



Iron and Manganese Treatment Upgrades for the Shingletown Wells Class Environmental Assessment

Class Environmental Assessment
Environmental Study Report
FINAL

Prepared for:
Region of Waterloo

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RVA 184245

February 24, 2022



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February 24, 2022

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Attention: Nicole Sapeta

Dear Ms. Sapeta:

Re: Class Environmental Assessment Environmental Study Report – FINAL
Iron and Manganese Treatment Upgrades for the Shingletown Wells Class
Environmental Assessment

Please see the enclosed the Class Environmental Assessment Environmental Study Report (ESR) regarding the Iron and Manganese Treatment Upgrades for the Shingletown Wells. The ESR has been updated to include comments made by the Ministry of Heritage, Sport, Tourism, and Culture Industries (MHSTCI) in response to the Notice of Completion Updated sections in the ESR are identified throughout the document via footnotes, and a copy of the MHSTCI's letter is provided in Appendix A-10.

Yours very truly,

R.V. ANDERSON ASSOCIATES LIMITED

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Encls. Environmental Study Report



Iron and Manganese Treatment Upgrades for the Shingletown Wells Class Environmental Assessment

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¹ Appendix A-10 added in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.

² Appendix I added in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.

EXECUTIVE SUMMARY

Project Overview

Wells K50, K51 and K52 (herein referred to together as the Shingletown Wells) and the corresponding treatment facility are located within the Wilmot Centre Well Field at 2324 Bleams Road in the Township of Wilmot. These wells draw non-GUDI (i.e., Non-Groundwater Under the Influence of Surface Water) raw water to a maximum combined production of 13,638,000 L/day (157.8 L/s) based on the Permit to Take Water (PTTW) 4874-9SGL5L. The overall existing wellfield property is approximately 2,100 m² in size while the fenced area is approximately 640 m² in size.

The Shingletown Wells operate continuously and are the sole water source for the community of Shingletown. The Wells also supply the Baden and New Hamburg water system and the Region of Waterloo's Integrated Urban System (IUS). Non-potable water from the Shingletown Wells discharges to the Eenkooren pond located approximately 530 m west of the Shingletown Wells at 2428 Bleams Rd.

Due to anticipated changes to the Ontario Drinking Water Standards (ODWS) in terms of the manganese aesthetic objective, the Shingletown Wells were identified for potential treatment upgrades to meet the anticipated new standard.

This project is a Schedule 'C' Class Environmental Assessment (Class EA) as it involves major expansions to the existing facilities. As part of the Schedule C Class EA, a list of alternative treatment and residual management solutions were reviewed and evaluated. Once the preferred treatment and residual management solutions were selected, several alternative location design concepts were developed and evaluated.

Evaluation Methodology

To evaluate the alternative solutions and alternative design concepts, four categories were proposed for the evaluation: Technical, Natural Environmental, Social, and Financial (25% weighting each). The highest scoring solution or design in the natural environmental, social, and financial categories represents a lesser impact or cost. Under the technical category, the highest scoring solution represents better performance.

Each of the primary categories was further subdivided into specific criteria that were used to inform its overall score, with each individual criterion equally weighted.

Development and Evaluation of Alternative Solutions

To reduce the manganese concentrations in the Shingletown Wells to meet the anticipated ODWS objectives, a long list of iron and manganese treatment technologies was identified and reviewed. The long list was then refined into a short list of three alternatives for detailed evaluation: Lime or Soda Softening, Oxidation and Filtration, and Membrane Filtration. The short list of alternatives was then evaluated with the developed criteria. The preferred treatment alternative was determined to be the use of chemical oxidation using chlorine as pre-treatment for filtration with catalytic media. This alternative is a proven and effective technology with relatively small footprint, no additional chemicals, and lower costs and impacts compared with other alternatives.

Similar to the evaluation of treatment alternatives, a long list of residual management alternatives was developed and refined into a short list of two alternatives: Backwash Equalization Tank (BET) + Recycling of Supernatant + Settled Solids Haulage, and BET + Pumping of Solids and Supernatant to Sanitary Sewer. The preferred residual management system will consist of a backwash equalization tank, recycling of the supernatant, and hauling of the residuals.

Sensitivity analyses were conducted where different weightings of the categories were evaluated to determine if the outcome of the different weightings would impact the selection of preferred alternatives. The preferred alternatives were not impacted by the variation in weighting.

Development and Evaluation of Alternative Design Concepts

Based on the preferred treatment and residual management approach, RVA worked with the Region to develop a conceptual building size. The building is estimated to be 28 m by 55 m. The total land area required for the building also included allowances for building setbacks, parking and driveway access for deliveries, and a construction laydown area. On this basis, a site measuring 75 m by 75 m was determined to be required.

Three locations for the iron and manganese facility were identified as the three alternative design concepts. These locations were identified based on considerations for land size available, vehicle access, distance to the existing

Shingletown Wells and watermains, environmental features, culture heritage features, areas of archaeological potential, and current and potential future land uses. Considerations were also made regarding the Source Protection Policies in the area and supply of non potable water to the Eenkooren pond.

The preferred location was the site located to the east of the existing well site (Location 3). This location would not require construction to take place in Bleams Rd or require crossing of a small watercourse. It is the furthest from existing houses resulting in less disturbances to locals during construction, has lower costs than the other design concepts and has the closest proximity to existing wells which results in simpler connections between the existing well site and the new facility.

