like at the Raymond A. Barker WTP or in the liquid hypochlorite form.

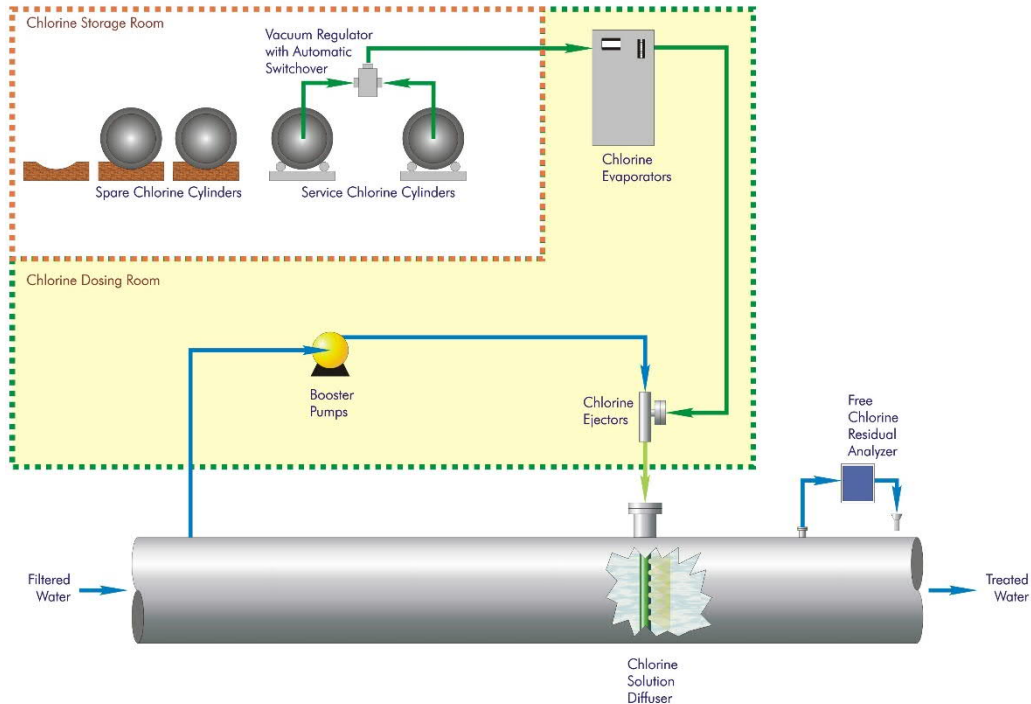


Figure 16 Schematic Diagram of Gas Chlorination

Ultraviolet (UV) Irradiation

UV is the most common type of non-chemical inactivation. UV is a physical process that uses ultraviolet irradiation to prevent the cellular replication of organisms so that they cannot reproduce, thus becoming inactivated. UV light is emitted through a series of lamps located in enclosed contactors (Figure 17).

UV irradiation has rapidly gained an important position in the industry due to its effectiveness against *Giardia* and *Cryptosporidium* within a very compact footprint; however, it is not effective for all viruses requiring a short chlorine contact time for 4-log virus inactivation on this project. UV disinfection is only effective while the water is actually being irradiated, and it is therefore only useful as a primary disinfection strategy, as it provides no residual. A secondary disinfectant such as chlorine or chloramines must be applied downstream of UV disinfection for protection of the distribution system.

UV technology also have the capability to provide UV advanced oxidation processes (UVAOP) when dosing an oxidant (e.g., hydrogen peroxide or chlorine) upstream of the UV reactors.

The UV transmittance (UVT) is the measure of the ability of UV light to penetrate the water and accounts for absorbance of UV light or reflection (some solids). UVT data in March 2019 showed a range of 94 to 97% with an average UVT of 94%. For this project, it is recommended that the UV system be designed for an UVT of 90% with an UVT of 96% used as part of the life cycle analysis when comparing UV disinfection and chlorination technologies.

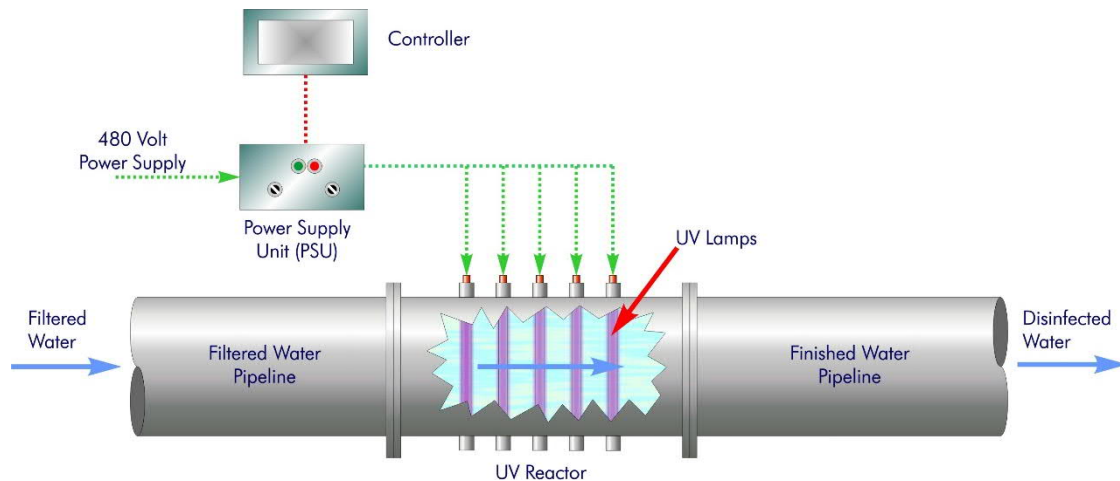


Figure 17 Schematic Diagram of Ultraviolet Disinfection

Ozonation

Ozonation involves the application of ozone to the water (Figure 18). Ozone is an unstable derivative of oxygen, which is formed on-site and immediately applied to the water. It is a very strong oxidant and disinfectant, but one which decays more rapidly than chlorine, and is therefore only suitable as a primary disinfectant. A secondary disinfectant such as chlorine or chloramines must be applied downstream of ozonation for protection of the distribution system. Ozone is also effective in removing taste and odor compound including geosmin and 2-Methylisoborneol (MIB), in many cases at the same ozone level as the one used for disinfection.

Ozone also offers benefits in the water treatment process itself, depending upon where it is placed within the process train. Some plants utilize pre-ozonation, which results in micro-flocculation, and can help solids removal in the process. Ozone is often a necessary precursor to biological filtration processes, as it reacts with natural organic matter (NOM) in the water to produce the Assimilable Organic Carbons (AOCs) necessary for biological growth on the filters.

Since ozone reacts with NOM in the water to produce AOC, which in turn promote bacterial regrowth in the distribution system, it might be necessary to allocate the provisional use of Biological Activated Carbon (BAC) contactors downstream of the ozone contactor to remove AOC to prevent bacterial regrowth and/or increase chlorine demand in the distribution system. However, given the low dissolved organic carbon (DOC) and low trihalomethane formation potential (THMFP) in the source water, it is anticipated that not much AOC will be produced from ozonation and hence, BAC contactors will not be needed. However, ozone reacts with bromide ions in water to produce bromate, which poses long-term health risks associated to reduced kidney function in some people.

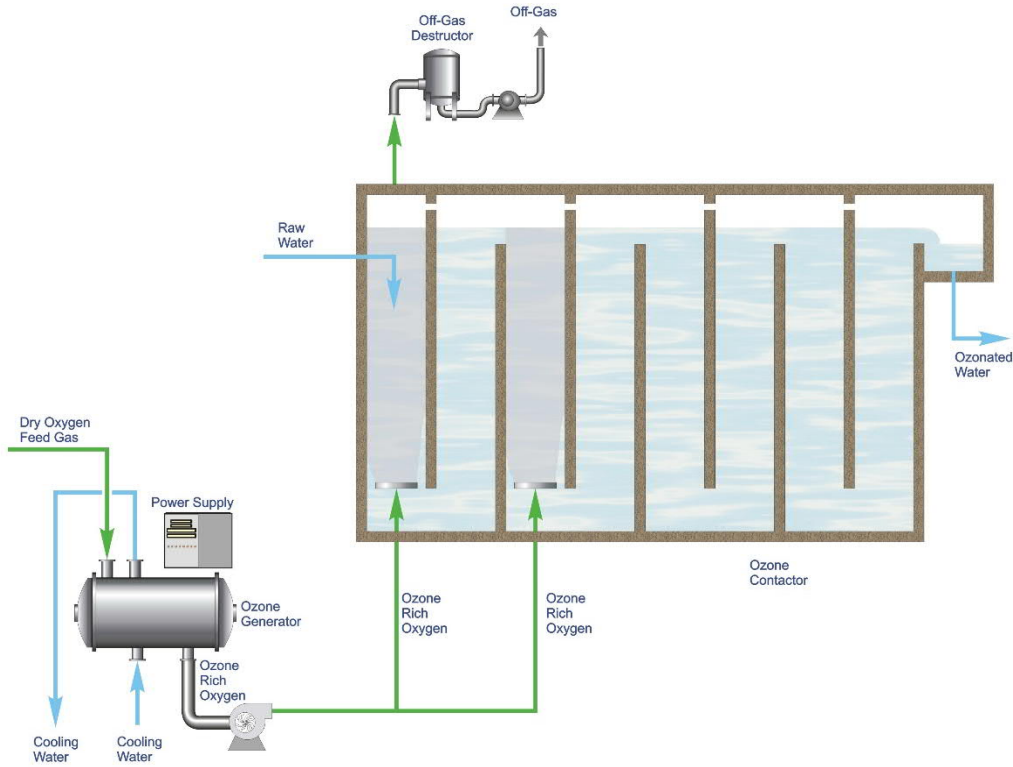


Figure 18 Schematic Diagram of Ozonation

Chlorine Dioxide Disinfection

Chlorine dioxide (ClO_2) has been used to disinfect water given it has strong disinfectant properties and it does not react with ammonia or related nitrogenous compounds, or organic compounds (to produce trihalomethanes). However, the high cost of generating it on-site limits its use, as well as the production of chlorite (ClO_2^-) and chlorate (ClO_3^-), which are disinfection by-products that have been linked to potential adverse health effects involving red blood cells and blood chemistry. A schematic of can be seen in Figure 19.

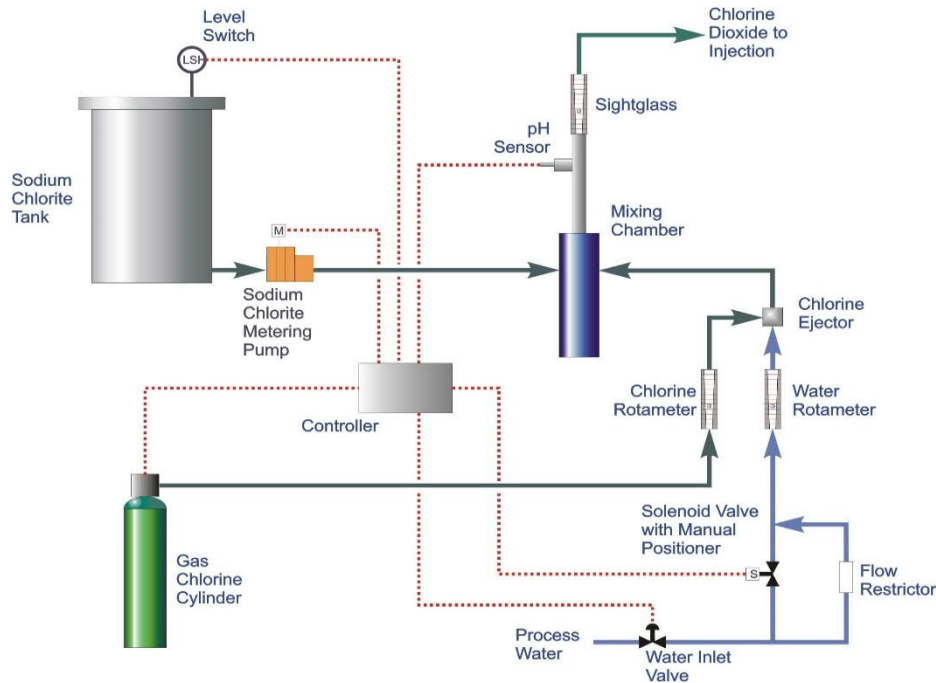


Figure 19 Schematic Diagram of Chlorine Dioxide Disinfection

Summary

Ozonation will not be further considered on this project since taste and odour control and emerging contaminants are currently not an issue at the plant and ozonation is considerably more expensive than the technologies mentioned above. Moreover, it produces the disinfection by-product bromate that needs to be monitored during its use.

Chlorine dioxide is rarely used in Ontario and trihalomethane (THM) formation is not an issue at the plant to warrant its consideration. Moreover, it produces the disinfection by-products chlorite and chlorate that need to be monitored during its use.

Given above, chlorination and UV with chlorination will be considered for the plant expansion.

5.6.2.2 Minimum Free Chlorine Residual Required for Primary Disinfection

Before chlorine disinfection alternatives can be reviewed, it is important to determine the appropriate **minimum** free chlorine residual to be used in all calculations where chlorination is being considered for primary disinfection. Table 11 shows the treated water free chlorine residual data statistics between 2017 and 2018. As shown, the average free chlorine residual of 1.66 mg/L was not achieved 49% of the time. The minimum residual was 0.90, with 0.82% of the residual data being below 1.40 mg/L and 8.24% of the residual data being below 1.50 mg/L.

Table 11 Treated Water Free Chlorine Residual (mg/L) Data (2017 to 2018)

Source	SC	Min.	Avg.	Max.	% Samples < 1.16 mg/L	% Samples < 1.50 mg/L	% Samples < 1.66 mg/L
Town	728	0.90	1.66	1.99	0.41%	8.24%	48.90%

The Town will like to reduce the target treated water free chlorine residual from 1.66 to 1.50 mg/L. To prevent the plant from shutting down under the worst-case scenario (maximum flowrate, maximum pH of 8.1 and minimum temperature of 0.5°C), it is recommended that a free chlorine residual of 1.0 mg/L be used in the disinfection calculations given the following recommended alarm response conditions:

- Low-low alarm to shut down plant – 1.00 mg/L
- Low alarm to warn operators and not shut-down plant – 1.25 mg/L (low-low alarm + 0.25 mg/L)
- Target average – 1.50 mg/L (low alarm + 0.25 mg/L)

Given above, a minimum free chlorine residual of 1.0 mg/L will be used for all disinfection calculations.

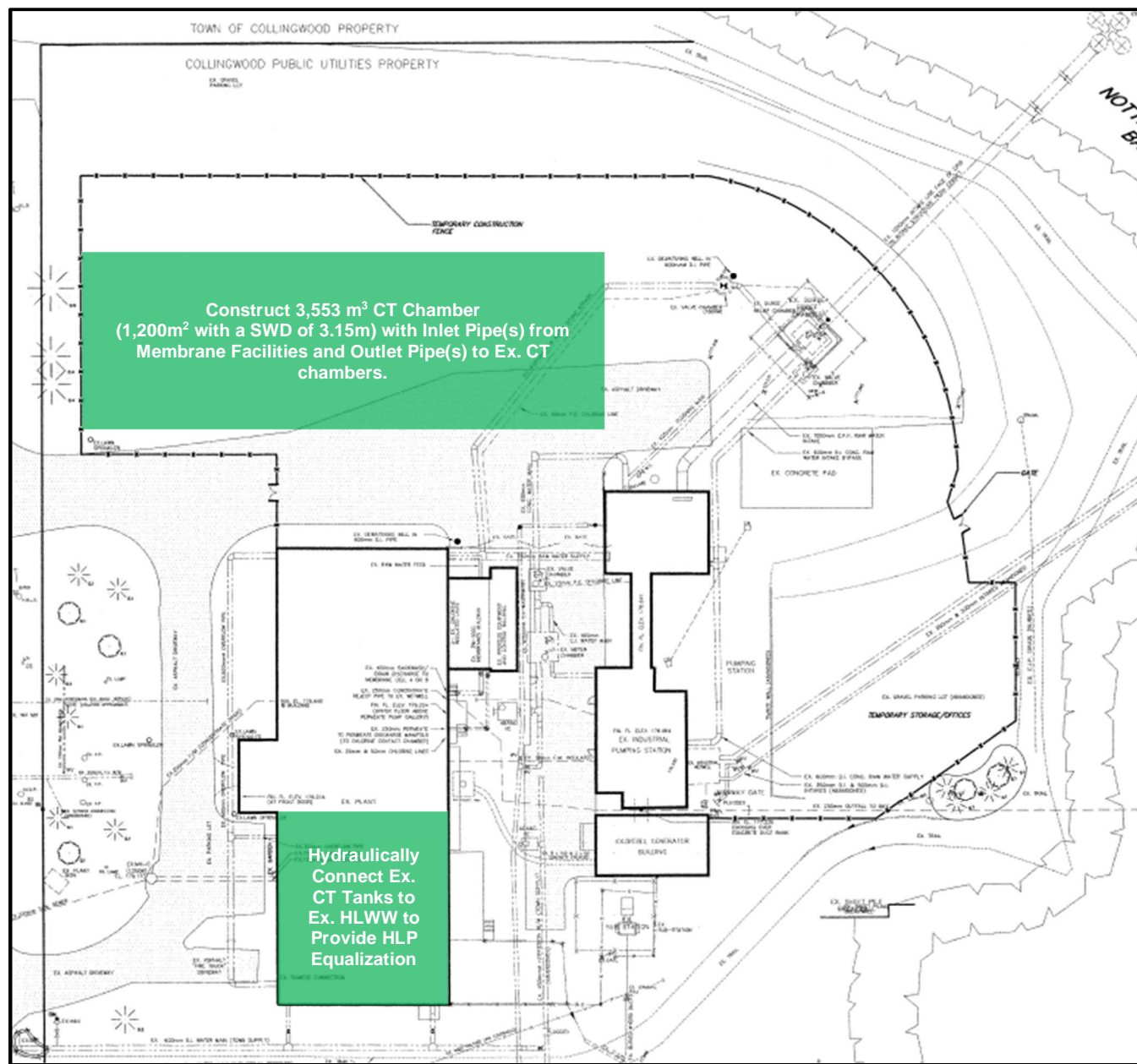
5.6.2.3 Alternatives to Achieving Phase 1 and Ultimate Flows

Table 12 shows disinfection alternatives to achieving the Phase 1 and ultimate net capacity requirements for this project.

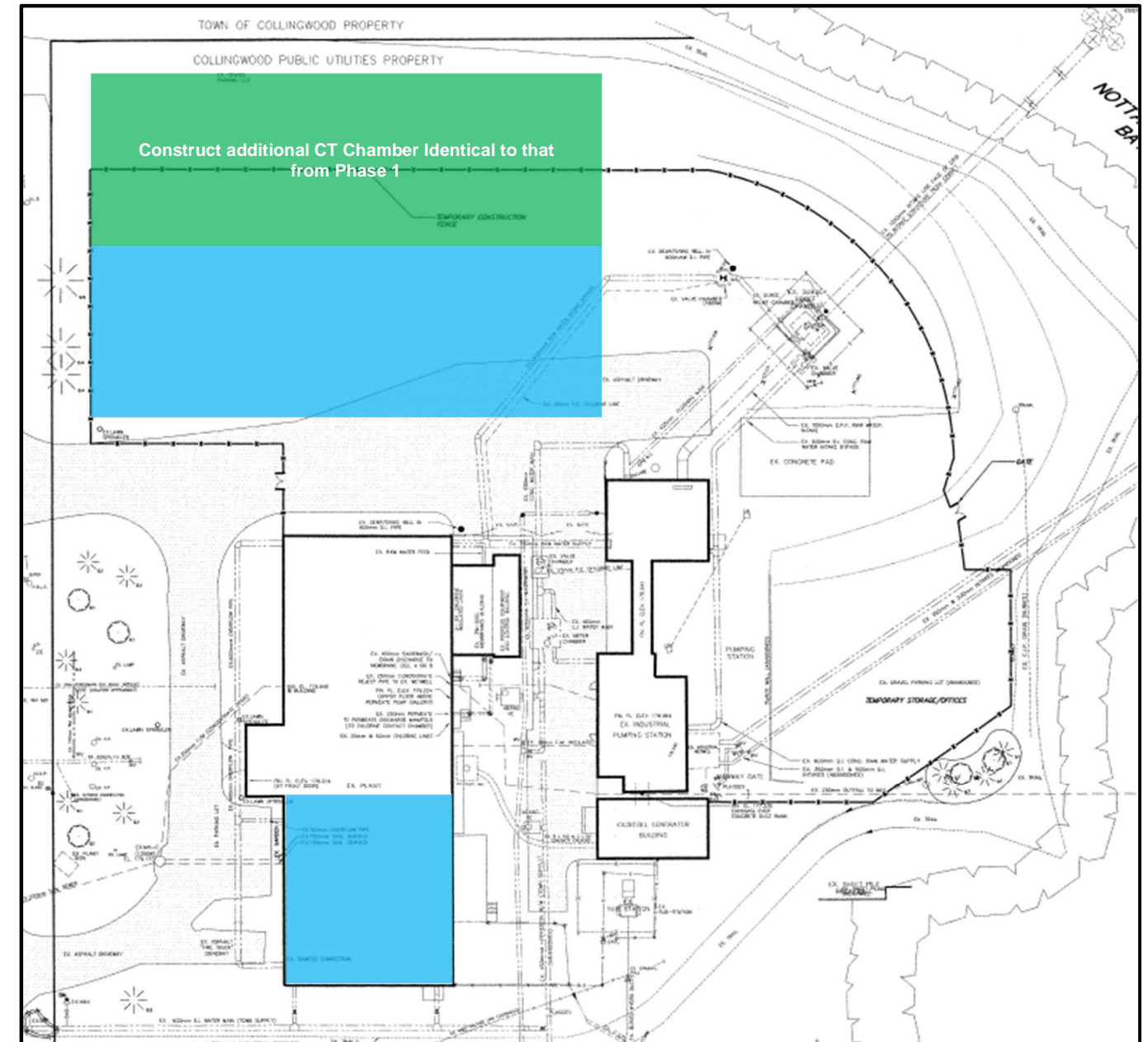
Table 12 Disinfection Alternatives to Achieving the Phase 1 and Ultimate Net Capacity Requirements

Title	Option #	Description	Alternative to be Shortlisted for Further Evaluation? <i>If no, provide reasoning.</i>
Chlorinate Year Round in Intake and CT Chambers	1A (Phase 1)	<ul style="list-style-type: none"> Dose chlorine year-round within the intake and within the CT chambers achieving a minimum free chlorine residual of 2.5 mg/L at all times. 	<p style="text-align: center;"><i>No</i></p> <ul style="list-style-type: none"> Raw water in the intake has solids that can shield pathogens from the chlorine, thus not guaranteeing inactivation of the pathogens. Chlorination year round within the intake tends not to be preferred by the MECP given the potential for chlorine to enter the raw water source (even though this is practiced in the warmer months for zebra mussel control). A higher chlorine dosage than normally practiced is required increasing the potential for disinfection by-products and decreasing the pH of the water making the water more corrosive, exceeding the water quality objectives in Table 3. Additional dechlorination will be required for the membrane reject being discharged back to the Nottawasaga Bay. At ultimate flows, this option does not provide sufficient disinfection as required in Table 3
	1B (Ultimate)	<ul style="list-style-type: none"> Dosing chlorine year-round within the intake and within the CT chambers to achieve a minimum free chlorine residual of 4.0 mg/L at all times (adverse level of chlorine residual within the distribution system) would still not achieve more than 0.39-log inactivation of <i>Giardia</i>. 	
Superchlorinate and Dechlorinate in Existing CT Chambers	2A (Phase 1)	<ul style="list-style-type: none"> Superchlorinate and then dechlorinate in the existing CT chambers. This will require a minimum free chlorine residual to be maintained at 4.8 mg/L at the end of the CT chambers before dechlorinating back down to an average of 1.66 mg/L free chlorine residual. 	<p style="text-align: center;"><i>No</i></p> <ul style="list-style-type: none"> There is a concern with disinfection by-product formation exceeding the water quality objectives in Table 3. There is a concern with a decrease in the pH of the water (chlorine gas is acidic) making the water more corrosive, exceeding the water quality objectives in Table 3. If dechlorination is not properly controlled, there is a concern of an adverse exceedance of 4.0 mg/L free chlorine residual in the distribution system, exceeding the water quality objectives in Table 3 A substantial amount of additional chlorine containers will need to be transported to and then stored on-site. Additional dechlorination will be required for the membrane reject being discharged back to the Nottawasaga Bay.
	2B (Ultimate)	<ul style="list-style-type: none"> Superchlorinate to achieve a minimum free chlorine residual of 10.5 mg/L at the end of the CT chambers prior to dechlorinating. 	
Practice pH Adjustment in Existing CT Chambers	3A (Phase 1)	<ul style="list-style-type: none"> Lower the pH within the CT chambers to 5.2 and then increase back to a minimum of 7.0 to reduce the corrosiveness of the treated water. 	<p style="text-align: center;"><i>No</i></p> <ul style="list-style-type: none"> There is a concern with increasing the corrosive nature of the water which is against the water quality objectives in Table 3. New chemical systems (acid and base) will need to be installed on-site requiring additional transportation, storage and handling of chemicals on-site.
	3B (Ultimate)	<ul style="list-style-type: none"> Lower the pH within the CT chambers to 4.1 and then increase back to a minimum of 7.0 to reduce the corrosiveness of the treated water. 	
Chlorinate in New CT Chambers (Figure 20)	4A (Phase 1)	<ul style="list-style-type: none"> Install one new CT chamber for 0.5-log <i>Giardia</i> inactivation control sized for a minimum effective storage volume of 3,553 m³ with baffles to provide a minimum baffling factor (T_{10}/T) of 0.7. Given a side water depth (SWD) of 3.15m, this requires a footprint of 1,200m² (assuming 6% footprint to be occupied by baffles), with one possible dimension being 20m x 60m. The ideal location of this new CT chamber will be north of the existing ZW500 membrane building to minimize the length of outlet pipe to the existing CT chambers and HLWW mentioned below. An alternative location will be below the new membrane building if selected as the preferred membrane alternative. Use existing CT chambers for high lift pump equalization by hydraulically connecting these chambers to the existing HLWW by cutting openings in the walls between both tanks at the CT chambers finished floor elevation. This will result in the required 15 minutes high lift pump equalization volume given ultimate net flows of 101,069 m³/d at the current SWD of 4.45m of the HLWW (with 1.5m high lift pump suction pipe submergence excluded from the operating volume calculations). At Phase 1 flows of 51,871 m³/d, the high lift pump equalization will be 29 minutes. 	<p style="text-align: center;">Yes</p>
	4B (Ultimate)	<ul style="list-style-type: none"> Install another CT chamber identical to that in Phase 1. 	
Practice UV Disinfection and Chlorinate in New CT Chambers (Figure 21)	5A (Phase 1)	<ul style="list-style-type: none"> Install minimum two UV reactors (1 duty, 1 standby) for 0.5-log <i>Giardia</i> inactivation, each UV reactor sized for a minimum diameter of 600 mm. The UV reactors can be located within a UV building on top of the new CT chambers discussed below. Estimated footprint of UV building is 16m x 10m. Install one CT chamber for 4-log virus inactivation sized for a minimum effective storage volume of 808 m³ with baffles to provide a minimum baffling factor (T_{10}/T) of 0.7. Given a side water depth (SWD) of 3.15m, this requires a footprint of 273m² (assuming 6% footprint to be occupied by baffles), with one possible dimension being 13m x 21m. The ideal location of this new CT chamber will be to the north of the ZW500 membrane building to minimize the length of outlet pipe to the existing CT chambers and HLWW mentioned below. An alternative location will be below the new membrane building if selected as the preferred membrane alternative. Use existing CT chambers for high lift pump equalization by hydraulically connecting these chambers to the existing HLWW by cutting openings in the walls between both tanks at the CT chambers finished floor elevation. This will result in the required 15 minutes high lift pump equalization volume given ultimate net flows of 101,069 m³/d at the current SWD of 4.45m of the HLWW (with 1.5m high lift pump suction pipe submergence excluded from the operating volume calculations). At Phase 1 flows of 51,871 m³/d, the high lift pump equalization will be 29 minutes. 	<p style="text-align: center;">Yes</p>

	5B (Ultimate)	<ul style="list-style-type: none">• Install 3rd duty UV reactor (if needed, depending on UV reactor size installed in Phase 1) for 0.5-log <i>Giardia</i> inactivation.• Install another CT chamber identical to that in Phase 1.	
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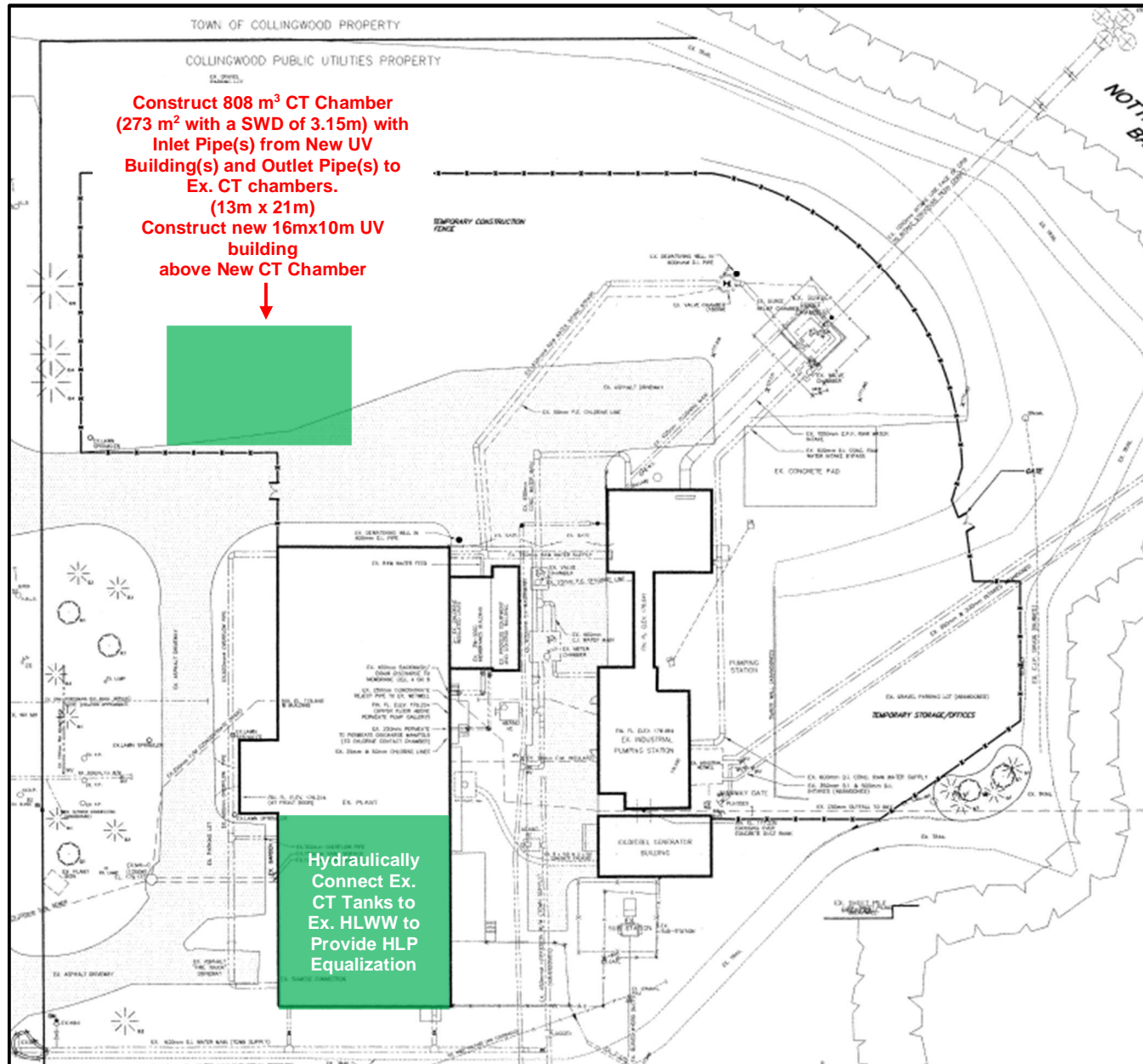


Option 4A - Phase 1 Concept

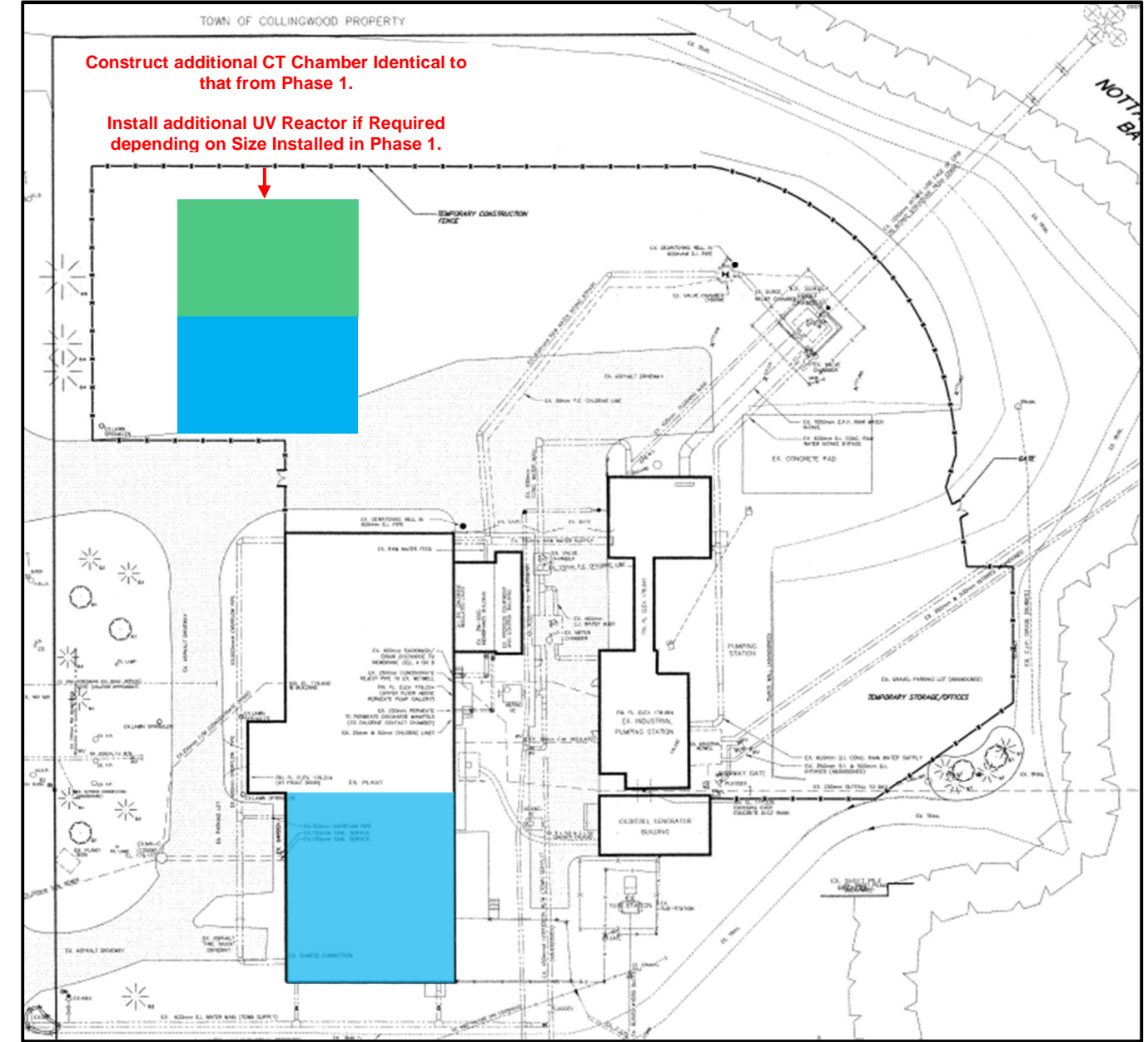


Option 4B - Ultimate Phase Concept

Figure 20 Option 4 Concept: Chlorinate in New CT Chambers (New Infrastructure Shown as Green)



Option 5A - Phase 1 Concept



Option 5B - Ultimate Phase Concept

Figure 21 Option 5 Concept: Practice UV Disinfection and Chlorinate in New CT Chambers (New Infrastructure Shown as Green)

5.6.2.4 Shortlisted Alternatives

Table 12 shows the following alternatives to be shortlisted for further evaluation as there is no reasoning to eliminate any of these alternatives at this stage:

- **Option 4:** Chlorinate in New CT Chambers
- **Option 5:** Practice UV Disinfection and Chlorinate in New CT Chambers

5.7 High Lift Pump Equalization

5.7.1 Current Capacity

Table 1 shows the current net capacity of the existing high lift wet well (HLWW) with an effective operating volume of 475 m³ to achieve 15 minutes high lift pump equalization is 45,600 m³/d.

5.7.2 Upgrade Requirements

Section 5.6.2.4 short listed two disinfection alternatives that require new CT chambers to be constructed. By allowing the existing CT chambers to be converted into high lift wet wells, the CT chambers can provide an additional effective equalization volume of 559 m³ given a typical operating side water depth (SWD) of the existing HLWW of 4.45m (based on February to October 2019 data) and a difference of 2.4m between the finished floor of the HLWW and CT chambers, i.e., SWD of the CT chambers of 2.05m. The combined volume of the HLWW and CT chambers is 1,034 m³, which provides 29 and 15 minutes of high lift pump equalization at the Phase 1 and ultimate high lift pumping flowrates of 51,871 and 101,069 m³, respectively.

The new CT chambers that will be constructed as part of the disinfection alternatives will need to feed the existing CT chambers with these existing CT chambers hydraulically to be connected to the existing HLWW by cutting openings in the walls between both the existing CT chambers and HLWW at the CT chambers finished floor elevation.

The top of the overflow flare in the HLWW is at an elevation of 178.30 m. However, the top of weir between the CT chambers and the HLWW is 178.40 m. Moreover, the high-water level (H.W.L.) in the common feed chamber to the CT chambers can be as high as 178.74 m. This means that the full volume of the HLWW is not being utilized for high lift pump equalization. However, this is done to allow for a greater contingency with regards to overflowing the HLWW. The overflow in the HLWW can be elevated to allow for additional high lift pump equalization in the existing HLWW. However, given the construction of a new CT chamber, the overflow within the HLWW can be decommissioned with an overflow installed between the new CT chamber and the new LLWW.

5.8 High Lift Pumping

5.8.1 Current Capacity

Table 1 shows the firm capacity of the Municipal high lift pumps (HLPs) to be 28,850 m³/d (334 L/s), which is slightly less than the Phase 1 flow requirement of 32,757 m³/d, but considerably less than the ultimate flow requirement of 51,483 m³/d, respectively (Table 4). Note that these capacities were based on simply adding the flowrates of each pump at the same TDH and will need to be revised during detailed design based on the distribution system analysis in **Appendix B**. Regardless, Table 13 shows the upgrades required.

Table 1 shows the firm capacity of the Regional high lift pumps (HLPs) to be 22,890 m³/d (265 L/s), which is more than the Phase 1 flow requirement of 19,114 m³/d, but less than the ultimate flow requirement of 49,586 m³/d (Table 4). Note that these capacities were based on simply adding the flowrates of each pump at the same TDH and will need to be revised during detailed design based on the distribution system analysis in **Appendix B**. Regardless, Table 13 shows the upgrades required.

5.8.2 Upgrade Requirements

Table 13 shows the high lifting pumping upgrades to achieve the Phase 1 and ultimate flow requirements, which are the firm capacities with the largest HLP out of service. These upgrades are based on the distribution system analysis provided in **Appendix B**. The following items should be considered during detailed design:

- **Transient Modeling:** Transient analysis should be conducted on the pipelines with the existing and proposed HLPs.
- **HLPs Staging/Sizes:** The preferred staging of the HLPs should be determined at the time that the capacity is needed to avoid oversizing HLPs for capacities that may not be needed at the time, understanding that by the time the capacities are needed, the HLP(s) may have reached its end of life anyway requiring replacement of the HLPs. For example, Table 13 shows that between Phase 1 and ultimate flows the Regional Pipeline flows will increase by 2.6X.

Table 13 High Lift Pumping Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Pipeline	Net Flowrate Requirements	Recommended Upgrades	Firm Capacity
Municipal	Phase 1 32,757 m ³ /d	Replace all of the existing Municipal HLPs with new pumps to achieve the firm capacity.	32,757 m ³ /d (379 L/s)
	Ultimate 51,483 m ³ /d	Replace pumps/impellers as needed to achieve the higher capacity, understanding that pump/impeller replacement may not be needed for the higher flow given a lower system curve (but need to review pump run-out at the time).	51,483 m ³ /d (596 L/s)
Regional	Phase 1 19,114 m ³ /d	Add one new Regional HLP to achieve the firm capacity.	19,114 m ³ /d (221 L/s)
	Ultimate 49,586 m ³ /d	Replace all of the Regional HLPs with new pumps to achieve the firm capacity.	49,586 m ³ /d (574 L/s)

5.9 Chlorine Gas System

5.9.1 Current Capacity

Table 1 shows the following net capacities for the chlorine system:

- **Chlorinators:** Net capacity of 103,013 m³/d, which exceeds the ultimate net capacity of 101,069 m³/d.
- **Rotameters:** Net capacity of 43,785 m³/d, which is less than the Phase 1 and ultimate net capacities.
- **Chlorine Gas Container Storage:** Net capacity of 30,941 m³/d with two full chlorine gas containers (and three empty containers)

5.9.2 Upgrade Requirements

Table 14 shows the chlorine gas system upgrades to achieve the Phase 1 and ultimate flow requirements.