A sensitivity analysis was performed on the evaluation of the location design concepts. The preferred location was not impacted by the variation in weighting.

Preferred Solution

To reduce the manganese concentrations in the Shingletown Wells to meet the anticipated aesthetic objective of 0.02 mg/L, the preferred treatment solution was 'Alternative 6 - Oxidation and Filtration'. This solution consisted of chemical oxidation using chlorine as pre-treatment for filters with catalytic media.

Following the selection of the preferred alternative treatment solution, the preferred residual management solution was determined to be 'Alternative F- Backwash equalization tank+ Recycling of the supernatant + Settled solids holding tank+ Settled solids haulage'.

Based on the preferred treatment and residual management solutions, a preliminary facility size and property size was determined. The preferred location was Location 3, the site located to the east of the existing well site.

Mitigation Measures

Measures were proposed to mitigate impacts to the community and the natural environment to be considered during design and implemented in construction. During design, consideration should be made for source protection policies, disruption to species at risk and their habitat and climate change. Measures to be considered for construction including minimizing noise, dust, vibration, traffic and ground and surface water contaminations. Sediment control fencing will be

required during construction of the new iron and manganese treatment facility to minimize erosion impacts.

Next Steps and Schedule

Following the publishing of this Environmental Study Report for the 30-day review period, if there are no comments, the next phase of this project will be to proceed with the property acquisition, detailed design, approvals, and construction of the preferred alternatives.

1.0 INTRODUCTION AND BACKGROUND

Wells K50, K51 and K52 (herein referred to together as the Shingletown Wells) and the existing treatment facilities are located within the Wilmot Centre Well Field at 2324 Bleams Road in the Township of Wilmot.

Potential water treatment upgrades have been identified based on anticipated changes to the Ontario Drinking Water Standards (ODWS). In May 2019, Health Canada issued the Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Manganese, which established an aesthetic objective of 0.02 mg/L. It can be noted that aesthetic objectives are intended to address non-health related items such as odour, taste, and colour. To be in line with Health Canada recommendations, it is anticipated the provincial objective for manganese will be reduced from 0.05 mg/L to 0.02 mg/L, with a design operating objective of 0.015 mg/L. The Shingletown Wells were identified for potential treatment upgrades to consistently meet the anticipated new standard. As such, the Region of Waterloo (Region) retained R.V. Anderson Associates Limited (RVA) to complete the Schedule 'C' Class Environmental Assessment for the Iron and Manganese Treatment Upgrades for the Shingletown Wells Project.

1.1 Class EA Process

The process used to undertake the Shingletown Class EA followed the Schedule C process as prescribed by the Municipal Class Environmental Assessment process per Environmental Assessment Act, R.S.O. 1990.

The Municipal Class Environmental Assessment (Class EA) is an approved planning procedure that municipal proponents can follow to meet the requirements of the Ontario Environmental Assessment Act. The Class EA approach guides proponents to evaluate the environmental impacts of alternatives to a project and alternative methods of carrying out the project.

The Class EA approach includes requirements for public, indigenous, and regulatory agency input. The Class EA planning process has five phases, including public consultation requirements, as follows:

- **Phase 1:** Definition of Problem or Opportunity, Optional Public Consultation
- **Phase 2:** Identification and Evaluation of Alternative Solutions, Mandatory Public Consultation

- **Phase 3:** Identification and Evaluation of Alternative Design Concepts for the Preferred Solution, Mandatory Public Consultation
- **Phase 4:** Completion of the Environmental Study Report, Mandatory Public Consultation
- **Phase 5:** Implementation of the Works (i.e., design and construction), Optional Public Consultation

As part of the Schedule C project, Phases 1 through 4 must be fulfilled, an Environmental Study Report (ESR) prepared, a notice of completion issued, and a 30-day public review period provided. During the 30-day public review period any comments or requests from stakeholders, agencies, or concerned parties will be addressed according to the procedures outlined in the Municipal Class EA Manual (2000, as amended in 2007, 2011, and 2015). If there are no concerns, then the proponent may proceed to implementation.

In addition, a request may be made to the Ministry of the Environment, Conservation and Parks (MECP) for an order requiring a higher level of study (i.e. requiring an individual/comprehensive EA approval before being able to proceed), or that conditions be imposed (e.g. require further studies), only on the grounds that the requested order may prevent, mitigate or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests on other grounds will not be considered.

1.2 Problem/Opportunity Statement

The Problem/Opportunity Statement for this project is as follows:

Anticipated future changes to the manganese concentrations in the Ontario Drinking Water Standards (ODWS) based on Health Canada's new guideline for manganese prompted the Region of Waterloo to assess potential impacts to its water treatment facilities. This assessment was completed in 2017 through the System Wide Water Supply Facility Assessment for the Proposed Health Canada Manganese Guidelines Study.

The study identified several facilities that would require water treatment upgrades to achieve a level below the Health Canada recommendation for an aesthetic objective of less than 0.02 mg/L of manganese. The Shingletown Wells were identified as one of the facilities that would require upgrades. They currently supply potable water to the Region's Integrated Urban System (IUS) and the Baden and New Hamburg

water system. The wells also supply untreated water to Eenkooren Pond (formerly referred to as Gastmeire Pond).

The purpose of this study is to identify a preferred treatment strategy for the Shingletown Wells to meet the anticipated new ODWS manganese guidelines. As the existing site for the Shingletown Wells has a constrained footprint, a new treatment approach may require land acquisition. If required, the study is to determine a preferred location, layout, and conceptual design of a new facility.