Table 14 Chlorine Gas System Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Equipment	Net Flowrate Requirements	Recommended Upgrades	Firm Capacity
Chlorinators	Phase 1 51,871 m ³ /d	No nothing.	103,013 m ³ /d
	Ultimate 101,069 m ³ /d	Do nothing.	103,013 m ³ /d
V-notch and Rotameters	Phase 1 51,871 m ³ /d	Move the existing 96 kg/d v-notch and rotameter from chlorinators 2 or 3 to chlorinator 1.	77,123 m ³ /d
		Replace the 96 kg/d v-notch and rotameters in chlorinators 2 and 3 with ones with a capacity of 114 kg/d.	51,963 m ³ /d
	Ultimate 101,069 m ³ /d	Replace the 96 kg/d v-notch and rotameter in chlorinator 1 with one with a capacity of 126 kg/d. Replace the 114 kg/d v-notch and rotameters in chlorinators 2 and 3 with ones with a capacity of 226 kg/d.	101,737 m ³ /d 103,013 m ³ /d
Chlorine Gas Containers	Phase 1 51,871 m ³ /d	Provide storage for an additional 5 chlorine gas containers so that 7 full containers (3 empty containers) can achieve the ultimate net rated capacity. This will require the existing chlorine building with monorail, and loading platform, to be extended eastwards as shown in Figure 22. Alternatively, if the existing ZW500 membrane building is repurposed as part of Option 3 of the membrane alternatives, then part, or all of the blower room can be used to store an additional 5+ chlorine containers. During a Workshop on November 19, 2019, the Town stated their preference to be the extension of the existing chlorine building eastwards.	108,292 m ³ /d (based on MDD/ADD of 1.291)
	Ultimate 101,069 m ³ /d	Do nothing.	104,351 m ³ /d (based on MDD/ADD of 1.244)
Other	Phase 1 51,871 m ³ /d	<ul style="list-style-type: none"> Install a one ton chlorine gas scrubber to ensure health and safety at all times. This scrubber can be located outside at the south east corner of the building just south of the chlorine container loading dock as shown in Figure 22. Program pre-chlorination based on the combined flowmeter readings of the new low lift pumps and the industrial pumps, instead of manually as currently practiced. <p>Note: There is no touch-up chlorination practiced to increase the free chlorine residual in the treated water leaving the plant (if needed). However, the operators have stated that they have no issues maintaining free chlorine residuals greater than 0.2 mg/L in the distribution system. Moreover, alarms in the SCADA system exist to notify the operators if the free chlorine residual leaving the plant drops below the target level to maintain this free chlorine residual in the distribution system.</p>	Impacts plant capacity if there is a shutdown with a chlorine gas leak; or, if chlorine is overdosed to the intake crib.
	Ultimate 101,069 m ³ /d	Do nothing.	-

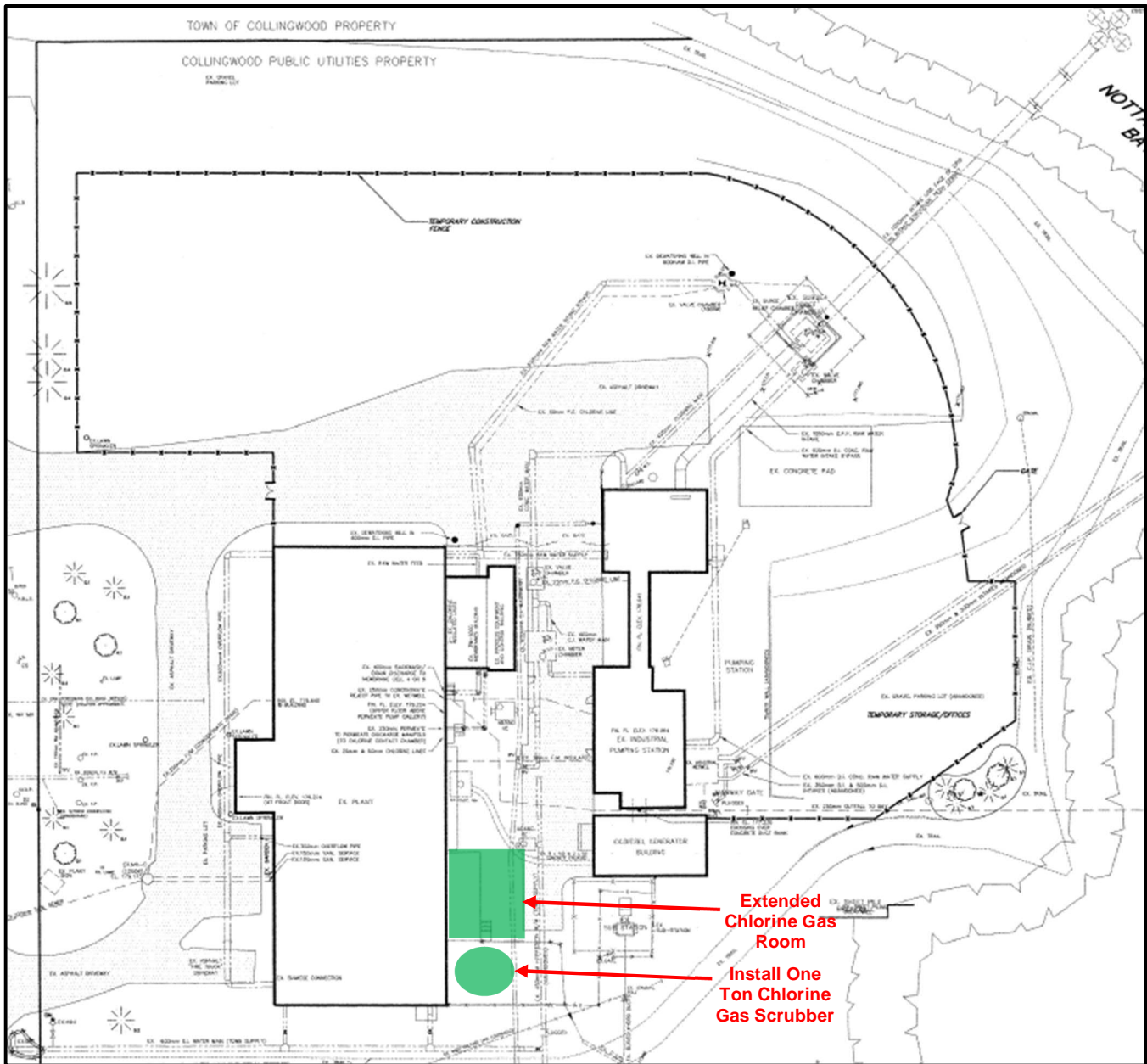


Figure 22 Proposed Extension of Chlorine Building and Addition of Chlorine Gas Scrubber

5.10 Chemical Systems

5.10.1 Current Capacity

The plant’s chemical systems only include the chlorine gas systems discussed above and chemical systems for membranes including the following:

- **12% sodium hypochlorite (for high pH CIP for ZW500/1000 Membranes and CEB for ZW1000 Membranes)** – Equipment distributed throughout the chlorine gas container room, chlorinator room and ZW1000 membrane building.
- **50% citric acid (for low pH CIP for ZW500/1000 Membranes)** – Equipment located within the blower room within the ZW500 membrane building blower room.

There has been no analysis of the chemical systems capacities as there has been no complaints. However, as discussed below, it is recommended that all chemicals be consolidated into a chemical building with proper health and safety features.

5.10.2 Upgrade Requirements

Table 15 shows the membrane chemical system upgrades to achieve the Phase 1 and ultimate flow requirements.

Table 15 Membrane Chemical Systems Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Equipment	Net Flowrate Requirements	Recommended Upgrades	Firm Capacity
Membrane Chemical Systems	Phase 1 51,871 m ³ /d	<ul style="list-style-type: none"> Consolidate into a chemical building with proper health and safety features. This building can be located either east of the blower room or east of the raw water building (and integrated into a new membrane building if this is the preferred membrane alternative). This is shown in Figure 23. Chemical systems for the membranes include sodium hypochlorite, citric acid, sodium bisulphite, hydrochloric acid and sodium hydroxide. Size chemical storage tanks for ultimate flow requirements. Above equipment to be part of membrane supplier scope. 	-
	Ultimate 101,069 m ³ /d	Do nothing.	-
Sodium Bisulphite Systems for Membrane Reject to Outfall	Phase 1 51,871 m ³ /d	<ul style="list-style-type: none"> Install a separate sodium bisulphite system (within the chemical building proposed above) dedicated to the membrane reject being discharged to the outfall. Currently, there is no sodium bisulphite system to dechlorinate the membrane reject being discharged through the existing 250 mm diameter outfall to the Nottawasaga Bay, in case some chlorine residual remains within the membrane reject. Size sodium bisulphite storage tank for ultimate flow requirements and bisulphite feed pumps for Phase 1 flows (or lower flows to allow for better turn down of the chemical metering pumps). 	-
	Ultimate 101,069 m ³ /d	Upsize the sodium bisulphite feed pumps if needed.	-

Given above, the new chemical building/room will store the following chemicals:

- Sodium hypochlorite
- Citric acid
- Sodium hydroxide
- Sodium bisulphite
- Hydrochloric acid

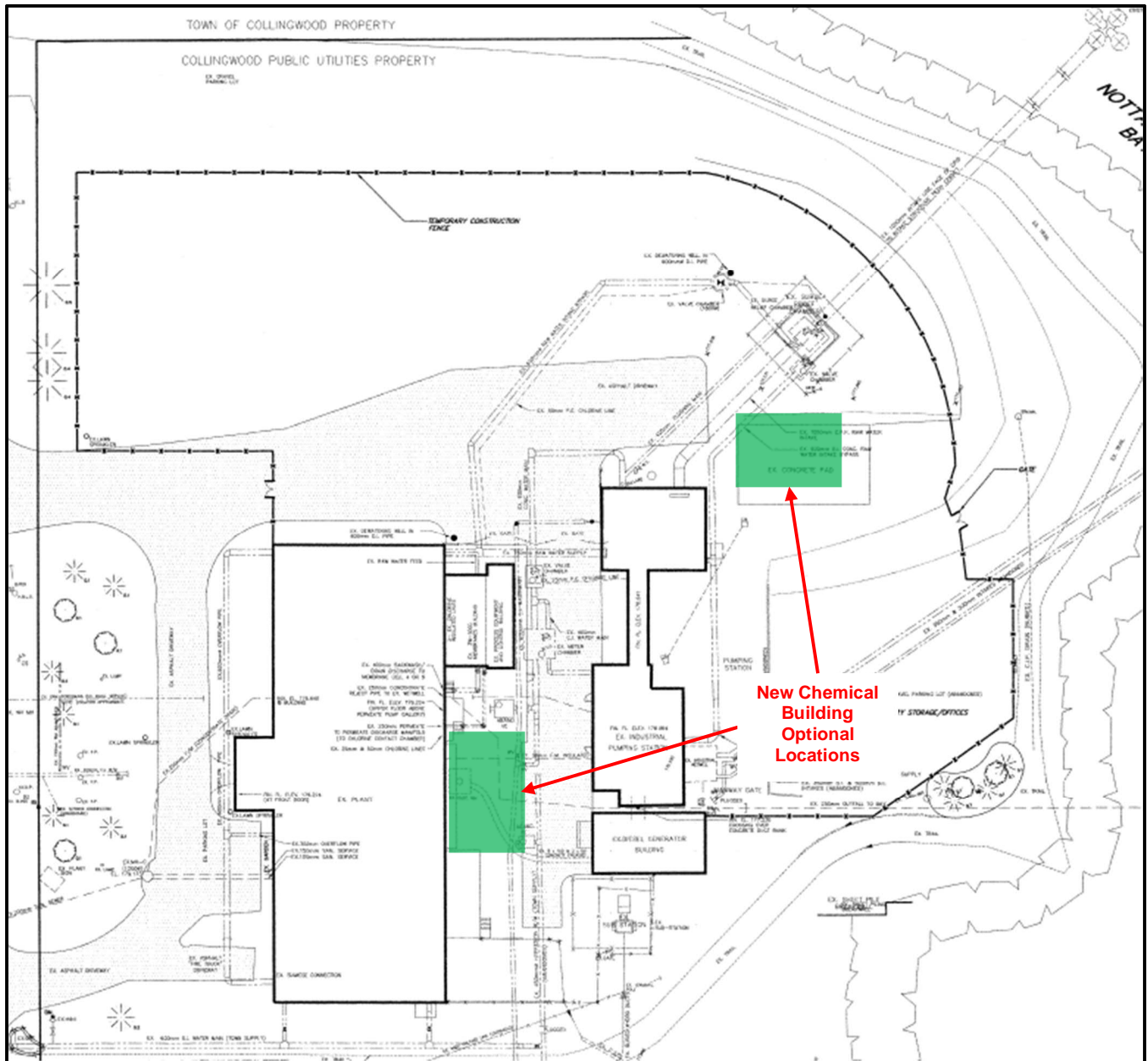


Figure 23 Proposed Optional Locations of New Chemical Building

5.11 Residue Management

5.11.1 Current Capacity

Not applicable.

5.11.2 Upgrade Requirements

Table 16 shows the residue management upgrades to achieve the Phase 1 and ultimate flow requirements. These tanks are different to those supplied with the membrane equipment, e.g., the CIP/neutralization tanks needed within the membrane ancillary building for the preferred membrane alternatives.

Table 16 Residue Management Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Equipment	Net Flowrate Requirements	Recommended Upgrades	Firm Capacity
Residue Management	Phase 1 51,871 m ³ /d	<p>Install two (2) wastewater equalization tanks (1 duty, 1 standby) below grade to equalize block and bleed wastewater, backwash wastewater from the new membrane system(s), and reject wastewater from the ZW500 system if remaining (tanks to operate as duty at all times except when CIP wastewater from ZW500 tanks is drained to one of the tanks to be manually neutralized prior to discharge into the sanitary sewer). Each tank should be sized for the following:</p> <ul style="list-style-type: none"> • Two (2) backwashes of the new membrane system. • One (1) CIP volume of the existing ZW500 tanks (if remaining). <p>Provide separate wastewater discharge headers to the outfall (when TSS < 25 mg/L) and sanitary sewer.</p> <p>Tank to be located below grade to accept membrane backwash wastewater as required. Location of tank can be east of the ZW500 membrane building or the industrial pumping station as shown in Figure 24.</p>	-
	Ultimate 101,069 m ³ /d	Do nothing.	-

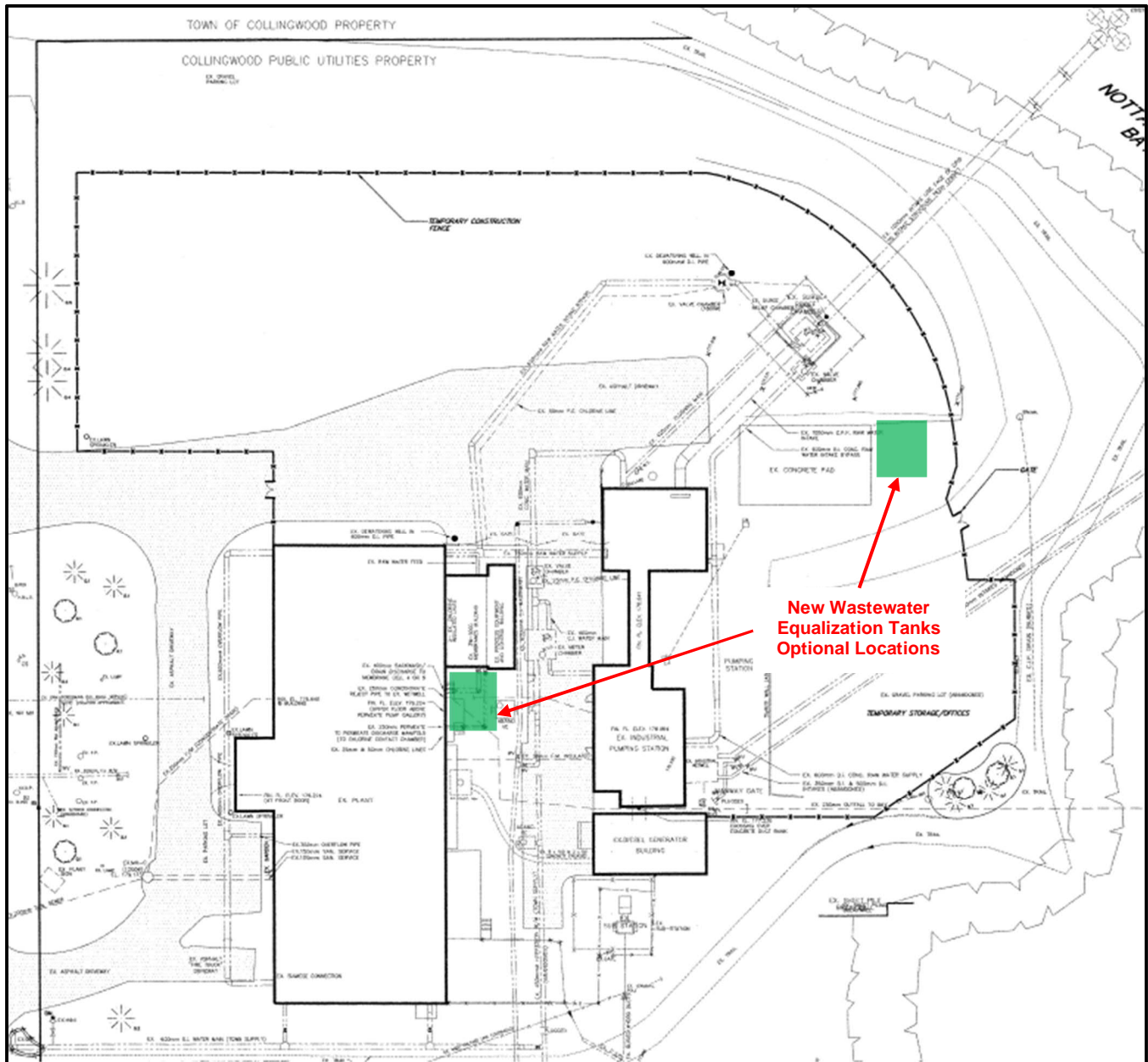


Figure 24 Proposed Optional Locations of Wastewater Equalization Tanks

5.12 Sanitary Sewage Transfer Systems

5.12.1 Current Capacity

Not applicable.

5.12.2 Upgrade Requirements

Table 17 shows the sanitary sewage transfer systems to achieve the Phase 1 and ultimate flow requirements.

Table 17 Sanitary Sewage Transfer Systems to Achieve the Phase 1 and Ultimate Flow Requirements

Equipment	Net Flowrate Requirements	Recommended Upgrades	Firm Capacity
Sanitary Sewage Transfer Systems	Phase 1 51,871 m ³ /d	Install sanitary sewage transfer system(s) to collect floor drains and any other sanitary waste from the new building(s) and then discharge to the sanitary sewer.	-
	Ultimate 101,069 m ³ /d	Do nothing.	-

5.13 Site Electrical

5.13.1 Current Capacity

A 44 kV primary cable runs from the terminal hydro pole to a 2000kVA pad mounted transformer, which is wound to transform 44kV to 600/347V. A single cable carries 600V power from the substation to the switchgear and motor control centre (MCC) in the diesel generator building. Electric wires then stem from this MCC to the other MCCs, with some electrical manholes existing.

5.13.2 Upgrade Requirements

Table 18 shows the site electrical upgrades to achieve the Phase 1 and ultimate flow requirements.

Table 18 Site Electrical Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Equipment	Net Flowrate Requirements	Recommended Upgrades	Firm Capacity
Site Electrical Upgrades	Phase 1 51,871 m ³ /d	<ul style="list-style-type: none"> Replace the existing 2000kVA transformer to a larger transformer to suit the site electrical requirements for Phase 1. Install new electrical manholes and ductbanks as required. Construct new electrical rooms where required for the various processes. 	-
	Ultimate 101,069 m ³ /d	<ul style="list-style-type: none"> Complete similar upgrades to that discussed above for Phase 1. 	-

5.14 Standby Power

5.14.1 Current Capacity

The prime rating and standby rating of the existing standby generator is 1,000 kW and 1,150 kW, respectively. There are four 2,270 diesel storage tanks within the diesel building which may not meet current codes and allowable volumes indoors

5.14.2 Upgrade Requirements

Table 19 shows the standby power upgrades to achieve the Phase 1 and ultimate flow requirements.

Table 19 Standby Power Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Equipment	Net Flowrate Requirements	Recommended Upgrades	Firm Capacity
Standby Power Upgrades	<p>Phase 1 51,871 m³/d</p>	<ul style="list-style-type: none"> • Demolish the existing industrial building after the new low lift pumping station has been constructed and new industrial pumps are installed and commissioned within the new low lift wet wells. • Construct a new generator building in the location of the industrial building, which is adjacent to the existing generator building. • Install a new generator sized for 100% of the loads at Phase 1 flows (including building loads) within the new generator building. • Install another new outdoor diesel storage tank (sized for 24 hours of storage) at the current location of the temporary ZW1000 membrane building (to be removed as part of this project). Install transfer pumps and day tanks inside the new generator building. Above concepts are shown in Figure 25. 	-
	<p>Ultimate 101,069 m³/d</p>	<ul style="list-style-type: none"> • Remove the existing generator and diesel storage tanks within the existing diesel generator building. • Install a new generator within the original generator building, such that when combined with the Phase 1 generator, 100% of the loads can be on standby power. • Install synchronization for both generators. • Install another new outdoor diesel storage tank next to that installed in Phase 1. Install transfer pumps and day tanks inside the original generator building. 	-

- ZW1000 membrane system
- Plant processes
- Regional high lift pumps

5.15.2 Upgrade Requirements

Table 20 shows the SCADA upgrades to achieve the Phase 1 and ultimate flow requirements.

The Town is planning to upgrade the SCADA system (HMI software) and replace the control wiring to the permeate pump room prior to the plant expansion.

Table 20 SCADA Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Equipment	Net Flowrate Requirements	Recommended Upgrades	Firm Capacity
SCADA Upgrades	Phase 1 51,871 m ³ /d	<ul style="list-style-type: none"> • Replace the PLCs and control wiring to all equipment. 	-
	Ultimate 101,069 m ³ /d	<ul style="list-style-type: none"> • Install new PLCs where required. 	-

5.16 Building Services

5.16.1 Current Capacity

Not applicable.

5.16.2 Upgrade Requirements

There are signs of corrosion within the existing ZW500 membrane building which can be attributed to poor ventilation amongst other causes. Moreover, the HVAC equipment is old and require replacement. Table 21 shows the building upgrades to achieve the Phase 1 and ultimate flow requirements.

Table 21 Building Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Equipment	Net Flowrate Requirements	Recommended Upgrades	Firm Capacity
Building Upgrades	Phase 1 51,871 m ³ /d	<ul style="list-style-type: none"> • Install dehumidification within the existing ZW500 membrane building if this building is to continue to house membranes since the existing dehumidification equipment has been removed over the years. • Complete the recommended upgrades within the Condition Assessment Report completed by AECOM in November 2019. • Install the following rooms within an administration building (new or repurposed): <ol style="list-style-type: none"> Men’s and Women’s washroom/change room complete with showers and lockers – 6 male lockers and 2 female lockers Lunch room for up to 8 operators Updated lab facilities – existing one can be reused but there should be budget to upgrade it Meeting/Training room for 10 to12 people that is AODA compliant for access AODA compliant washroom associated with the meeting/training room 	-

		f. There should also be a control room in any membrane facility so if there are two buildings with membranes, there needs to be a control room in each.	
	Ultimate 101,069 m³/d	<ul style="list-style-type: none"> Complete building upgrades where required. 	-

5.17 Site Services

5.17.1 Current Capacity

Not applicable.

5.17.2 Upgrade Requirements

Table 22 shows the site servicing upgrades to achieve the Phase 1 and ultimate flow requirements.

Table 22 Site Servicing Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Equipment	Net Flowrate Requirements	Recommended Upgrades	Firm Capacity
Building Upgrades	Phase 1 51,871 m³/d	<ul style="list-style-type: none"> Complete site grading, landscaping and yard piping. 	-
	Ultimate 101,069 m³/d	<ul style="list-style-type: none"> Complete site grading and landscaping. 	-

6. Alternatives for Further Evaluation

Table 23 shows the processes that have alternatives for further evaluation as discussed in Section 5. It is assumed that the upgrades recommended within this report for the other processes will proceed with an opinion of cost of these processes provided in Section 13.

Table 23 Alternatives for Further Evaluation

Option #	Alternative
Membrane Alternatives	
1	Maintain Existing ZW500 Membrane Building Capacity with Minor Retrofit of ZW500d Trains and Construct New Membrane Building
2.1	Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 2 Remaining ZW500d Trains
2.2	Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 0 Remaining ZW500d Trains
3	Repurpose Existing ZW500 Membrane Building and Construct New Membrane Building
Disinfection Alternatives	
4	Chlorinate in New CT Chambers
5	Practice UV Disinfection and Chlorinate in New CT Chambers

7. Technical Evaluation of Short-Listed Alternatives

7.1 Overview

This section describes the results of the detailed technical evaluation for the short-listed alternatives.

7.2 Evaluation Criteria and Weights

The short-listed alternatives were assessed relative to each other and evaluated against a set of pertinent criteria and factors. The proposed evaluation criteria are based on four primary criteria typically used in the water industry for the selection of alternatives as part of a Cost-Benefit analysis:

- Water Quality
- Technical Considerations
- Social Considerations
- Natural Environmental Considerations

Secondary criteria or sub-criteria were identified within each primary criterion. The secondary criteria aim to describe specific aspects of the criteria to be evaluated. Weighting factors that correspond to the degree of importance within the overall evaluation scheme were assigned to each of the primary and secondary evaluation criteria based on project team judgment and previous experience in similar projects.

The proposed evaluation criteria and weighting factors, grouped by primary categories, are shown in Table 24 for the membrane alternatives and Table 25 for the disinfection alternatives. The only difference between the tables is the elimination of the primary criteria *Water Quality* for the membrane alternatives since all of the membrane alternatives will provide similar performance credits in Ontario.

It is important to note that the decision model considers factors not directly related to costs. As such, economic considerations (capital and O&M costs) were not included as part of the technical evaluation criteria. Weightings for each criterion were developed and used during the Cost-Benefit analysis, with results presented in succeeding sections of this report.

Table 24 Evaluation Criteria and Weighting – Membrane Alternatives

Primary Criteria	Weight	Secondary Criteria	Relative Weight	Absolute Weight
Technical Considerations	80	Operation and maintenance requirements, including process complexity	50.0	40
		Ease of implementation (construction schedule)	30.0	24
		Process robustness	20.0	16
Maximum Sub-total Score – Technical Considerations				80
Social Considerations	20	Minimize footprint and site impacts /architectural aesthetics (plant appearance)	70.0	14
		Minimize truck traffic (during construction and operation)	30.0	6
Maximum Sub-total Score – Social Considerations				20
Total Overall Maximum Score				100

Table 25 Evaluation Criteria and Weighting – Disinfection Alternatives

Primary Criteria	Weight	Secondary Criteria	Relative Weight	Absolute Weight
Water Quality	35	Pathogen control	100.0	35
Maximum Sub-total Score – Water Quality				35
Technical Considerations	50	Operation and maintenance requirements, including process complexity	50.0	25
		Ease of implementation (construction schedule)	30.0	15
		Process robustness (multi-barrier treatment)	20.0	10
Maximum Sub-total Score – Technical Considerations				50
Social Considerations	15	Minimize footprint and site impacts /architectural aesthetics (plant appearance)	66.7	10
		Minimize truck traffic (during construction and operation)	33.3	5
Maximum Sub-total Score – Social Considerations				15
Total Overall Maximum Score				100

The **primary criteria** listed below were also considered for evaluation purposes, however they were not included for the following reasons:

- **Regulatory risk:** Each of the short-listed alternatives is expected to receive approval from the MECP.
- **Natural Environmental Considerations:** This primary criterium normally includes the following secondary criteria: *minimize air emissions* and *minimize residual impacts*. There is negligible differentiation between the short-listed alternatives for these criteria.

The **secondary criteria** listed below were also considered for evaluation purposes, however they were not included since there is negligible differentiation between the short-listed alternatives for these criteria and there was a preference for secondary criteria that have considerable differences between the various alternatives.

- **Water Quality (applicable to the disinfection alternatives only)**
 - *Minimize disinfection by-products* – The target free chlorine residual leaving the plant will be identical at 1.0 mg/L minimum (average of 1.5 mg/L) regardless of the preferred disinfection alternative.
 - *Flexibility for future objectives including taste and odour control and removal of emerging contaminants* – The Town has had no complaints for taste and odour control and there are currently no concerns of emerging contaminants. As a result, the Town prefers that the UV disinfection system (if chosen as the preferred alternative) be installed for disinfection only with no provision for future UV oxidation. If future UV oxidation is required, the Town will then review the replacement of the UV disinfection system with a UV oxidation system.
- **Technical Considerations (applicable to the membrane and disinfection alternatives)**
 - *Compatibility with existing systems and site* – Only alternatives that are compatible with the existing systems and site were short listed.
 - *Flexibility for expansion (future phases)* – All alternatives considered can meet ultimate flows.
 - *Proven track record* – All alternatives considered have a proven track record.
 - *Safety requirements* – All alternatives considered are safe.
- **Social Considerations (applicable to the membrane and disinfection alternatives)**

- *Minimize noise (during operation)* – There are no noise differences between the short-listed alternatives.
- *Minimize odour (during operation)* – There are no odour differences between the short-listed alternatives.

7.3 Technical Evaluation

The detailed technical evaluation process applied herein follows the evaluation methodology explained in Section 7.2.

The evaluation methodology compares the features of each short-listed alternative, relative to each other. Each short-listed alternative has been assigned a technical score out of 10 for each evaluation criteria. The assigned score represents how well the specific alternative meets the criterion under consideration - the higher the ability to perform or meet the criterion, the higher the score assigned. The short-listed alternative with the highest score suggests that it provides the most “benefits” to this project.

A summary of the technical scoring for the short-listed alternatives are provided at the following locations:

- **Membrane Alternatives:** Table 26 and graphically represented in Figure 26.
- **Disinfection Alternatives:** Table 27 and graphically represented in Figure 27

Details of the complete evaluation of the short-listed alternatives, as well as the rationale upon which the scores have been relatively assigned, are presented in **Appendix A**. The individual scores for each short-listed alternative were determined by the Town of Collingwood and the Ainley/AECOM project team.

Table 26 Summary of Technical Scores for *Membrane Alternatives*

Option	Alternative Description	Total Technical Score	Technical Ranking
1	Maintain Existing ZW500 Membrane Building Capacity with Minor Retrofit of ZW500d Trains and Construct New Membrane Building	52.8	4
2.1	Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 2 Remaining ZW500d Trains	56.0	3
2.2	Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 0 Remaining ZW500d Trains	67.6	2
3	Repurpose Existing ZW500 Membrane Building and Construct New Membrane Building	79.8	1

Table 27 Summary of Technical Scores for *Disinfection Alternatives*

Option	Alternative Description	Total Technical Score	Technical Ranking
4	Chlorinate in New CT Chambers	49.0	2
5	Practice UV Disinfection and Chlorinate in New CT Chambers	74.0	1

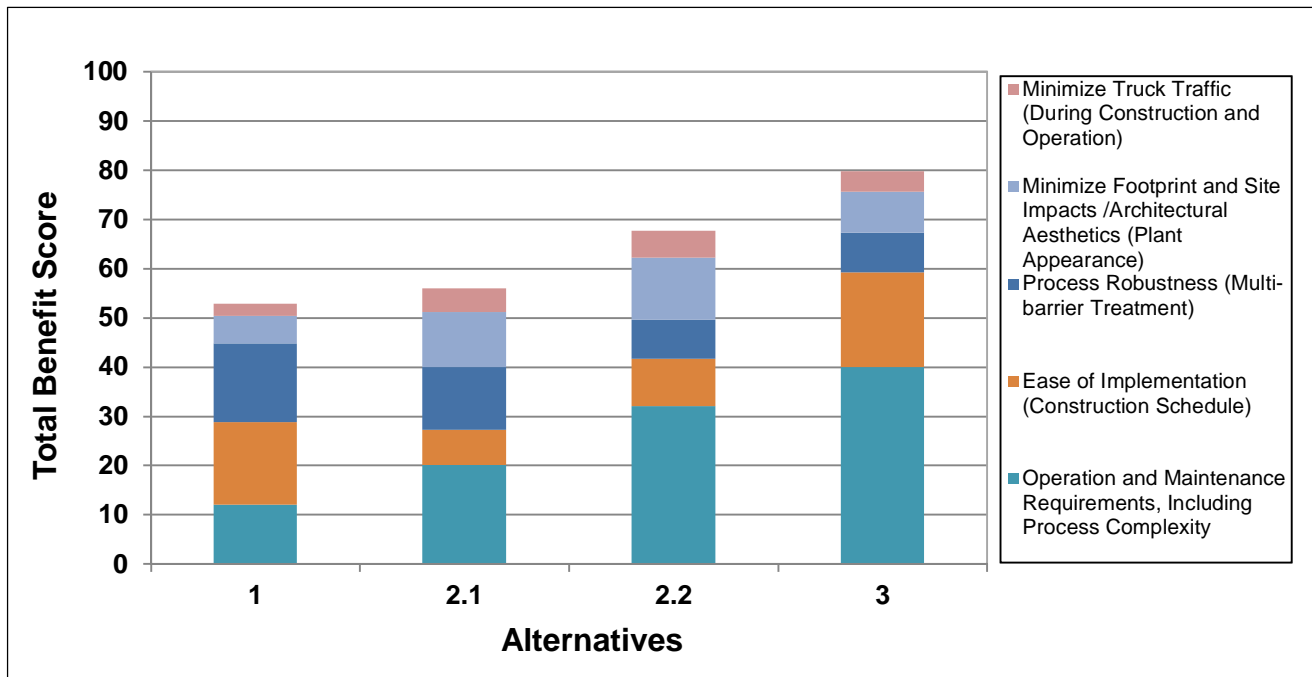


Figure 26 Technical Scoring Results for *Membrane* Alternatives

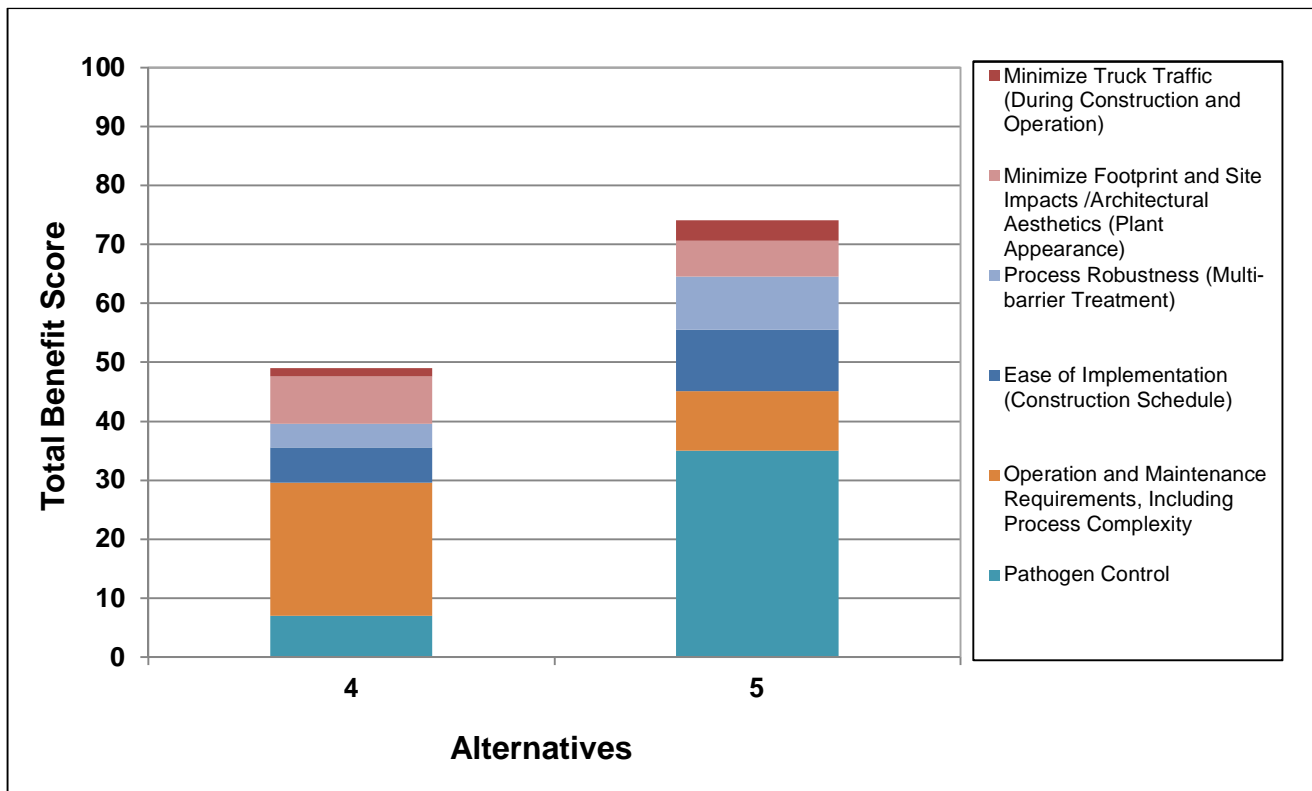


Figure 27 Technical Evaluation Scoring Results for *Disinfection* Alternatives

8. Cost Evaluation of Short-Listed Alternatives

8.1 Cost Assumptions

The following general assumptions were made for the short-listed alternatives:

- A US\$ conversion rate of US\$1 = CDN\$1.30 was assumed. This can change by the time the contract is tendered.
- Estimates of probable capital costs have been developed based on prices obtained from suppliers and from data in AECOM's possession from projects of similar nature and scope. However, the cost estimates presented in this report may be significantly affected by a number of factors that cannot be readily forecasted. This includes volume of work in hand or in prospect for contractors or suppliers at the time of the tender calls, future labour contract settlements, inflation and market escalation, amongst others. For this reason, the actual costs may be different from those presented in this report.
- For the purpose of a relative economic evaluation amongst all short-listed alternatives under consideration, it should be highlighted that costs for all alternatives were calculated under the same assumptions and rationale. Should prices change over time, the changes would apply proportionally for all short-listed alternatives and the results of the comparative cost evaluation would remain unaltered.
- Operation and maintenance costs for comparing short-listed alternatives in this evaluation assume the following:
 - Chlorine gas costs = \$3.03/kg
 - 12% Sodium hypochlorite costs = \$0.47/L
 - 50% Citric acid costs = \$1.10/L
 - 50% Sodium hydroxide costs = \$0.94/L
 - 38% Sodium bisulphite costs = \$0.31/L
 - 12% Hydrochloric Acid = \$0.45/L
 - Power costs = \$0.151/kW.h
 - Full time employee (FTE) (operator or millwright) = \$100/hr
 - Annual equipment maintenance = 3% of equipment costs
- All taxes (including the 13% HST) have been excluded.
- Life cycle costs have been estimated based on the following:
 - Phase 1 works will be completed by 2024.
 - Ultimate works will be completed by 2044 (understanding that the Town would most likely stage the works between Phase 1 flows and ultimate flows). 2044 was used instead of 2038 for the following reasons:
 - The intake PTTW is the limiting factor. The final membrane system design may allow for the instantaneous raw water flowrate to allow for flows up to 2044 projections.
 - 2044 allows for two membrane replacement cycles.
 - An annual inflation rate of 3.0% and an annual interest rate of 5.5% will be assumed to give a market/discount rate of 2.5%.
 - A net present value analysis will be conducted based on above and a 30-year operation and maintenance period at average day flows between 2024 and 2054 allowing for at least two membrane replacement from the 2024 expansion and then one membrane replacement for the 2044 expansion.
- For the disinfection alternatives, the capital, operating and net present value for the chlorine dosing equipment (not the CT chambers) will be ignored since they would have identical costs for both chlorine only (option 4) and UV/chlorine (option 5) since the CT chambers would have been designed given an identical free chlorine residual. So only the capital costs associated with the CT chambers will be considered regarding the chlorine portion of the evaluation.

8.2 Alternative Estimates

Table 28 and Table 29 summarize the capital and operating cost estimates and net present value for the short-listed *membrane* and *disinfection* alternatives, respectively.

Table 28 Capital and Operating Cost Estimates and NPV for Short-Listed *Membrane* Alternatives

Option	Alternative Description	Capital Costs (\$M)	Operating Costs (\$M)	Net Present Value (\$M)
1	Maintain Existing ZW500 Membrane Building Capacity with Minor Retrofit of ZW500d Trains and Construct New Membrane Building	\$55.1	\$22.6	\$77.6
2.1	Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 2 Remaining ZW500d Trains	\$46.6	\$14.7	\$61.3
2.2	Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 0 Remaining ZW500d Trains	\$40.7	\$10.8	\$51.6
3	Repurpose Existing ZW500 Membrane Building and Construct New Membrane Building	\$39.1	\$9.6	\$48.6

Table 29 Capital and Operating Cost Estimates and NPV for Short-Listed *Disinfection* Alternatives

Option	Alternative Description	Capital Costs (\$M)	Operating Costs (\$M)	Net Present Value (\$M)
4	Chlorinate in New CT Chambers	\$9.2	\$0.06	\$9.3
5	Practice UV Disinfection and Chlorinate in New CT Chambers	\$6.1	\$0.86	\$7.0

9. Cost-Benefit Analysis Results

9.1 Overview

The Cost-Benefit analysis is a value analysis tool that provides an alternative means to include costs in the evaluation process. The Cost-Benefit analysis is carried out as follows:

- Total technical score obtained for each short-listed alternative, as presented in Section 7.3, are carried forward.
- The calculated net present value (NPV) for each short-listed alternative has been presented in Section 8.2 with a cost score calculated based on the weightings of a technical versus cost rating of 70% to 30%, which provides a greater emphasis on technical features, rather than costs.
- The cost score is added to the technical score to result in a *Total Score* with the highest score being the preferred alternative.