In addressing the objectives of the study, consideration shall be given to technical requirements of the Region, as well as impacts on the area's natural, cultural, and social environments, and overall cost.

1.3 Project Background

1.3.1 Existing Water Supply System

The existing Shingletown Wells site consists of two well houses for the Wells K50 and K51 in the Wilmot Centre Well Field. A chemical room connects the two well houses and stores the sodium hypochlorite used for disinfection. North west of the facilities is the diesel generator building. Well K52 has not yet been connected to the water distribution system and does not have a well house built. A fence runs around the buildings with space for vehicles to park. The property is approximately 2,100 m² in size while the fenced area is approximately 640 m² in size. A photo of the existing facility is shown in **Figure 1.1**.

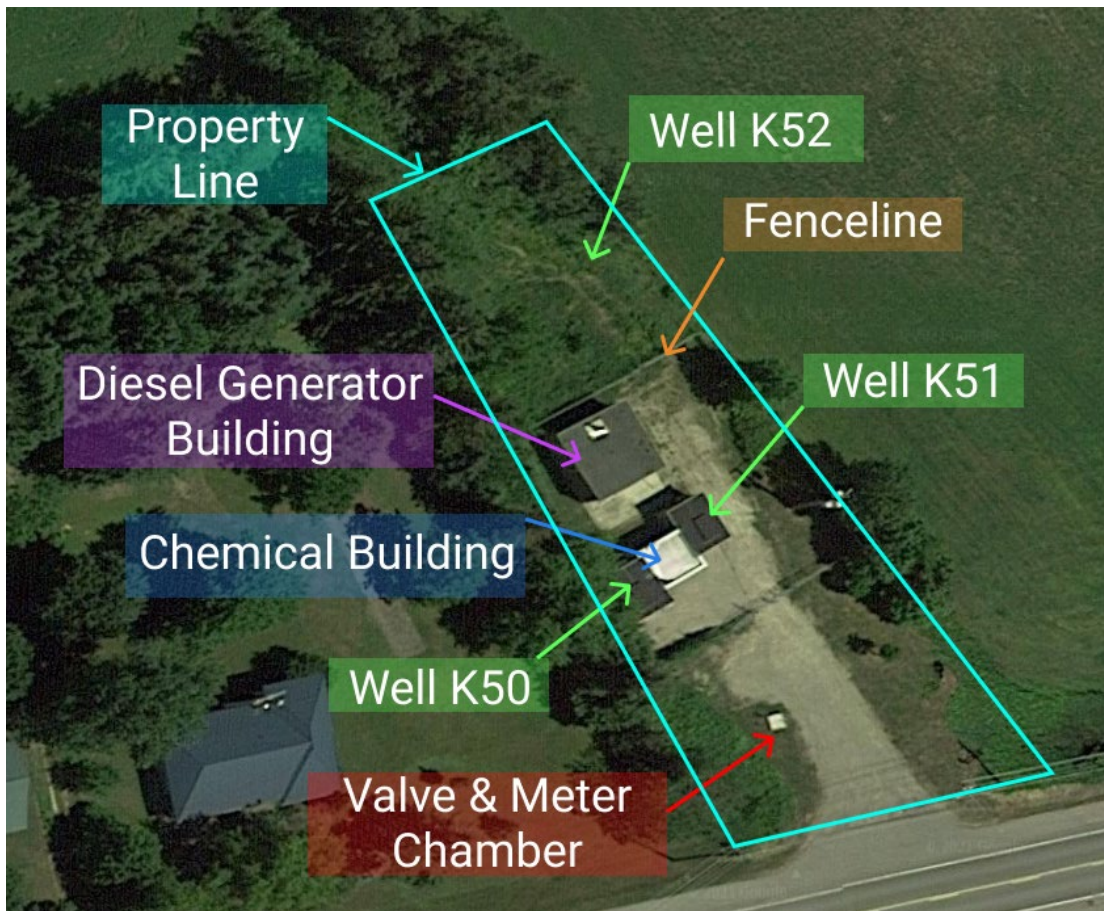


Figure 1.1: Shingletown Wells Existing Facility

The Wells K50 and K51 are approximately 10 m apart from one another. Well K52 is located on the site, approximately 13 m north of the existing diesel generator building. These wells draw non-GUDI (i.e., Non-Groundwater Under the Influence of Surface Water) raw water using vertical turbine pumps to a maximum combined production of 13,638,000 L/day (157.8 L/s) based on the Permit to Take Water (PTTW) 4874-9SGL5L. Sodium hypochlorite is injected into the discharge of each well, before the water is combined. The combined flow then passes through a serpentine watermain on the site's south side to provide the required disinfection contact time.

The Shingletown Wells operate continuously and are the sole water source for the community of Shingletown. The Wells also provide a primary supply to the Baden and New Hamburg water system, where they are supplemented by the New Hamburg Water Treatment Plant supply. Water is directed to Baden from the Shingletown Wells via a valve located in a valve chamber on the Shingletown Wells

facility property. Water from the Shingletown Wells also supplies the Region of Waterloo's Integrated Urban System (IUS), where it is directed to the Mannheim Reservoirs. The water supplied to the IUS is blended in the Mannheim Reservoirs with water from the Mannheim Water Treatment Plant and other groundwater wells.

Non-potable water from the Shingletown Wells discharges to the Eenkooren pond located approximately 530 m west of the Shingletown Wells at 2428 Bleams Rd. The water is fed from individual connections on each well discharge, prior to chlorination, that combine into a flow metered common discharge pipe. Each discharge point is equipped with a valve to control flow and a backflow preventor. The supply of non-potable water was originally put in place as a mitigation measure for potential impacts of pumping on baseflow to Hunsburger Creek (which is fed from the Eenkooren pond). Historically this requirement was included in the PTTW, however, this clause was not included when the PTTW was renewed in 2006. In 2009, the Region provided a letter agreement to the property owner to confirm Wells K50 and K51 will continue to be operated to provide a minimum flow of 6 L/s of water to maintain water levels at the Eenkooren pond.

Allocation of flows between the IUS and the Township of Wilmot are based on the Wilmot Agreement, approved by Regional Council in 1980. The agreement applies to three separate wellfields (Mannheim West, Wilmot Centre, and Erb St) and specifies a maximum transfer from these wellfields to the IUS.

1.3.2 Design Objective Based on New Regulations

Based on the ODWS, the current aesthetic objective (AO) for manganese in water is 0.05 mg/L. However, a new AO of 0.02 mg/L has been established by Health Canada to ensure that discolouration of the water will not result in aesthetic concerns in the drinking water distribution system. Along with the new AO, Health Canada has identified a target of 0.015 mg/L so that precipitated manganese does not gradually accumulate within the distribution system.

Additionally, a maximum acceptable concentration (MAC) of 0.12 mg/L of manganese has been put in place by Health Canada.

The design objective of this project is to treat the Shingletown Wells to meet the goal of less than 0.015 mg/L of manganese in the treated water.

1.3.3 Raw Water Quality

Water quality data was provided by the Region for the raw and treated water from the Shingletown Wells. The data was collected by the Region’s Environmental Enforcement and Lab Services staff and/or Water Operations staff. The data is stored in the Region’s Hydrogeology & Source Water’s Water Quality Database (eWRAS in-house database).

The historical water quality for the Shingletown Wells over the past 10 years (2009 - 2018) was evaluated for the maximum, minimum and average concentrations of manganese and iron.

Although manganese is being targeted for removal based on the anticipated new treatment objectives, the treatment equipment used for manganese removal will also reduce iron concentrations since iron is oxidized before manganese.

Since Well K52 has not yet been placed in regular operation, K52 water quality data was taken from the pumping test conducted between December 2013 and January 2014.

Total Manganese

Manganese concentrations in the raw water from the active wells at Shingletown well field (K50, K51) average 0.028 mg/L for the years 2009 – 2018 while K52 has slightly lower concentrations of manganese averaging 0.022 mg/L (2013-2014) as seen in **Table 1.1**.

Table 1.1: Manganese Concentration in Shingletown Wells Incoming Well Quality and Treated Water (2009-2018) (Regional Municipality of Waterloo)

		K50	K51	K52
Average	mg/L	0.0266	0.0296	0.0222
Maximum	mg/L	0.0360	0.0515	0.0260
Minimum	mg/L	0.0170	0.0010	0.0200

As shown in **Table 1.1**, Wells K50 and K52 were consistently below the current ODWS AO. Well K51 experienced one spike above the current AO in 2016. However, the Shingletown Wells are consistently above the proposed ODWS AO limit.

Refer to Technical Memorandum #1 in **Appendix B** for more information regarding the total manganese concentrations for each of the three (3) wells over time.

Total Iron

For the years 2009-2019, the average iron concentrations of the Shingletown Wells are less than 10% of the ODWS aesthetic objective of 0.3 mg/L. Concentrations average 0.0235 mg/L for K50 and K51 as seen in **Table 1.2**. The iron levels in K52 were measured to be much lower at 0.0005 mg/L.

Table 1.2: Iron Concentration in Shingletown Wells Incoming Well Quality and Treated Water (2009-2018) (Regional Municipality of Waterloo)

		K50	K51	K52
Average	mg/L	0.0230	0.0240	0.0005
Maximum	mg/L	0.0500	0.0500	0.0005
Minimum	mg/L	0.0020	0.0020	0.0005

Refer to **Appendix B** for more information regarding the total iron concentrations in each of the three (3) wells over time.

1.3.4 Previous Reports

A background review was completed of previous studies and available information related to the Shingletown Wells. The following documents were reviewed and summarized in **Appendix B**:

- Baden and New Hamburg Water and Wastewater Master Plan Update - Master Plan Report (Aecom, June 2011)
- Construction and Testing of Test Production Well WT-WC-TW1-13 (Stantec, July 2014)
- Wilmot Centre Well Field Condition Assessment (Stantec, June 2016)
- K52 Conceptual Design Report (Stantec, June 2016)
- Annual Monitoring Report - Wilmot Centre Monitoring Program (R.J. Burnside, Dec 2017)
- System Wide Water Supply Facility Assessment for the Proposed Health Canada Manganese Guidelines (Stantec, June 2017)

- William Street and Strange Street Water Supply System - Confirmation of Process Design (Stantec, June 2018)

1.4 Existing Conditions of Study Area

Natural environment and archaeological desktop studies were conducted for an area roughly within 1 km in all directions surrounding the Shingletown Wells site. A summary of the findings is included below. **Figure 1.2** is a map of the study area containing information from the natural environment and archaeological desktop studies. **Appendix B** also includes information based on a walkthrough of the existing facility.