9.2 Cost-Benefit Analysis

The results of the Cost-Benefit analysis for the *membrane* alternatives are shown in Table 30 and plotted in Figure 28. Similarly, the results for the *disinfection* alternatives are shown in Table 31 and plotted in Figure 29. The detailed technical evaluation scoring and results are shown in **Appendix A**. As shown, the following alternatives had the highest Cost-Benefit Analysis scores:

- **Membrane Alternative:** Repurpose Existing ZW500 Membrane Building and Construct New Membrane Building.
- **Disinfection Alternative:** Practice UV Disinfection and Chlorinate in New CT Chambers

Table 30 Cost-Benefit Analysis for Membrane Alternatives

Option	Description	Scenario No.1 (Original Weighting)				
		Net Present Value (\$M)	Cost Score (Points out of 100)	Technical Score (Points out of 100)	Total Score	Overall Ranking
1	Maintain Existing ZW500 Membrane Building Capacity with Minor Retrofit of ZW500d Trains and Construct New Membrane Building	\$77.6	62.7	52.8	55.8	4
2.1	Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 2 Remaining ZW500d Trains	\$61.3	79.4	56.0	63.0	3
2.2	Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 0 Remaining ZW500d Trains	\$51.6	94.4	67.6	75.6	2
3	Repurpose Existing ZW500 Membrane Building and Construct New Membrane Building	\$48.6	100.0	79.8	85.9	1

Notes:

1. Sample calculation is shown below for Option 2.1:

$\begin{aligned} \text{Cost Score} &= \frac{\text{Lowest Option NPV}}{\text{Option 2.1 NPV}} \times 100\% \\ &= \frac{\$48.6\text{M}}{\$61.3\text{M}} \times 100\% \\ &= 79.4 \end{aligned}$	$\begin{aligned} \text{Total Score} &= (\text{Cost Score} \times 30\%) + (\text{Technical Score} \times 70\%) \\ &= (79.4 \times 30\%) + (56.0 \times 70\%) \\ &= 23.8 + 39.2 \\ &= 63.0 \end{aligned}$
--	---

Table 31 Cost-Benefit Analysis for Disinfection Alternatives

Option	Description	Scenario No.1 (Original Weighting)				
		Net Present Value (\$M)	Cost Score (Points out of 100)	Technical Score (Points out of 100)	Total Score	Overall Ranking
4	Chlorinate in New CT Chambers	\$9.3	75.2	49.0	56.9	2
5	Practice UV Disinfection and Chlorinate in New CT Chambers	\$7.0	100.0	74.0	81.8	1

Notes:

1. Sample calculation is shown below for Option 4:

$\begin{aligned} \text{Cost Score} &= \frac{\text{Lowest Option NPV}}{\text{Option 5 NPV}} \times 100\% \\ &= \frac{\$7.0\text{M}}{\$9.3\text{M}} \times 100\% \\ &= 75.2 \end{aligned}$	$\begin{aligned} \text{Total Score} &= (\text{Cost Score} \times 30\%) + (\text{Technical Score} \times 70\%) \\ &= (75.2 \times 30\%) + (49.0 \times 70\%) \\ &= 22.6 + 34.3 \\ &= 56.9 \end{aligned}$
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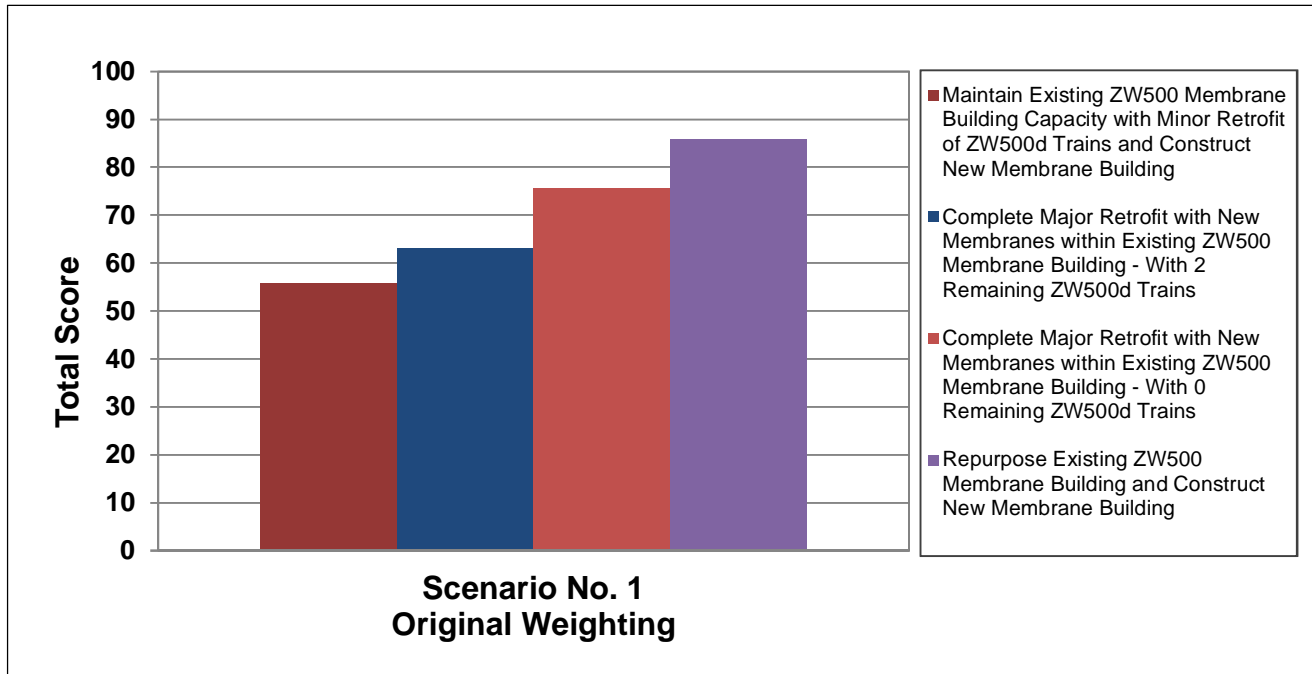


Figure 28 Cost-Benefit Analysis Results for *Membrane Alternatives*

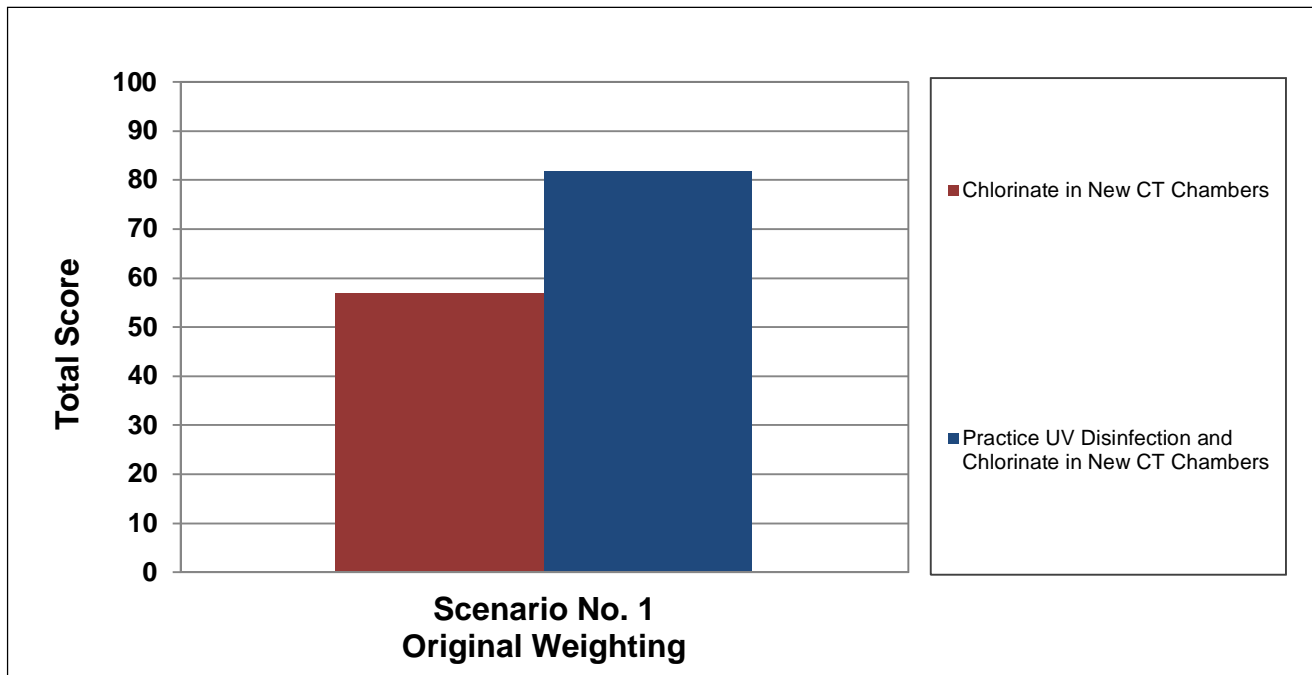


Figure 29 Cost-Benefit Analysis Results for *Disinfection Alternatives*

10. Sensitivity Analysis

10.1 Overview

The decision model incorporated a sensitivity analysis exercise that helps examine the overall Benefit-to-Cost ratio results based on different criteria weightings. This analysis helps us to understand whether the short-listed alternative with the highest Benefit-to-Cost ratio remains the highest scoring alternative when criteria weighting factors are altered.

The model was run for an additional scenario that had different technical and cost weighting factors. This allowed the project team to observe whether the changes had an effect on the original results and also indicates whether the preferred option favours one set of criteria over the other. The technical criteria weights are explained in detail in Section 10.2 below.

10.2 Sensitivity Analysis Results based on Different Evaluation Criteria Weights

The original and modified weighting scenarios for the short-listed alternative sensitivity analysis are described in Table 32 for the *membrane* alternatives and Table 33 for the *disinfection* alternatives.

Table 32 Technical Criteria Weights for Sensitivity Analysis – Membrane Alternatives

Primary Criteria	Secondary Criteria	Scenario 1 (Original Weighting)			Scenario 2 (Modified Weighting)		
		Primary Criteria Weight	Secondary Criteria Relative Weight	Absolute Weighting	Primary Criteria Weight	Secondary Criteria Relative Weight	Absolute Weighting
Technical Considerations	Operation and maintenance requirements, including process complexity	80	50	40	65	53.8	35
	Ease of implementation (construction schedule)		30	24		38.5	25
	Process robustness		20	16		7.7	5
Social Considerations	Minimize footprint and site impacts /architectural aesthetics (plant appearance)	20	70	14	35	71.4	25
	Minimize truck traffic (during construction and operation)		30	6		28.6	10

Table 33 Technical Criteria Weights for Sensitivity Analysis – *Disinfection* Alternatives

Primary Criteria	Secondary Criteria	Scenario 1 (Original Weighting)			Scenario 2 (Modified Weighting)		
		Primary Criteria Weight	Secondary Criteria Relative Weight	Absolute Weighting	Primary Criteria Weight	Secondary Criteria Relative Weight	Absolute Weighting
Water Quality	Pathogen control	35	100.0	35	25	100.0	25
Technical Considerations	Operation and maintenance requirements, including process complexity	50	50.0	25	45	66.7	30
	Ease of implementation (construction schedule)		30.0	15		22.2	10
	Process robustness (multi-barrier treatment)		20.0	10		11.1	5
Social Considerations	Minimize footprint and site impacts /architectural aesthetics (plant appearance)	15	66.7	10	30	66.7	20
	Minimize truck traffic (during construction and operation)		33.3	5		33.3	10

The modified weights for Scenario No. 2 were applied to the technical scores, presented in Section 7.3. The NPV calculated for the short-listed alternatives, as shown in Section 8.2, were used for the calculation of the revised Benefit-to-Cost ratio. **The overall scores for Scenario No. 2 were calculated based on 50% of the weight given to technical aspects and 50% based on cost.**

Recall that the Cost-Benefit analysis in Section 9.2 was performed using Scenario No. 1 (original weighting) based on an overall weigh of 70% for technical criteria and 30% for cost based on the net present value of the different alternatives. The results for Scenario No. 2 in addition to those obtained for Scenario No.1 are presented in Table 34 and Figure 30 for the *membrane* alternatives, and Table 35 and Figure 31 for the *disinfection* alternatives.

Table 34 Sensitivity Analysis Results – Benefits-to-Cost Ratio Results – Membrane Alternatives

Option	Description	Net Present Value (\$M)	Scenario No.1 (Original Weighting)				Scenario No.2 (Modified Weighting)			
			Cost Score (Points out of 100)	Technical Score (Points out of 100)	Total Score	Overall Ranking	Cost Score (Points out of 100)	Technical Score (Points out of 100)	Total Score	Overall Ranking
1	Maintain Existing ZW500 Membrane Building Capacity with Minor Retrofit of ZW500d Trains and Construct New Membrane Building	\$77.6	62.7	52.8	55.8	4	62.7	47.0	54.8	4
2.1	Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 2 Remaining ZW500d Trains	\$61.3	79.4	56.0	63.0	3	79.4	57.0	68.2	3
2.2	Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 0 Remaining ZW500d Trains	\$51.6	94.4	67.6	75.6	2	94.4	72.0	83.2	2
3	Repurpose Existing ZW500 Membrane Building and Construct New Membrane Building	\$48.6	100.0	79.8	85.9	1	100.0	79.5	89.8	1

Table 35 Sensitivity Analysis Results – Benefits-to-Cost Ratio Results – Disinfection Alternatives

Option	Description	Net Present Value (\$M)	Scenario No.1 (Original Weighting)				Scenario No.2 (Modified Weighting)			
			Cost Score (Points out of 100)	Technical Score (Points out of 100)	Total Score	Overall Ranking	Cost Score (Points out of 100)	Technical Score (Points out of 100)	Total Score	Overall Ranking
4	Chlorinate in New CT Chambers	\$9.3	75.2	49.0	56.9	2	75.2	57.0	66.1	2
5	Practice UV Disinfection and Chlorinate in New CT Chambers	\$7.0	100.0	74.0	81.8	1	100.0	67.5	83.8	1

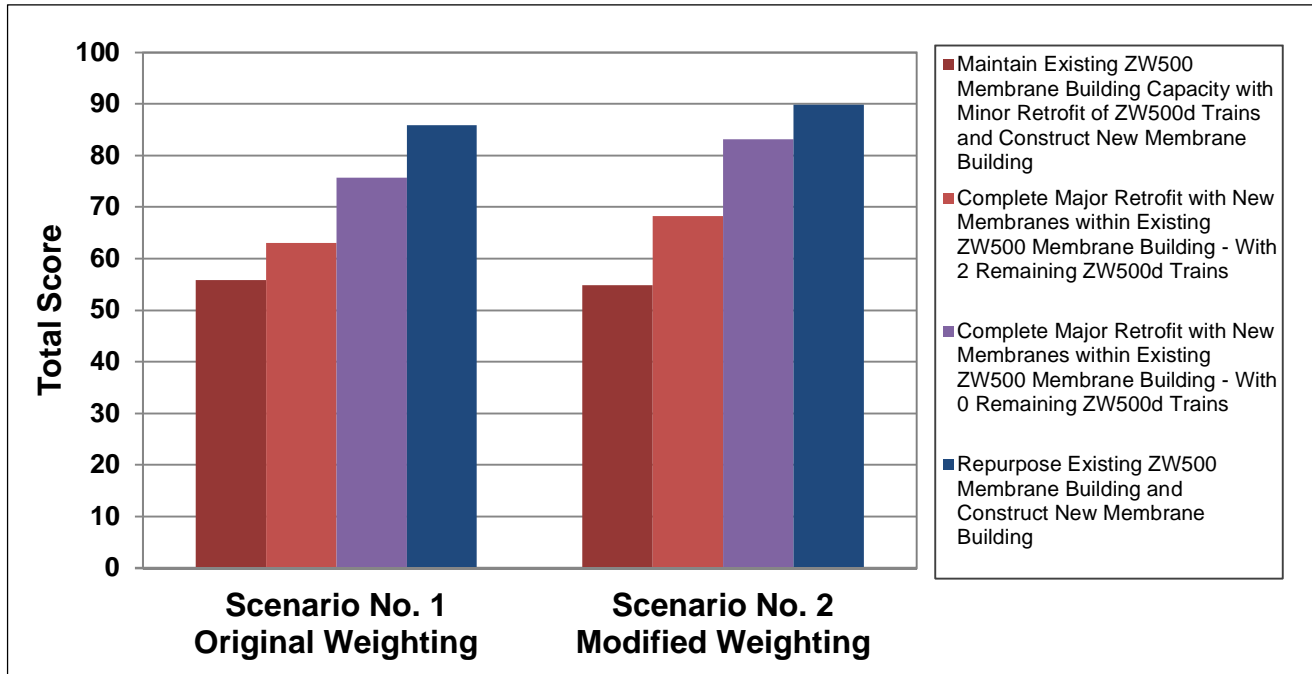


Figure 30 Sensitivity Analysis Results for *Membrane Alternatives*

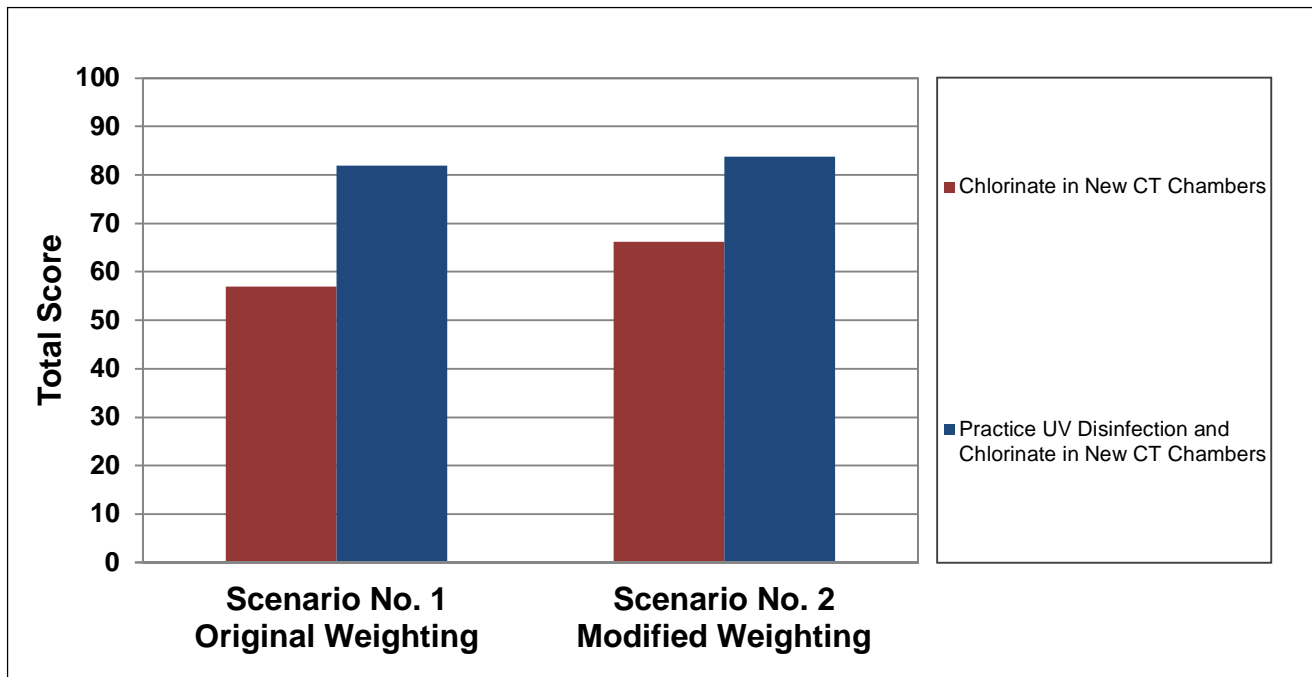


Figure 31 Sensitivity Analysis Results for *Disinfection Alternatives*

From the results of the sensitivity analysis exercise, the following alternatives had the highest cost-benefit analysis scores:

- **Membrane Alternative:** Repurpose Existing ZW500 Membrane Building and Construct New Membrane Building
- **Disinfection Alternative:** Practice UV Disinfection and Chlorinate in New CT Chambers

11. Preferred Alternatives

Given the Cost-Benefit analysis in Sections 9.2 and 10.2 (sensitivity analysis), AECOM recommends the following updates to the *membrane* (Table 36) and *disinfection* (Table 37) systems to achieve the Phase 1 and ultimate flow requirements. It is important to note that the recommended option will not require additional temporary units of any sort to be in place during construction, maintaining plant capacity through appropriate provisions outlined during the staging phase.

Table 36 Membrane Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Equipment	Net Flowrate Requirements	Recommended Upgrades	Firm Capacity
Membranes	Phase 1 51,871 m ³ /d	<ul style="list-style-type: none"> • Abandon existing ZW500 trains. • Repurpose the ZW500 membrane building as the new administration building. • Construct new two-storey membrane building sized for ultimate flows with membranes installed to achieve Phase 1 net capacity only. • Install chemical systems for entire plant within this new building. These include sodium hypochlorite, citric acid, sodium bisulphite, hydrochloric acid, and sodium hydroxide. 	-
	Ultimate 101,069 m ³ /d	<ul style="list-style-type: none"> • Install new membranes within membrane building constructed as part of Phase 1. 	-

Table 37 Disinfection Upgrades to Achieve the Phase 1 and Ultimate Flow Requirements

Equipment	Net Flowrate Requirements	Recommended Upgrades	Firm Capacity
Disinfection	Phase 1 51,871 m ³ /d	<ul style="list-style-type: none"> Install minimum two UV reactors (1 duty, 1 standby) for 0.5-log <i>Giardia</i> inactivation, each UV reactor sized for a minimum diameter of 600 mm. The UV reactors can be located within a UV building on top of the new CT chambers discussed below. Estimated footprint of UV building is 16mx10m. Install one CT chamber for 4-log virus inactivation sized for a minimum effective storage volume of 808 m³ with baffles to provide a minimum baffling factor (T10/T) of 0.7. Given a side water depth (SWD) of 3.15m, this requires a footprint of 273m² (assuming 6% footprint to be occupied by baffles), with one possible dimension being 13mx21m. The ideal location of this new CT chamber will be to the north of the ZW500 membrane building to minimize the length of outlet pipe to the existing CT chambers and HLWW mentioned below. Use existing CT chambers for high lift pump equalization by hydraulically connecting these chambers to the existing HLWW by cutting openings in the walls between both tanks at the CT chambers finished floor elevation. This will result in the required 15 minutes high lift pump equalization volume given ultimate net flows of 101,069 m³/d at the current SWD of 4.45m of the HLWW (with 1.5m high lift pump suction pipe submergence excluded from the operating volume calculations). At Phase 1 flows of 51,871 m³/d, the high lift pump equalization will be 29 minutes. 	-
	Ultimate 101,069 m ³ /d	<ul style="list-style-type: none"> Install 3rd duty UV reactor (if needed, depending on UV reactor size installed in Phase 1) for 0.5-log <i>Giardia</i> inactivation. Install another CT chamber identical to that in Phase 1. 	-

Figure 32 presents the proposed new treatment train resulting from the recommended upgrades and the Cost-Benefit analysis. Similarly, Figure 33 shows a conceptual layout of the preferred alternatives and required upgrades to meet Phase 1 and ultimate flows. During detailed design, there will be opportunities to optimize the layout for both phases.

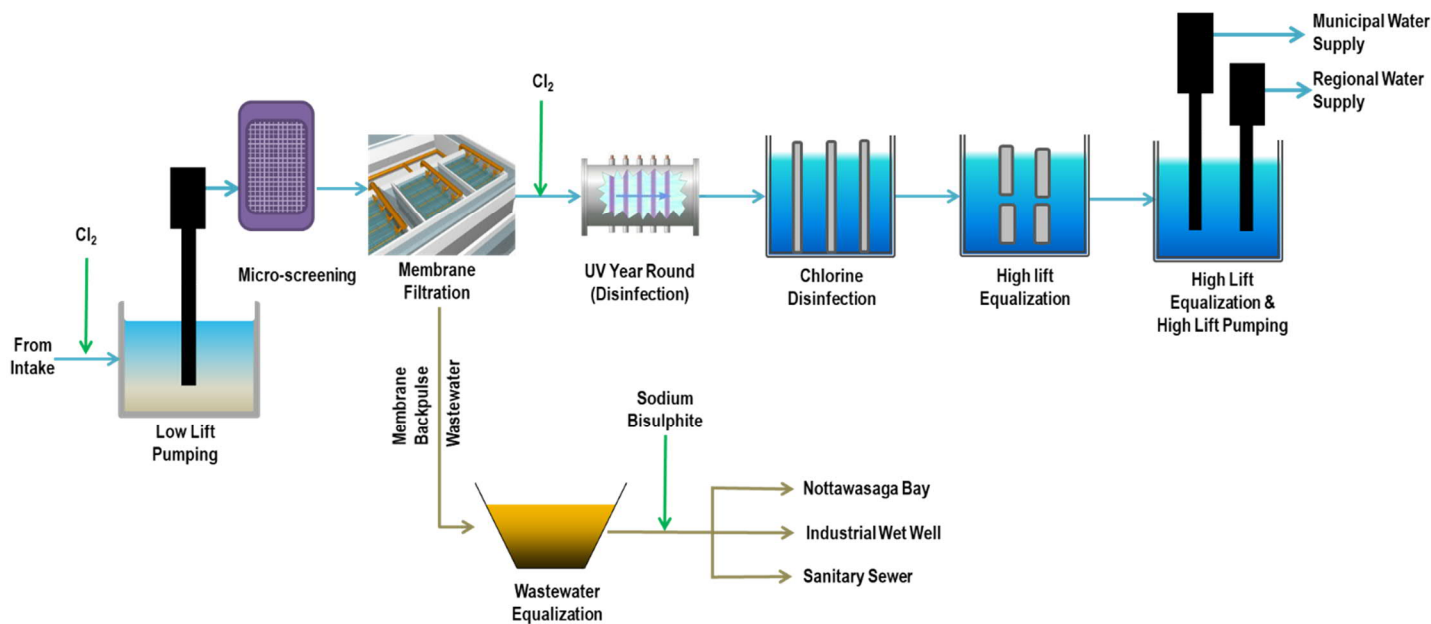
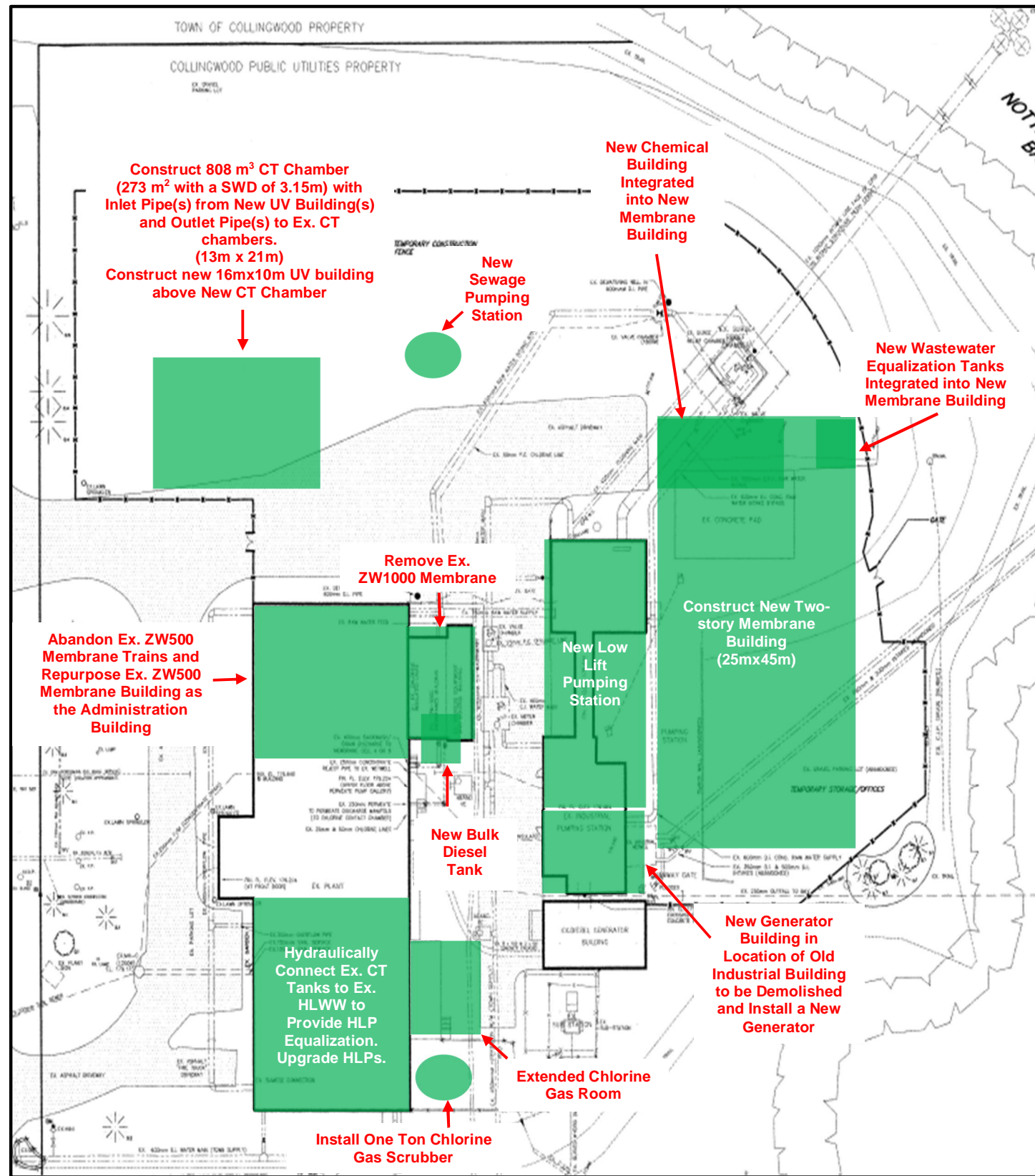
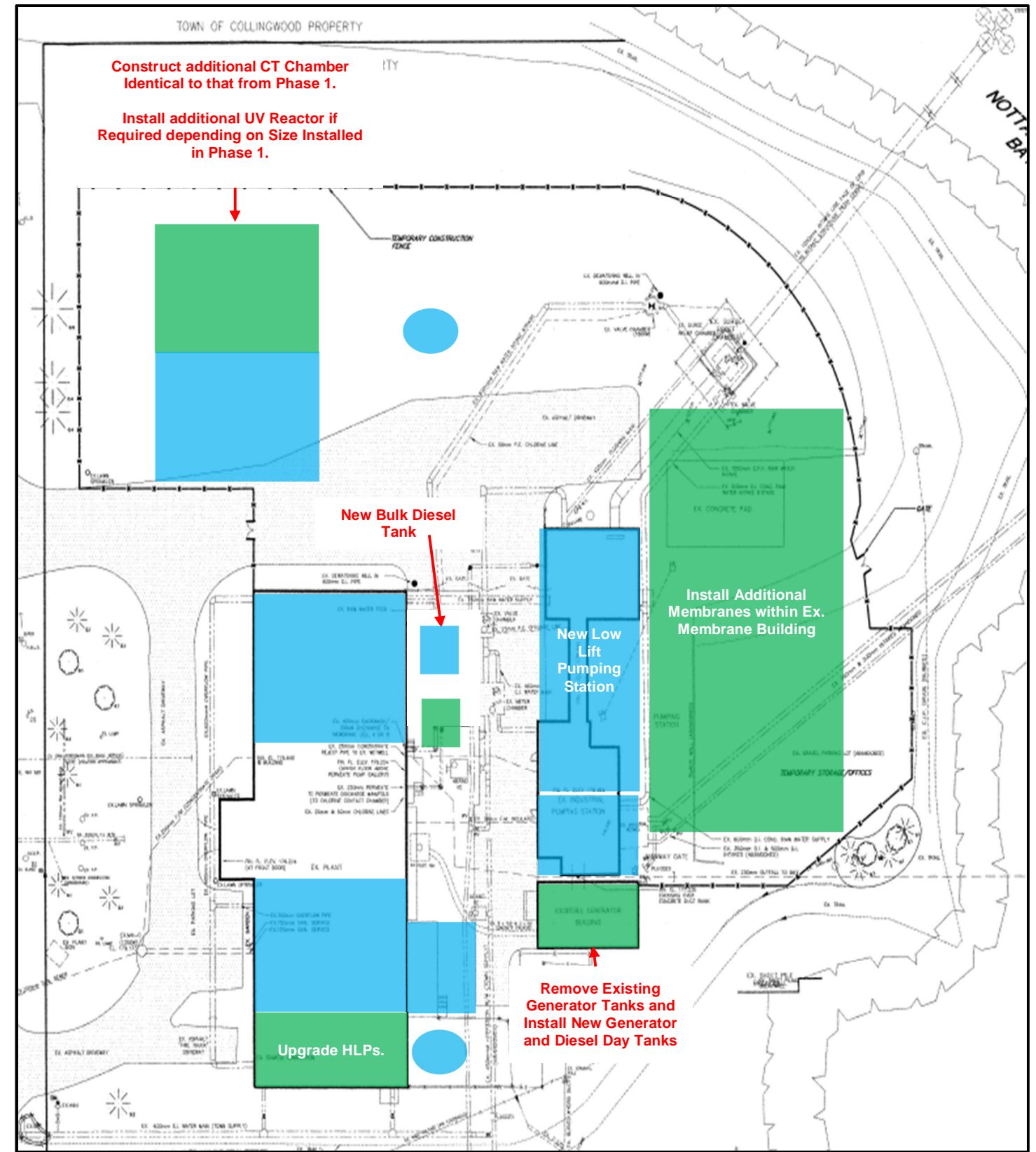


Figure 32 Recommended New Treatment Train for the Raymond A. Barker WTP



Phase 1



Ultimate

Figure 33 Preferred Alternatives and Required Upgrades to Meet Phase 1 and Ultimate Flows

12. Conceptual Design

The upgrades proposed for the Raymond A. Barker WTP will bring changes to the exterior look of the property, which in turn influences the experience of the community living in the surrounding areas. The following figures show the existing infrastructure and the optional concept proposed to achieve ultimate flows side by side from different views for comparison purposes. Figure 34 is a north aerial view of the site to display the full extent of the expansion of the plant. Figure 35 and Figure 36 show the visual impact of the proposed upgrades to residents living in houses on Raglan Street, and the condominiums adjacent to the property, respectively.



Figure 34 North Aerial View of the Existing Infrastructure and Optional Concept to Achieve Ultimate Flows



Figure 35 Raglan Street View of the Existing Infrastructure and Optional Concept to Achieve Ultimate Flows



Figure 36 Condo Top Floor View of the Existing Infrastructure and Optional Concept to Achieve Ultimate Flows

13. Opinion of Costs

Table 38 shows the opinion of costs in for the preferred upgrades to meet Phase 1 and ultimate flows regarding capital cost. The costs are based on Phase 1 upgrades occurring initially followed by the ultimate upgrades.

Table 38 Opinion of Capital Costs for Preferred Upgrades to Meet Phase 1 and Ultimate Flows

Parameter	Opinion of Cost	
	Phase 1 Upgrades	Ultimate Upgrades
	2024	2044
Intake	\$0	\$0
Low Lift Pumping Station and Micro-screening	\$4,308,531	\$694,887
Industrial Pumping	\$930,329	\$0
Membranes	\$20,831,566	\$5,084,671
Disinfection	\$2,938,445	\$1,588,453
High Lift Pump Equalization	\$250,000	\$0
High Lift Pumping	\$560,388	\$2,646,000
Chlorine Gas System	\$738,370	\$20,250
Chemical Systems (separate to membrane systems)	\$494,613	\$0
Residue Management	\$1,102,508	\$0
Sanitary Sewage Transfer Systems	\$481,457	\$0
Site Electrical	\$540,000	\$0
Standby Power	\$1,563,750	\$1,073,250
SCADA	\$877,500	\$0
Building Services	\$1,644,500	\$0
Site Services	\$550,000	\$75,000
Sub-total (A)	\$37,811,957	\$11,182,511
Division 1 - General Requirements (6%)	\$2,268,717	\$670,951
Contractor Profit (8%)	\$3,024,957	\$894,601
Sub-total (B)	\$43,105,631	\$12,748,062
Provisional and Cash Allowances (2%)	\$862,113	\$254,961
Construction Contingency (10%)	\$4,310,563	\$1,274,806
Sub-total (C)	\$48,278,307	\$14,277,830
Overall Level of Accuracy (20%)	\$9,655,661	\$2,855,566
Total Excluding HST and Engineering (2020\$) (D)	\$57,933,968	\$17,133,396

Engineering fees are shown separately in Table 39. Additionally, Table 40 has been included to summarize the total opinion of cost for capital and engineering fees for the project.

Table 39 Engineering Fees Estimate

Parameter	Opinion of Cost	
	Phase 1 Upgrades	Ultimate Upgrades
	2024	2044
Design and Contract Administration (12% of capital costs)	\$6,952,076	\$2,056,007

Table 40 Opinion of Cost for Capital and Engineering Fees

Parameter	Opinion of Cost	
	Phase 1 Upgrades	Ultimate Upgrades
	2024	2044
Capital and Engineering Excluding HST (2020\$)	\$64,886,045	\$19,189,403

Appendix A Detailed Technical Evaluation Scoring and Results

Table A1 Detailed Technical Evaluation Scoring and Results for *Membrane Alternatives*

Option	Technical Consideration									Social Considerations						Total Score	Rank	
	Operation and Maintenance Requirements, Including Process Complexity			Ease of Implementation (Construction Schedule)			Process Robustness			Minimize Footprint and Site Impacts /Architectural Aesthetics (Plant Appearance)			Minimize Truck Traffic (During Construction and Operation)					
	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE			
TOTAL WEIGHT	40			24			16			14			6			100		
1	Maintain Existing ZW500 Membrane Building Capacity with Minor Retrofit of ZW500d Trains and Construct New Membrane Building	Complexity is the highest because it requires two membrane systems in two separate buildings with double the amount of equipment to be monitored and maintained over time.	3	12.0	This option allows a new membrane building to be constructed prior to retrofit of the existing membrane building to minimize plant downtime. The membrane infrastructure/ equipment for the existing ZW500 membranes will be upgraded in addition to construction of the new membrane building. A new administration building can be combined with the new membrane building.	7	16.8	Two separate membrane buildings exist allowing one building to be out-of-service while the other building is able to continue producing water. However, the intent is to design the membrane systems with multiple tanks (including a redundant tank) and standby equipment, such that the impact of one tank/equipment being out-of-service is not significant.	10	16.0	Involves the construction of a new ancillary building for the existing ZW500 membranes between the existing ZW500 membrane building and the raw water building; and, a new building for the new membranes as well as administration facilities east of the raw water building. This option will have the largest new building footprint east of the existing raw water building which will be observed by pedestrians traveling along the shoreline.	4	5.6	During construction, requires most excavation followed by trucking off-site and trucking of materials to site for new buildings (ancillary building for existing ZW500 membrane system, and new membrane and administration buildings). ZW500 membrane system will require more chemicals (and thus deliveries) than newer membrane systems given larger tanks and lesser capacity per membrane footprint.	4	2.4	52.8	4
2.1	Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 2 Remaining ZW500d Trains	Process complexity will be higher than Options 2.2 and 3 because it will have two membrane systems in operation. However, both membrane systems will be within the same building. Given the retrofit within the existing membrane building, clearances around some equipment will be less than a greenfield building.	5	20.0	Major retrofits in the existing membrane building means that renting a membrane trailer during construction is necessary. Keeping two ZW500d trains will result in less modifications to the existing infrastructure but will require construction within the building in the future when additional plant capacity is required beyond a certain capacity between Phase 1 and ultimate. Moreover, the membrane infrastructure/ equipment for the existing ZW500 membranes will be upgraded. A new administration building will need to be	3	7.2	Two separate membrane systems exist allowing one system to be out-of-service while the other system is able to continue producing water (but potentially at significant less flowrate if the new system is out-of-service). However, the intent is to design the membrane systems with multiple tanks (including a redundant tank) and standby equipment, such that the impact of one tank/equipment being out-of-service is not significant.	8	12.8	Involves the construction of a new ancillary building for the existing ZW500 membranes and new membranes between the existing ZW500 membrane building and the raw water building; and, a new building for administration facilities potentially east of the raw water building. The new ancillary building will be larger than that for option 2.2 since ancillary equipment for two types of membranes will be required. The new administration building	8	11.2	Compared to Option 2.2, during construction, requires slightly more excavation followed by trucking off-site and trucking of materials to site for new buildings (ancillary building for existing ZW500 membrane system and new membrane system, and new administration building). ZW500 membrane system will require more chemicals (and thus deliveries) than newer membrane systems given larger tanks and lesser capacity per membrane footprint.	8	4.8	56.0	3