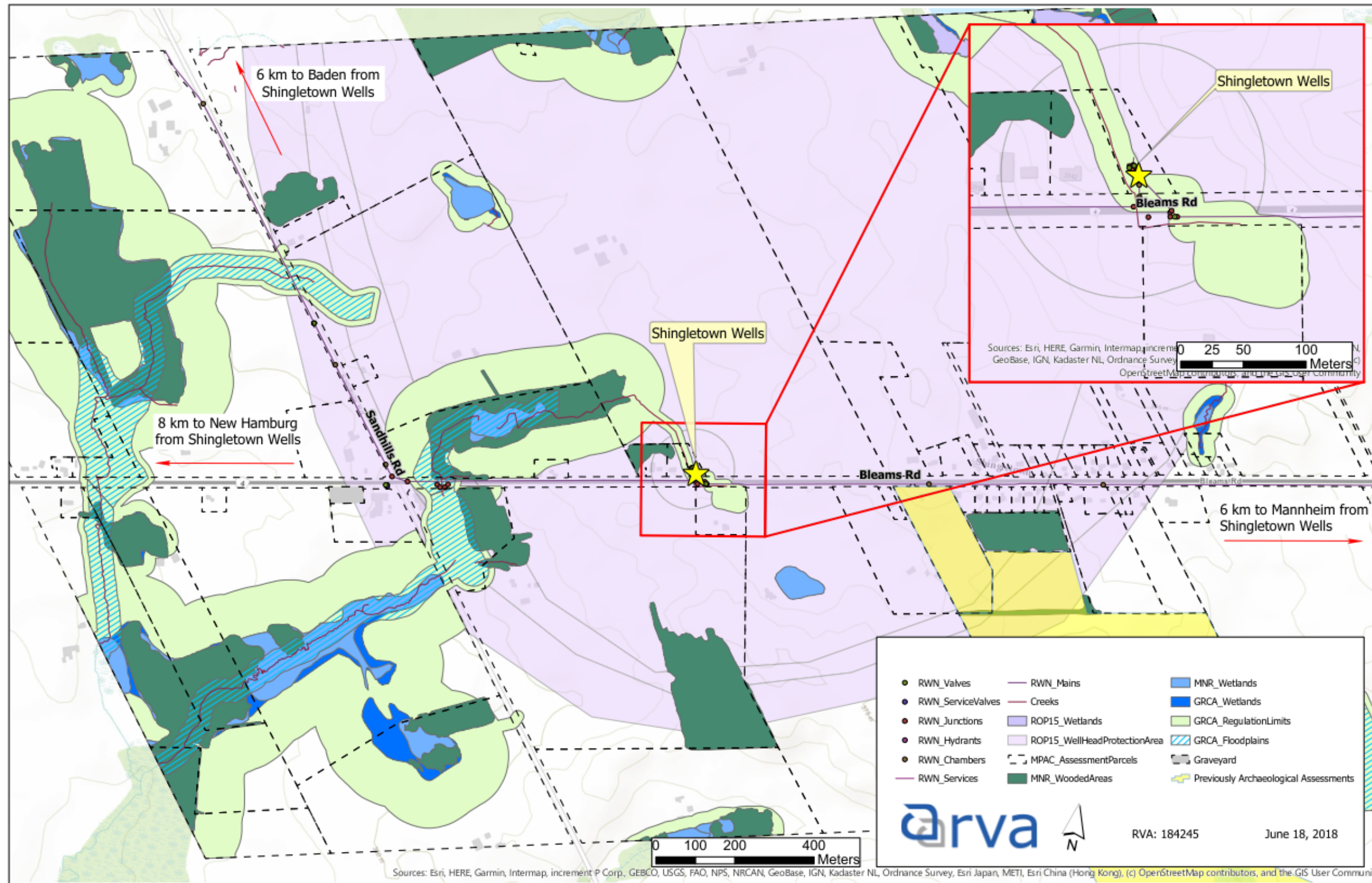


Figure 1.2: Map of Study Area

1.4.1 **Natural Environment Existing Conditions Report (LGL Limited, May 2019)**

LGL Limited (LGL) completed a desktop existing condition report on the natural environment surrounding the Shingletown Wells location. The report is included in **Appendix B** as part of Technical Memorandum #1.

Vegetation:

LGL determined that most of the vegetation in the study area is agricultural and residential. Certain sensitive vegetation communities do exist in the study area, particularly those around the Hunsburger Creek Evaluated Wetland Complex, local forested communities, and local small ponds.

Wildlife Habitats:

The report did not identify any significant wildlife habitats, as most of the land in the study area is assigned to rural residential and agricultural uses. It is possible that certain sensitive species may inhabit hay or pasture farmland. Within the study area, the property directly east of the Shingletown Wells site has been used for hay and pasture.

Species at Risk:

The report provides an outline of potential species at risk in the study area based on information from Ontario Nature.

Several fish species are found in the Hunsburger Creek and Silver Creek. The Hunsburger and Silver Creeks are designated cold water streams and are regulated by the GRCA.

Woodland areas, buildings, hay fields, fallow fields or meadows within the study area are potential habitats for some of the outlined species at risk.

Next Steps:

Following the short-listed location design alternatives, field investigations were conducted and summarized in Section 4.0.

1.4.2 Cultural Heritage Environment³

Cultural heritage resources include archaeological resources, built heritage resources and cultural heritage landscapes.