Option	Technical Consideration									Social Considerations						Total Score	Rank
	Operation and Maintenance Requirements, Including Process Complexity			Ease of Implementation (Construction Schedule)			Process Robustness			Minimize Footprint and Site Impacts /Architectural Aesthetics (Plant Appearance)			Minimize Truck Traffic (During Construction and Operation)				
	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE		
TOTAL WEIGHT	40			24			16			14			6			100	
				constructed separate to the new membrane ancillary building.						east of the raw water building will be smaller than the new membrane building in options 1 and 3.							
2.2 Complete Major Retrofit with New Membranes within Existing ZW500 Membrane Building - With 0 Remaining ZW500d Trains	Process complexity will be minimized by having a single type of membrane system in one building. However, given the retrofit within the existing membrane building, clearances around some equipment will be less than a greenfield building.	8	32.0	Major retrofits in the existing membrane building means that renting a membrane trailer during construction is necessary. Complete renovation of all membrane trains results in more construction during Phase 1 in comparison to Option 2.1. However, with upgrades of the existing ZW500d trains infrastructure/ equipment not being required, this will reduce the construction schedule compared to Option 2.1. A new administration building will need to be constructed separate to the new membrane ancillary building.	4	9.6	Only one membrane system exists such that the entire plant will be offline if the membrane system is out-of-service. However, the intent is to design the membrane system with multiple tanks (including a redundant tank) and standby equipment, such that the impact of one tank/equipment being out-of-service is not significant.	5	8.0	Involves the construction of a new ancillary building for the new membranes between the existing ZW500 membrane building and the raw water building; and, a new building for administration facilities potentially east of the raw water building. The new ancillary building will be smaller than that for option 2.1 since ancillary equipment for one type of membranes will be required. The new administration building east of the raw water building will be smaller than the new membrane building in options 1 and 3.	9	12.6	During construction, requires the least excavation than the other options, followed by trucking off-site and trucking of materials to site for new buildings (ancillary building for new membrane system, and new administration building). With one membrane system in operation at a high capacity per membrane, this option may have similar chemical deliveries to that of Option 3.	9	5.4	67.6	2
3 Repurposing Existing ZW500 Membrane Building and Construct New Membrane Building	Having a single membrane system in one building minimizes process complexity. Moreover, with a greenfield building, there will be more clearances allowance for all equipment.	10	40.0	This option allows a new membrane building to be constructed with negligible impacts to plant operations. This option also requires only one membrane system to be installed and commissioned. The existing ZW500d membrane building can be retrofitted into an administration building.	8	19.2	Only one membrane system exists such that the entire plant will be offline if the membrane system is out-of-service. However, the intent is to design the membrane system with multiple tanks (including a redundant tank) and standby equipment, such that the impact of one tank/equipment being out-of-service is not significant.	5	8.0	Involves the construction of a new membrane building east of the raw water building, with retrofit of the existing ZW500 membrane building with administration facilities. Unlike above options, this option requires no new ancillary building to be constructed between the existing ZW500 membrane building and the raw	6	8.4	During construction, requires more excavation than Options 2.1 and 2.2, followed by trucking off-site and trucking of materials to site for new membrane building (and materials for existing ZW500 membrane building repurpose). With one membrane system in operation at a high capacity per membrane, this option	7	4.2	79.8	1

Table A2 Detailed Technical Evaluation Scoring and Results for *Disinfection* Alternatives

Option	Water Quality			Technical Consideration									Social Considerations						Total Score	Rank
	Pathogen Control			Operation and Maintenance Requirements, Including Process Complexity			Ease of Implementation (Construction Schedule)			Process Robustness (Multi-barrier Treatment)			Minimize Footprint and Site Impacts /Architectural Aesthetics (Plant Appearance)			Minimize Truck Traffic (During Construction and Operation)				
	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE	RATIONALE	SCORE OUT OF 10	WEIGHTED SCORE		
TOTAL WEIGHT	35			25			15			10			10			5			100	
4 Chlorinate in New CT Chambers	Very effective against bacteria and viruses. Less effective against <i>Giardia</i> cysts than UV disinfection. Almost completely ineffective against <i>Cryptosporidium</i> oocysts.	2	7.0	Currently in place at the plant, so the operators have familiarity with process. Larger tank to maintain than that below.	9	22.5	Requires large 3,353 m ³ (1200 m ² footprint) tank to construct after excavation/rock drilling thus requiring a longer construction schedule.	4	6.0	Compared to option below, this option has no multi-barrier approach. However, it has less components to operate/fail with using UV.	4	4.0	Requires a larger tank to be constructed on-site. However, most of the tank will be below grade.	8	8.0	During construction, requires more excavation/rock drilling followed by trucking off-site and trucking of concrete to site.	3	1.5	49.0	2
5 Practice UV Disinfection and Chlorinate in New CT Chambers	Very effective against <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts. Virus inactivation and secondary disinfection is obtained through chlorination post UV disinfection.	10	35.0	Added maintenance and replacement of the UV lamps and associated UV components. Adds further complexity to the treatment process despite being relatively simple. Smaller tank to maintain than that above.	4	10.0	Requires much smaller 808 m ³ (273 m ² footprint) tank to construct after excavation/rock drilling. However, requires a UV building to be constructed, which will be above grade and have a footprint of approximately 16m x 10m. This will result in a much lesser construction schedule.	7	10.5	UV provides additional disinfection of <i>Cryptosporidium</i> not provided by chlorine only. Moreover, UV can provide additional <i>Giardia</i> disinfection credits by simply turning up the lamp power. However, it has more components to operate/fail with using UV than chlorine only.	9	9.0	Requires a smaller tank to be constructed on-site. However, a small superstructure is required to house the new UV units.	6	6.0	During construction, requires less excavation/rock drilling followed by trucking off-site and trucking of concrete to site. During operation, requires delivery/removal of UV lamps and other UV components to/from site. However, the frequency is minimal (annually).	7	3.5	74.0	1

Appendix B Distribution System Analysis

**Collingwood Raymond A.
Baker WTP:
System Analysis**

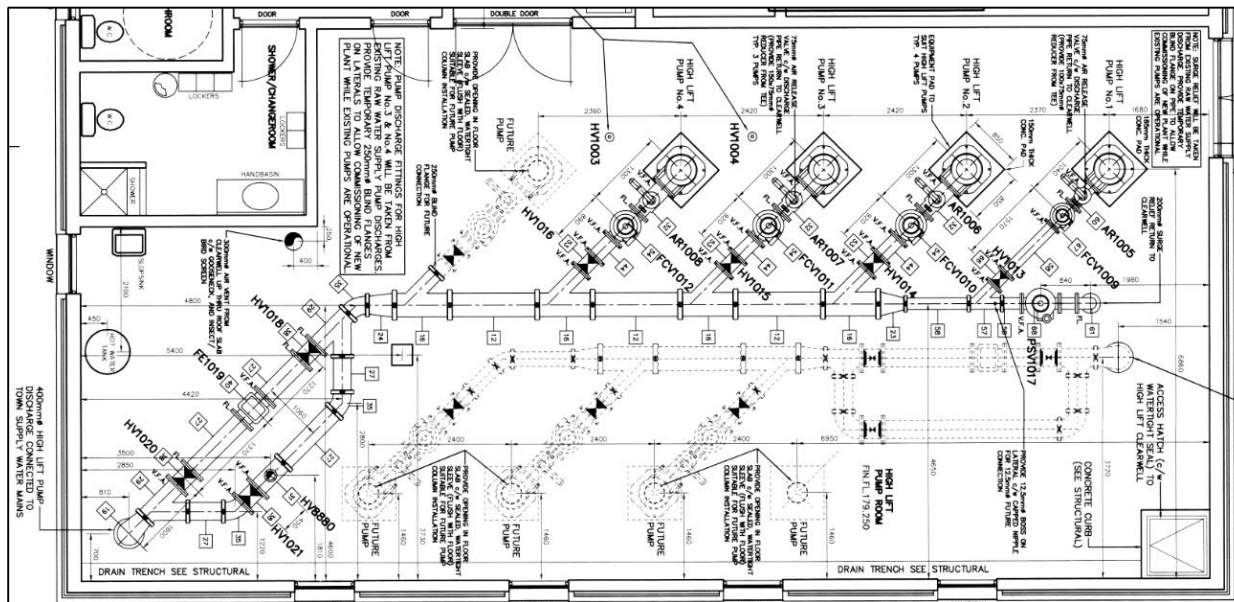
C3 WATER

Existing Pumps

Supply	Zone Supplied	# Units	Pump Type	Rated Flow (L/s)	Firm Capacity (L/s)	Rated Head (m)	HGL (m)	Drive Type
Raymond A. Baker	Zone 1	2	vertical turbine	138.6	333.9	55	227	variable speed
		1	vertical turbine (standby)	138.6		55		constant speed
		1	vertical turbine (jockey)	56.7		37		variable speed
	Regional Transmission	3	vertical turbine	136.1	272.2	55	222	variable speed

Pump & System Curve Analysis

- Determined losses out of pump station from 1st principles
- Determined system losses in model



Pump & System Curve Analysis

- Pump station losses were calculated from 1st principles:
 - Based on existing process piping from record drawing
 - PS losses were kept constant at flows greater than firm capacity, since it was assumed discharge piping upgrades would be designed in the future to avoid unrealistic higher losses
- System losses were determined in the model
 - Existing 400mm & 350mm PS discharge piping is in the model for the distribution system connection for both System and Regional PL based
 - The model provides a conservative estimate of losses since there are low C-factors on many existing pipes specifically near the WTP that will be investigated in future model calibration efforts.

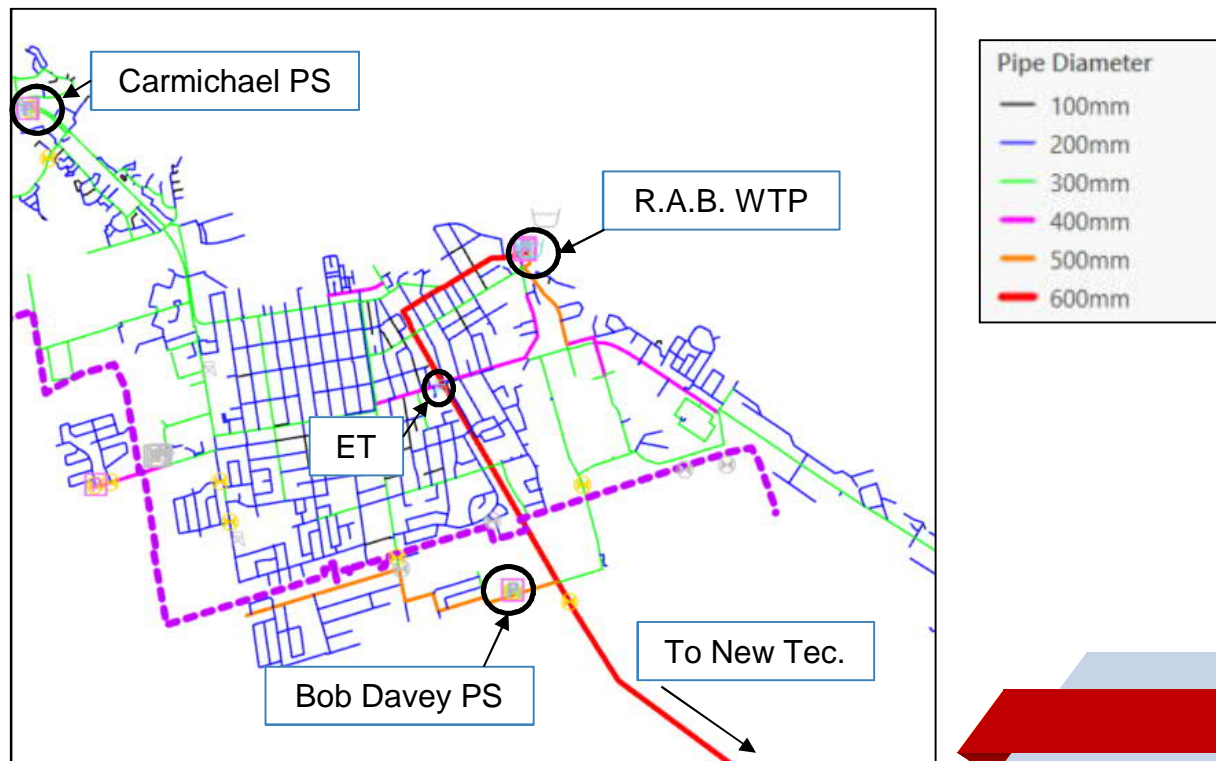
Scenario Development – Zone 1

Zone 1 Pumps – Scenarios:

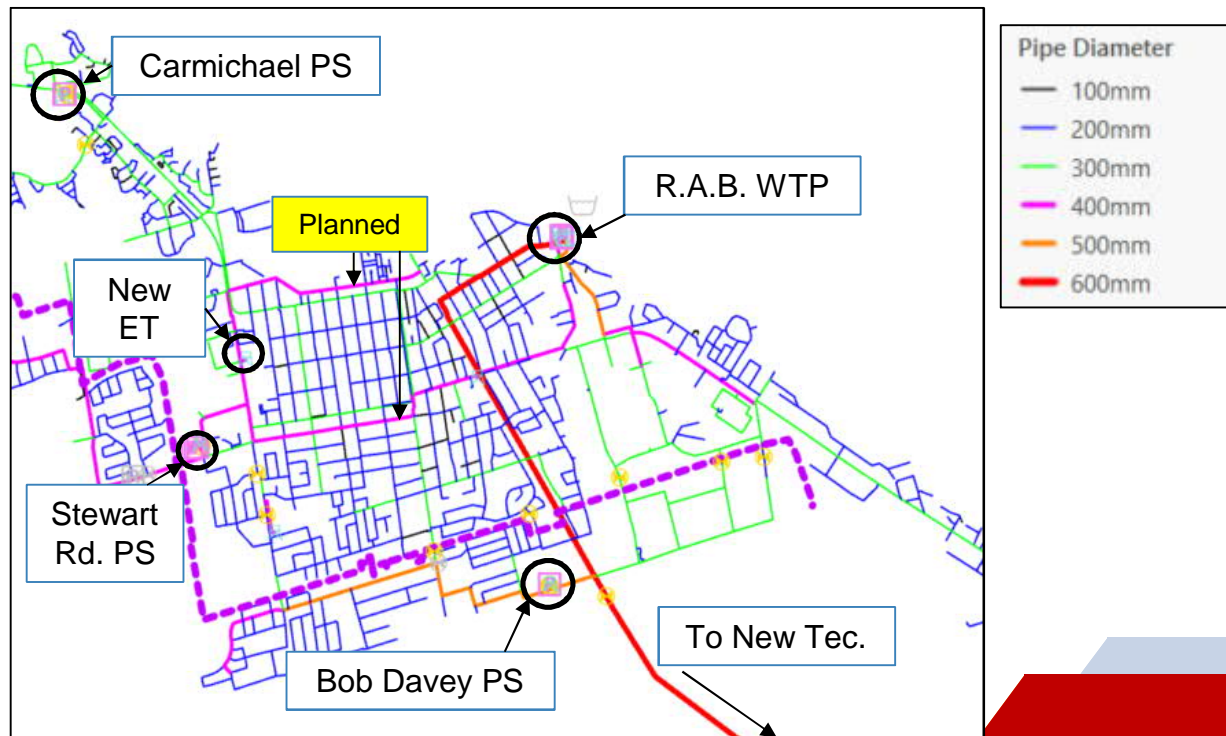
- Existing
 - 2016 ADD
 - 2016 MDD
- Future
 - 2032 (Planned) ADD
 - 2044 (Planned Potential) ADD
 - 2044 (Planned Potential) MDD
 - 2044 (Planned Potential) MDD + downtown fire (189L/s at Hurontario and 1st)
- Future Redundancy
 - 2032 and 2044 with Carmichael PS pumping to Z1E and Z1W
 - Was not found to have significant impact on system curve

Model run under specified demand and planning horizon conditions. Pumps were run at a range of flows

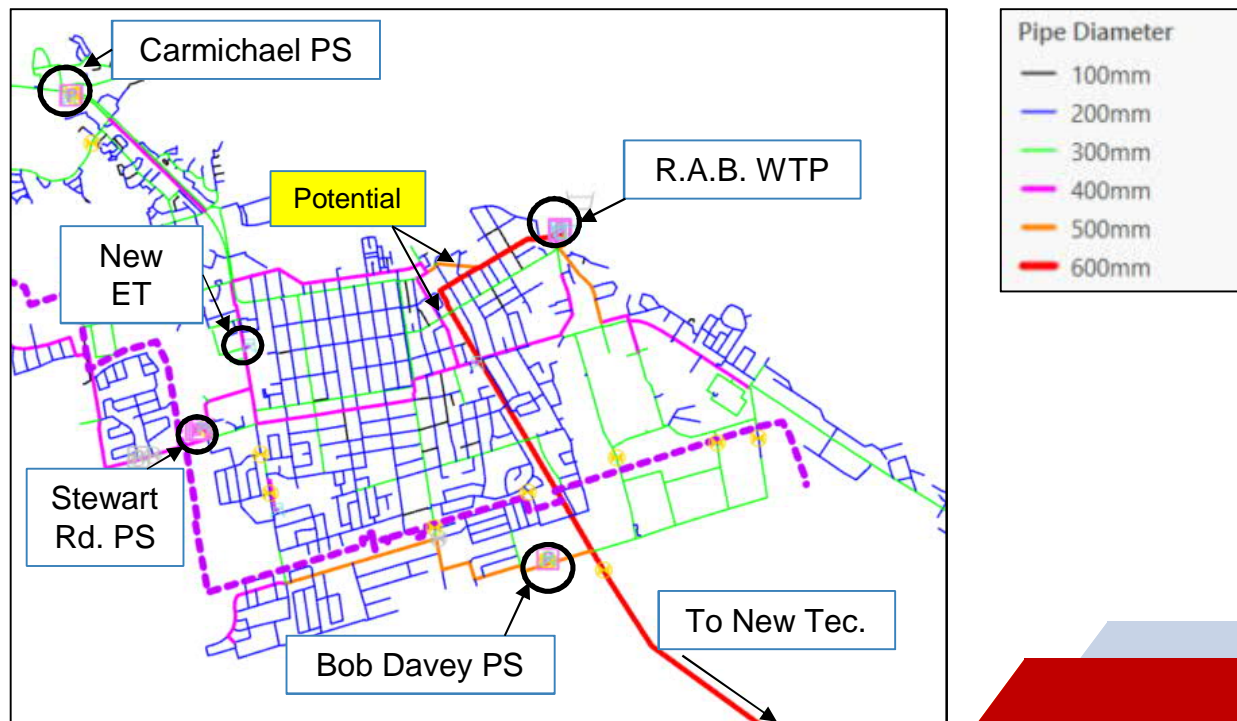
Existing (2016)



Planned (2032)



Potential (2044)



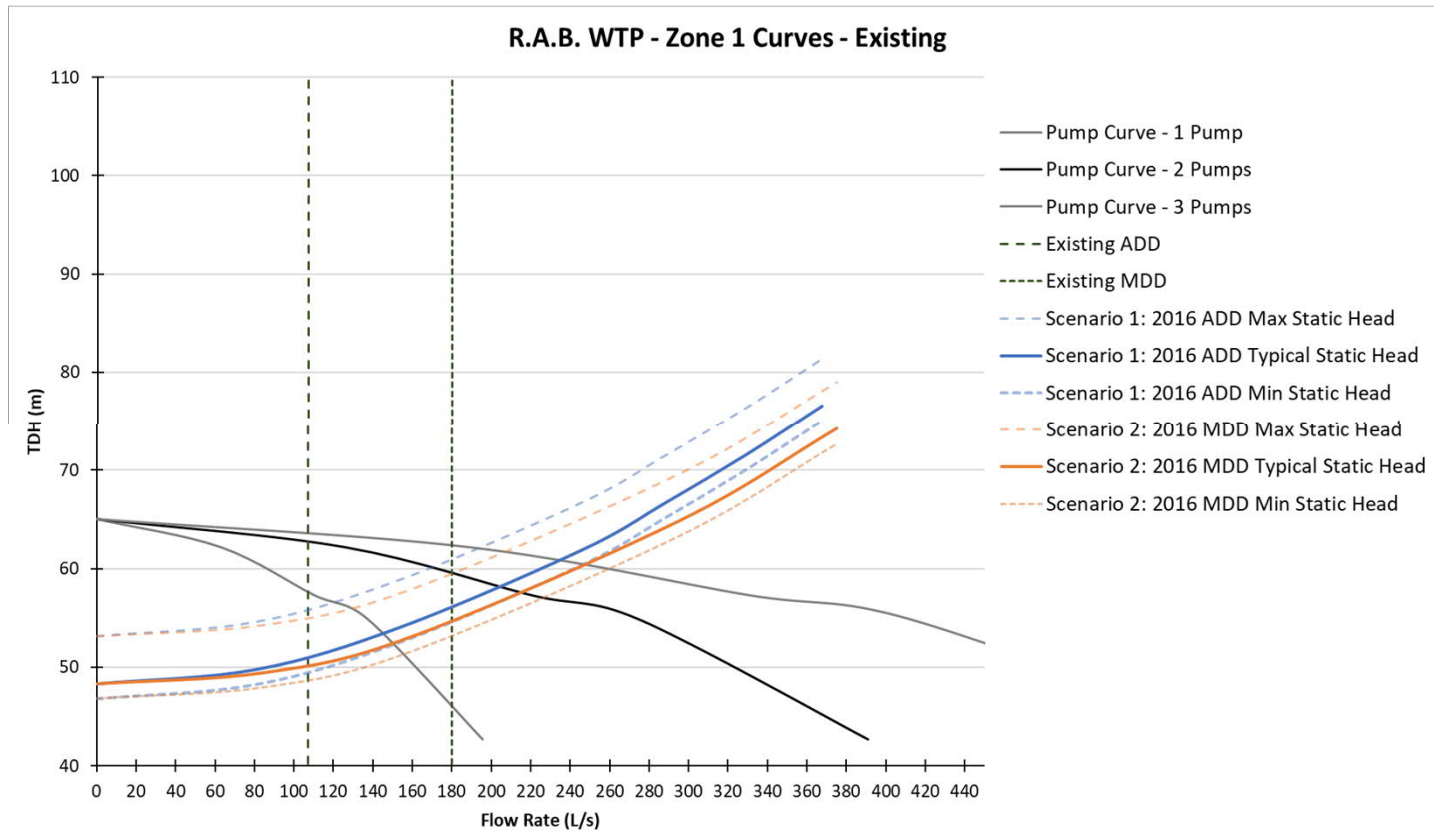
Zone 1 – Static Pressure

Tank	Bottom Elevation (m AMSL)	Typical Water Level (m)	Min Water Level (m)	Max Water Level (m)	Typical Water Elevation (m AMSL)	Min Water Elevation (m AMSL)	Max Water Elevation (m AMSL)
R.A.B. Clearwell	173.2	4.0	1.0	5.0	177.2	174.2	178.1
Collingwood ET	219.9	5.5	5.0	7.3	225.4	224.9	227.2
Future Zone 1 Tank	218.0	9.0	6.0	12.0	227.0	224.0	230.0

Scenario	Static Pressure Lift Required by Pumps (m)		
	Typical	Min	Max
Existing	48.3	46.8	53.1
Future	49.9	45.9	55.9

Zone 1 Pump Curves

- Pump curve field testing data is not available for the Zone 1 20BHC pumps
- For this analysis, the model pump curves were used. These were developed in the Ainley model prior to the Collingwood Master Plan.
- It is recommended that field testing is undertaken to confirm the performance of the Zone 1 pumps.



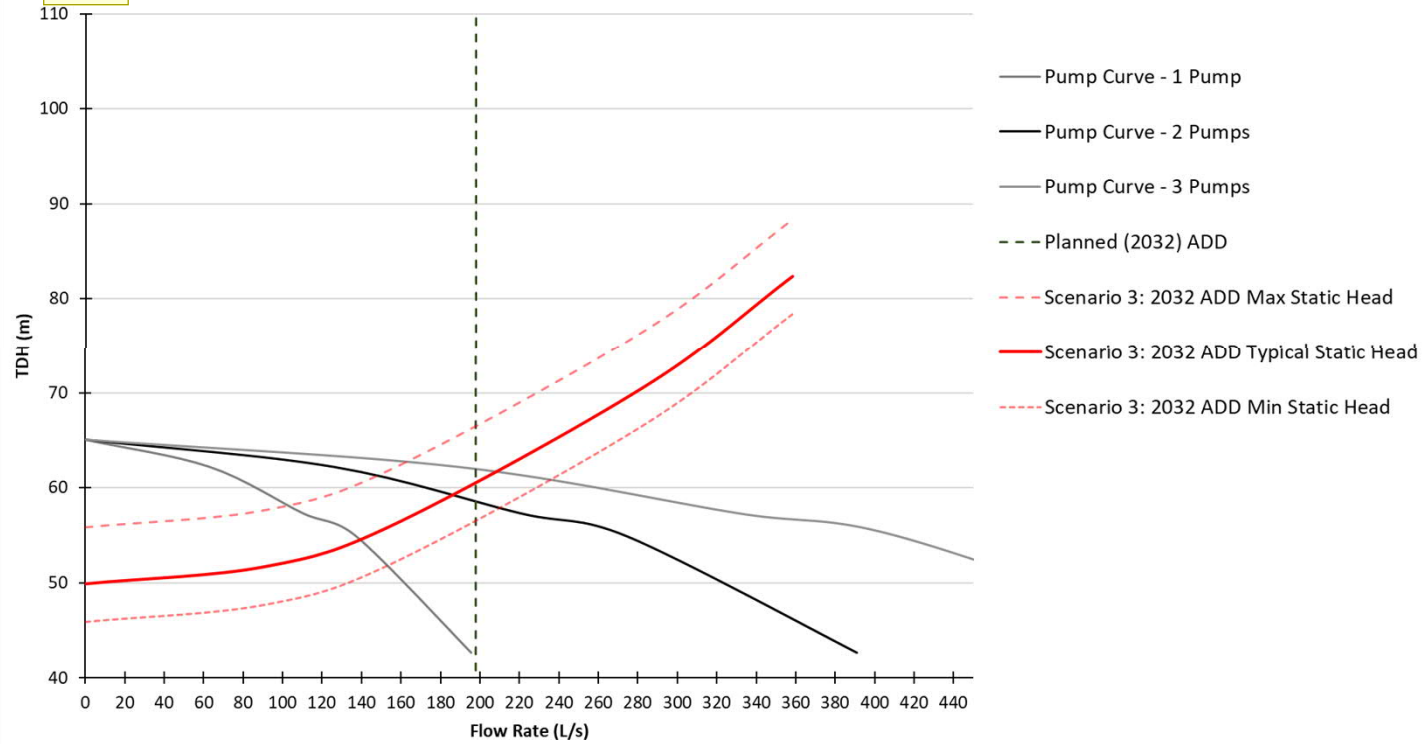
Operating Lines:

- Existing ADD: 103 L/s to Coll. + 14 L/s to TOBM - 10 L/s from Davey
- Existing MDD: 175 L/s to Coll. + 14 L/s to TOBM - 10 L/s from Davey

SZ22

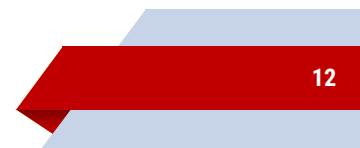
SZ23

R.A.B. WTP - Zone 1 Curves - Planned (2032)



Operating Line:

■ Planned (2032) ADD: 162 L/s to Coll. + 46 L/s to TOBM - 10 L/s for SZ21



SZ21 How is Davey impacted?

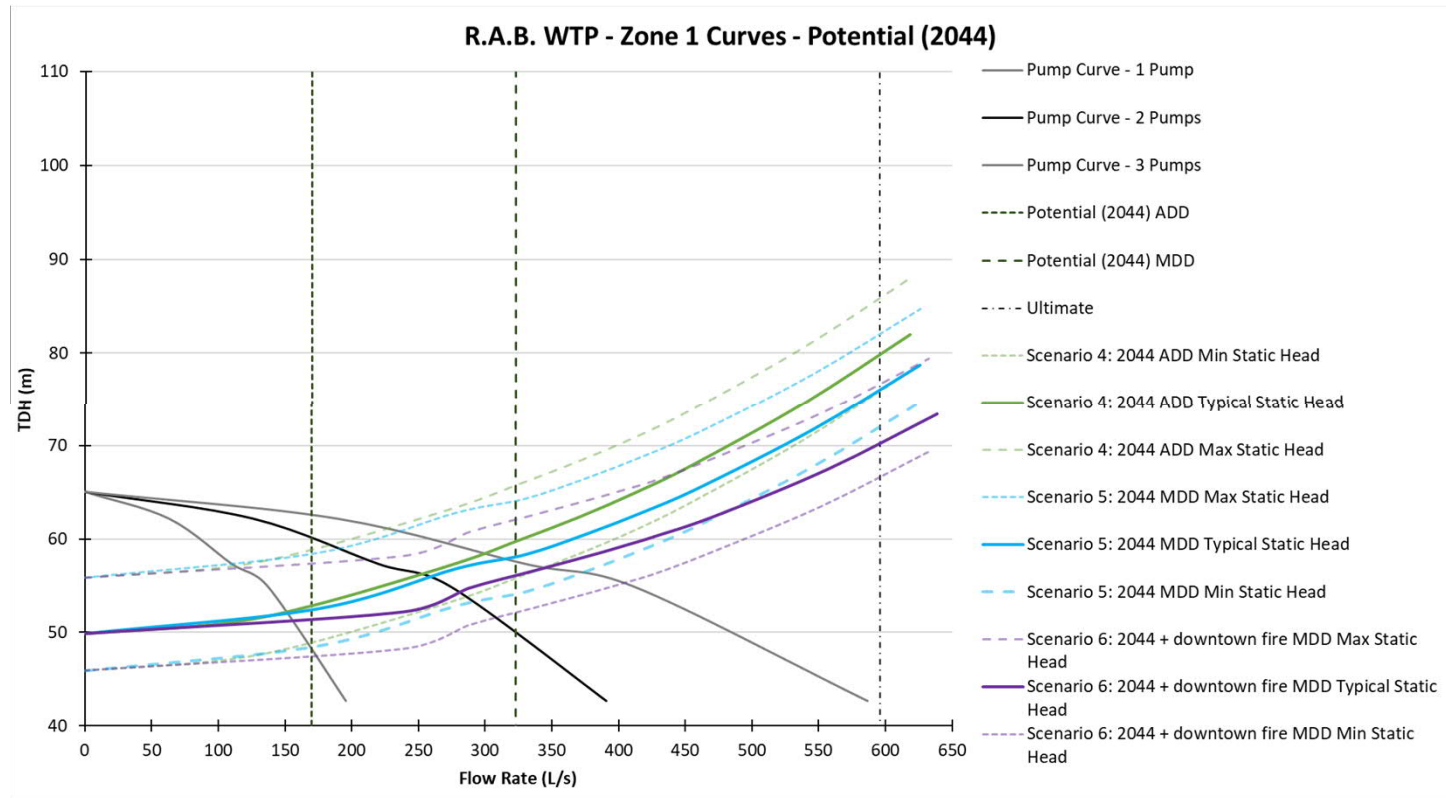
Samuel Ziemann, 4/3/2020

SZ22 Might be worth putting a note on this Y-axis indicating the increase in Static head from existing. The curves appear steeper as well in 2032? Is this true?

Samuel Ziemann, 4/3/2020

SZ23 Were we going to run a sensitivity analysis on the C-factors out of the plant?

Samuel Ziemann, 4/3/2020



Operating Lines:

- Potential (2044) ADD: 207 L/s to Coll. + 93 L/s to TOBM - 130 L/s from Davey
- Potential (2044) MDD: 360 L/s to Coll. + 93 L/s to TOBM - 130 L/s from Davey
- Ultimate: 536 L/s to Coll. + 190 L/s to TOBM - 130 L/s from Davey

Scenario Development – Regional PL

Regional Pipeline Pumps – Scenarios:

- Existing
 - 23 L/s to Bob Davey and 110 L/s to New Tecumseth
- Future
 - 130 L/s to Bob Davey and 388 L/s to New Tecumseth
- Future with Clearview
 - 186 L/s to Bob Davey and 388 L/s to New Tecumseth
 - Includes 56 L/s to Clearview through Bob Davey
- Future Scenarios were run under redundancy scenario with the watermain from the WTP to Bob Davey twinned

Model run to maintain flow into Bob Davey at specified flow rate. Pumps operated to maintain head of 220 mASL at New Tecumseth at a range of flowrates.

Regional Pipeline – Static Pressure

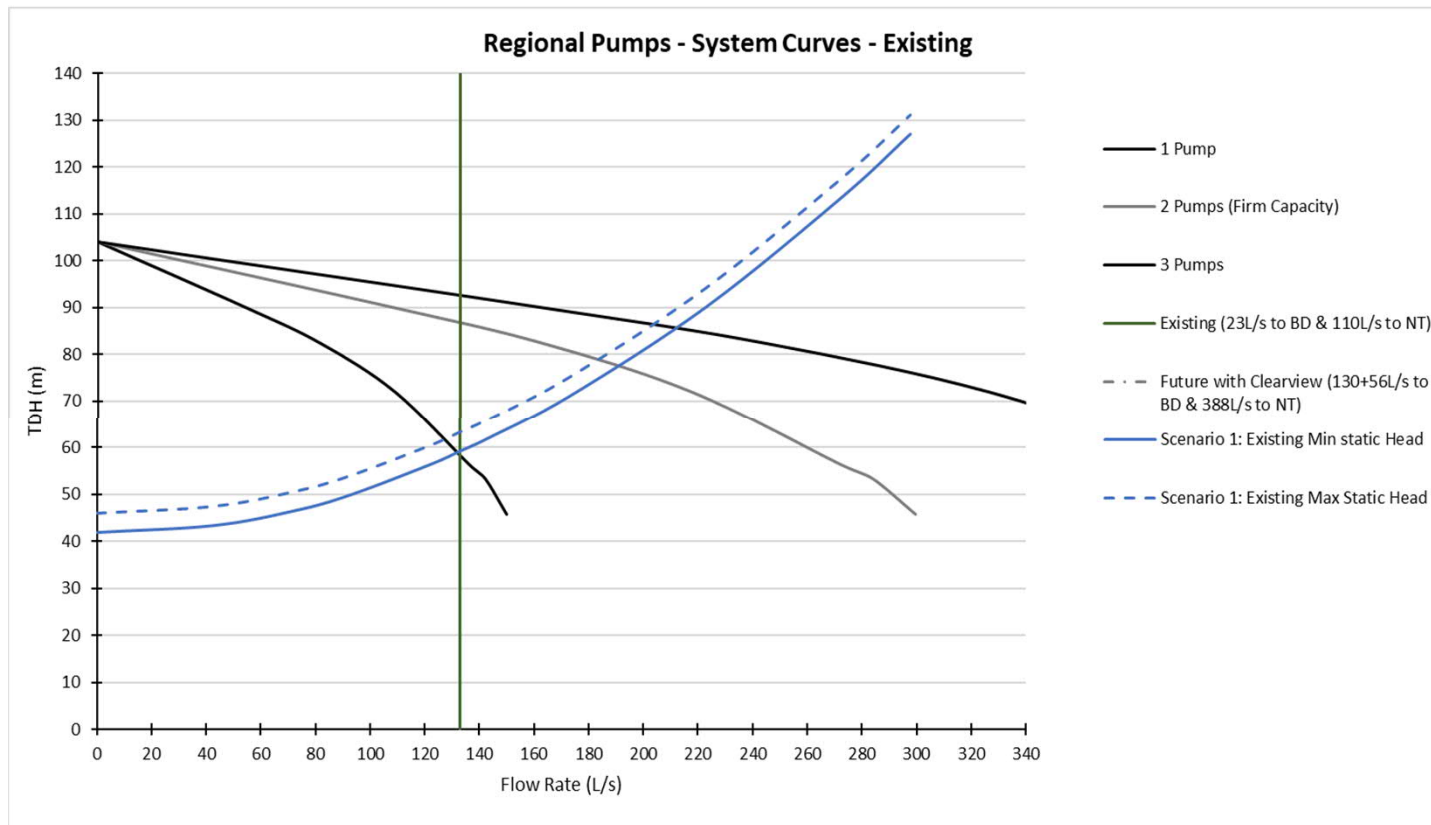
Location	Base Elevation (m AMSL)	Min Water Level (m)	Max Water Level (m)	Min Water Elevation/Head (m AMSL)	Max Water Elevation/Head (m AMSL)
R.A.B. Clearwell	173.2	1.0	5.0	174.2	178.1
Bob Davey Res.	191.3	2.5	5.0	193.8	196.3
New Tec.				220.0	220.0

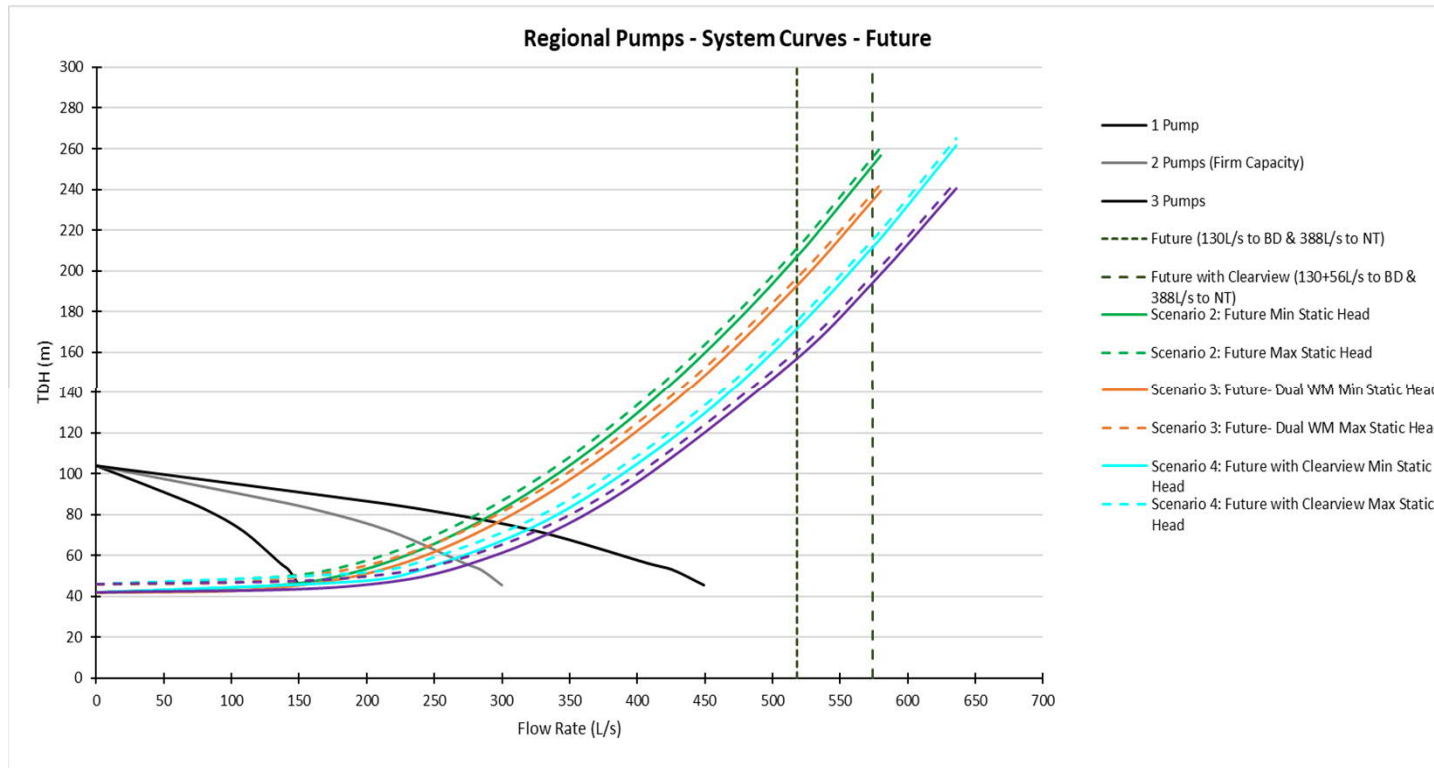
Static Pressure Lift Required by Pumps (m)

Min	Max
41.9	45.9

Regional Pipeline – Pump Curves

- The pump curves used in this analysis are from 2010 performance test results on the 14RJ Regional PL pumps.
- The performance test results are consistent with the original pump curves in the model.





Results Summary – Regional Pipeline

Scenario	Flow (L/s)	TDH (m)	TDH (m) (dual WM to Bob Davey)	HL from Town Boundary to New Tec. (m)
Existing	133	59-63		14 (0.3 m/km)
Future	518	207-211	193-197	140 (2.7 m/km)
Future with Clearview	574	211-215	194-198	

- In future scenarios, majority of the headloss occurs in the 600mm watermain from the Town boundary to New Tec.
- It is understood that in the future, in-line booster pumps will be required to service New Tec. through the Regional Pipeline

Results Summary – Regional Pipeline

Maximum operating points with 3 of existing pumps running

Scenario	Total Flow (L/s)	Approximate TDH (m)	Flow to New Tec. (L/s)	Flow to Bob Davey (L/s)
Existing	200	85	177	23
Future	270	80	140	130
Future with Clearview	310	75	124	186 (130 + 56)