1.4.2.1 Archaeological Resources-

A Stage 1 Archaeological Assessment (AA) (under Project Information Form number P1059-0008-2019) was undertaken on June 7th, 2019 by Archeoworks Inc., in support of this environmental assessment. A Stage 1 AA consists of a review of geographic, land use and historical information for the property and the relevant surrounding area and contacting the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI) to find out whether or not there are any known archaeological sites on or near the property. Its purpose is to identify areas of archaeological potential and further archaeological assessment (e.g. Stage 2,3,4) as necessary. The Stage 1 AA is included in Appendix H.

From the Stage 1 AA, the following recommendations are presented:

1. Lands that were subjected to previous archaeological assessments (AHA, 2007; ARA, 2018) and deemed free of further archaeological concern are recommended to be exempt from further assessment.
2. Parts of the study area that were identified as having archaeological potential removed are exempt from requiring Stage 2 AA (extents of these areas to be confirmed during the Stage 2 AA).
3. Parts of the study area that were identified as having no or low archaeological potential are exempt from requiring Stage 2 AA (extents of these areas to be confirmed during the Stage 2 AA).
4. All areas identified as retaining archaeological potential must be subjected to a Stage 2 AA. These areas must be subjected to pedestrian or test pit survey at five-metre intervals in accordance with the standards set within Sections 2.1.1 and 2.1.2 of the 2011 S&G.

³ Section 1.4.2 was revised in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.

5. Lands within the 20-metre-wide cemetery investigation area surrounding the current cemetery property limit/fence line of the Wilmot Centre Cemetery that were identified as having no potential for unmarked burials will not require a Stage 3 cemetery investigation. A Cemetery Investigation Authorization (CIA) is also not required for any invasive Stage 2-4 archaeological fieldwork within the 20-metre cemetery investigation area.

6. As per the Funeral, Burial and Cremation Services Act, 2002, S.O. 2002, c.33 no intrusive activity may occur within the limits of the Wilmot Centre Cemetery without consent from the cemetery operator (the Wilmot S.S. # 10 Cemetery Board) and the Bereavement Authority of Ontario.

- a. Should the area within the current cemetery limits be impacted, additional archaeological investigation consisting of Stage 2 test pit survey followed by Stage 3 mechanical topsoil removal is required. A Cemetery Investigation Authorization (CIA) issued by the Bereavement Authority of Ontario is also required and needs to be obtained prior to conducting any soil-intrusive work (e.g., Stage 2/3/4 investigations; construction monitoring).

No construction activities shall take place within the study area prior to the Ministry of Heritage, Sport, Tourism and Culture Industries (Archaeology Programs Unit) confirming in writing that all archaeological licensing and technical review requirements have been satisfied.

Depending on the location of the iron and manganese treatment facility, a Stage 2 AA may be required. A Stage 2 AA will be undertaken for parts of the study area that were identified as having archaeological potential and may be impacted by the future location of the facility as early as possible during detailed design and prior to any ground disturbing activities.

1.4.2.2 Built Heritage Resources and Cultural Heritage Landscapes

The screening checklist, Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes, developed by the MHSTCI was completed as part of this ESR and attached in Appendix I⁴.

Based on the results of the checklist, it was determined that there are no known or potential heritage properties within the Shingletown Wells site area or Project area, and there will be no impacts to cultural heritage resources due to the Iron and Manganese upgrades for the Shingletown Wells.

⁴ Appendix I was added in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.

2.0 EVALUATION METHODOLOGY

The following four categories are used for the evaluation of the alternatives identified during Phase 2 and 3 of the Class EA process:

- Technical
- Natural Environmental
- Social
- Financial

The highest scoring solution or design for the natural environmental, social, and financial categories represents a lesser impact or cost. Under the technical category, the highest scoring solution represents better performance.

To produce an overall score for each alternative solution/design, the scores from each category had an equal weighting (25%).

Each of the primary categories was further subdivided into specific criteria that were used to inform its overall score. Individual criterion within each category was equally weighted.

A description of the four categories and their criteria are listed below. Refer to Technical Memorandum #2 in **Appendix C** for more detail on the individual criteria.

Note that two social criteria, “Conserves Built Heritage Resources and/or Cultural Heritage Landscapes, and Conserves Archaeological Resources,” have been modified in this document from Appendix C, Appendix D, and Appendix F, to reflect comments made by the MHSTCI in response to the Notice of Completion.⁵

Technical Criteria

Technical criteria reflect those engineering considerations that relate to the design, functionality and feasibility of the proposed solutions or design concepts. These criteria are meant to evaluate how well the design solves the project goal originally

⁵ This paragraph has been added in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.

outlined by the Region. Technical criteria used in the evaluation were as follows. The solution:

- Provides reliable service
- Meets existing and future needs
- Aligns with existing and planned infrastructure
- Aligns with existing and future use
- Aligns with approval and permitting process
- Manages and minimizes construction risks
- Has the ability to adapt to climate change

Natural Environmental Criteria

Natural environmental criteria evaluate the degree to which the solution/design impacts the natural environment, with emphasis on those sensitive areas that are most critical to human or ecological functions and are most likely to be disturbed. An ideal solution/design should have the least amount of ecological impact. The criteria used in the evaluation were as follows. The solution:

- Protects environmental features
- Protects wildlife and species at risk
- Protects groundwater, streams and rivers
- Minimizes climate change impacts

Social Criteria

Social criteria represent the effect a solution or design will have on the local human environment. Overall, the solution/design should have a positive effect on the functioning of the community without imposing an economic burden or altering the community's sociocultural fabric. The social criteria used in the evaluation were as follows. The solution:

- Minimizes impacts to residents related to noise, odour, traffic, and aesthetics
- Minimizes impacts to businesses
- Manages and minimizes construction impacts

- Conserves built heritage resources and/or cultural heritage landscapes⁶
- Conserves archaeological resources⁷
- Protects health and safety

Financial Criteria

Financial factors quantify the cost of the solution to the Region over its service life. All costs should be minimized. In other words, the solution:

- Provides low lifecycle costs






2.1 Scoring Method

A graphical-numerical scoring method, as shown in **Table 2.1**, was used to evaluate the criteria within the four main categories. Preference for an alternative solution or design is indicated by the direction and colour of the arrow, as well as the magnitude of the numerical score. A double blue arrow represents an optimal option, and a double orange arrow represents a poor alignment with the criteria objective. **Table 2.1** below gives an example of the five possible scorings and their meanings relative to each other.

⁶ Revised in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.

⁷ Revised in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.

Table 2.1: Example Scoring Graphics

				
1	2	3	4	5
Low Alignment with Criteria	Not Well Aligned with Criteria	Somewhat Aligned with Criteria	Well Aligned with Criteria	Very Well Aligned with Criteria

Each major category was assigned a single score based on the combined scores of the various criteria. The scores for the categories were then combined into an overall score to provide a final assessment of the alternative solutions/designs.

For the assessment of the alternatives, the majority of the scoring was based on a qualitative assessment with assumptions supporting the rationale described. For the ‘Provides Low Lifecycle Cost’, scoring was based on a quantitative assessment using preliminary lifecycle costs, which are included in **Appendices D** and **F**. Technical Memorandum #3 in **Appendix D** includes calculations for the alternative treatment and residual management solutions and Technical Memorandum #5 in **Appendix F** includes calculations for the alternative location design concepts.

3.0 DEVELOPMENT AND EVALUATION OF ALTERNATIVE SOLUTIONS

To reduce the manganese concentrations in the Shingletown Wells to meet the anticipated ODWS objectives, a list of iron and manganese treatment technology alternatives were identified and reviewed. The options were evaluated using the criteria identified in Section 2.0. Following the selection of the treatment alternative, the residual management alternatives were developed and evaluated.

3.1 Discussion of Treatment Alternatives

The following long list of treatment alternatives was developed and pre-screened to obtain a short list that was subsequently developed reviewed in detail:

- **Alternative 1 – Do Nothing**
- **Alternative 2 – Iron and Manganese Sequestration**
- **Alternative 3 – In Situ Removal**
- **Alternative 4 – Lime or Soda Softening**
- **Alternative 5 – Ion Exchange Softening**
- **Alternative 6 – Oxidation and Filtration**
- **Alternative 7 – Biological Filtration**
- **Alternative 8 – Membrane Filtration**

Table 3.1 summarizes the preliminary assessment of the long list of treatment alternatives. Only the alternatives that passed the pre-screening were evaluated further with the evaluation criteria outlined in Section 2.0. For the alternatives that were not carried forward to detailed evaluation, refer to Technical Memorandum #3 in **Appendix D** for more detail.

Table 3.1: Preliminary List of Treatment Alternatives

Preliminary List of Treatment Alternatives	Preliminary Assessment
Alternative 1 – Do Nothing Alternative 2 – Iron and Manganese Sequestration	Because manganese would not be removed, Alternatives 1 and 2 do not meet the Problem/Opportunity Statement and therefore were not considered further.

<p>Alternative 3 – In Situ Removal</p>	<p>The success of this alternative is dependent on the aquifer composition, water composition and location/installation of the recharge wells. This alternative will not be considered further due to the lack of compatibility with existing infrastructure, the risk of clogging the aquifer and its unknown reliability to meet the anticipated water quality objectives.</p>
<p>Alternative 4 – Lime or Soda Softening</p>	<p>Alternative 4 is a feasible solution and will be reviewed and evaluated in detail to identify a preferred solution.</p>
<p>Alternative 5 – Ion Exchange Softening</p>	<p>This process would generate a large volume of waste brine solution. It also would add significant sodium to the treated water which could have a negative impact on some water customers. Due to the increased sodium levels and the complexity of the brine disposal, this alternative will not be carried to the detailed evaluation stage.</p>
<p>Alternative 6 – Oxidation and Filtration</p>	<p>Alternative 6 is a feasible solution and will be reviewed and evaluated in detail to identify a preferred solution.</p>
<p>Alternative 7 – Biological Filtration</p>	<p>Due to the unknown effectiveness of the technology to meet water quality objectives and the lack of consistency with existing infrastructure in the Region, this alternative will not be carried forward to the detailed evaluation stage.</p>
<p>Alternative 8 – Membrane Filtration</p>	<p>Alternative 8 is a feasible solution, and will be reviewed and evaluated in detail to identify a preferred solution</p>

Based on the review, the following short list of technology alternatives were selected for detailed evaluation:

- **Alternative 4 – Lime or Soda Softening**
- **Alternative 6 – Oxidation and Filtration**
- **Alternative 8 – Membrane Filtration**

The descriptions of the short-listed alternatives are listed below:

Alternative 4 – Lime or Soda Softening

This alternative involves the addition of lime or soda to raise the water pH to above 11 to precipitate iron and manganese. This process is proven and reliable in removing iron and manganese. A typical lime softening treatment process includes a silo for storage of the lime, feed equipment, clarifiers, re-carbonation tanks, gravity filters and significant residual management facilities such as lagoons to deal with the large volume of sludge generated.

Alternative 6 –Oxidation and Filtration

This alternative involves oxidizing the water to precipitate the iron and manganese and removing the solids through filtration. For oxidation, aeration or chemical oxidants including potassium permanganate, chlorine dioxide, ozone, and chlorine can be used. For filtration, gravity or pressure filters can be used with dual granular media or catalytic media (manganese dioxide coated or solid manganese dioxide). To be effective, the use of dual media (anthracite and sand) would require a large contact chamber upstream of the filters. Catalytic media (solid manganese dioxide or manganese dioxide coated media) adsorbs the dissolved iron and manganese and helps to complete the oxidization catalytically through a catalytic process within the media itself. This media approach typically eliminates the need for an additional contact chamber and was therefore recommended for this alternative.

Aeration, potassium permanganate, chloride dioxide, ozone and chlorine were considered as oxidants as part of this alternative, but only chlorine was considered for detailed evaluation due to its simplicity, track record, and low cost as part of the complete Alternative 6 –Oxidation and Filtration.

The use of chlorine and filtration with catalytic media has been proven effective for iron and manganese removal throughout North America and within the Region of Waterloo. It can consistently achieve manganese concentrations <0.015 mg/L, the project's objective.

Alternative 8 – Membrane Filtration

This alternative involves pumping water under pressure through a membrane following oxidization pre-treatment like Alternative 6. Membrane technology is effective in iron and manganese removal and compared to other iron and manganese removal technologies, does not require a large footprint. Additional chemicals are required to clean the membranes increasing operator complexity. Disposal and storage of these chemicals would need to be considered. There is the risk the membranes could gradually plug through accumulation of the precipitated manganese and precipitation of calcium carbonate from the natural hardness of the groundwater.
















3.1.1 Treatment Alternatives Evaluation

The short-listed alternative solutions were evaluated following the evaluation criteria outlined in Section 2.0 in **Table 3.2** to **Table 3.5**.

As part of the evaluation, the approximate site area required for each alternative was estimated based on past project experience. For comparison, the approximate site requirements for Alternatives 4, 6 and 8 were considered large, medium, and, small, respectively.

For comparison of the lifecycle costs, a high-level cost estimate was conducted based on historical data from similar projects. These values are not to be used as a construction cost estimate and do not include the cost of land acquisition; they are intended only for the relative comparison of the alternatives at this stage.

Table 3.2: Evaluation of Alternative Solutions- Technical Category

Evaluation Category	Criteria	Percentage	Alternative 4	Alternative 6	Alternative 8
			Lime or Soda Softening	Chlorine + Filtration	Membrane Filtration
Technical	Provides Reliable Service	3.6%	<ul style="list-style-type: none"> Technology will reliably provide drinking water Complex to operate with multiple chemicals required 	<ul style="list-style-type: none"> Technology will reliably provide drinking water 	<ul style="list-style-type: none"> Technology will reliably provide drinking water Complex to operate with multiple chemicals required 
Technical	Meets Existing and Future Needs	3.6%	<ul style="list-style-type: none"> Technology meets existing and future needs for drinking water 	<ul style="list-style-type: none"> Technology meets existing and future needs for drinking water 	<ul style="list-style-type: none"> Technology meets existing and future needs for drinking water 
Technical	Aligns with Existing and Planned Infrastructure	3.6%	<ul style="list-style-type: none"> Treatment technology not used in the Region for manganese removal Additional chemicals are required 	<ul style="list-style-type: none"> Treatment technology currently used in the Region Chlorine is currently in use at the existing facility 	<ul style="list-style-type: none"> Treatment technology not used in the Region for manganese removal Additional chemicals are required 
Technical	Aligns with Existing and Future Land Use	3.6%	<ul style="list-style-type: none"> Treatment will require large sized property acquisition in designated agricultural land 	<ul style="list-style-type: none"> Treatment will require medium sized property acquisition in designated agricultural land 	<ul style="list-style-type: none"> Treatment will require smallest sized property acquisition in designated agricultural land 
Technical	Aligns with Approval and Permitting Process	3.6%	<ul style="list-style-type: none"> Standard permits and approvals for treatment technology are required 	<ul style="list-style-type: none"> Standard permits and approvals for treatment technology are required 	<ul style="list-style-type: none"> Standard permits and approvals for treatment technology are required 










Evaluation Category	Criteria	Percentage	Alternative 4	Alternative 6	Alternative 8
			Lime or Soda Softening	Chlorine + Filtration	Membrane Filtration
Technical	Manages and Minimizes Construction Risks	3.6%	<ul style="list-style-type: none"> Treatment technology will not impact construction risks 	<ul style="list-style-type: none"> Treatment technology will not impact construction risks 	<ul style="list-style-type: none"> Treatment technology will not impact construction risks 
Technical	Ability to Adapt to Climate Change	3.6%	<ul style="list-style-type: none"> Treatment facility lagoons may be less resilient to extreme weather events. 	<ul style="list-style-type: none"> Treatment facility design will be resilient to extreme weather events. 	<ul style="list-style-type: none"> Treatment facility design will be resilient to extreme weather events. 
Overall Technical Score					

Table 3.3: Evaluation of Alternative Solutions- Natural Environment Category





































Evaluation Category	Criteria	Percentage	Alternative 4	Alternative 6	Alternative 8
			Lime or Soda Softening	Chlorine + Filtration	Membrane Filtration
Natural Environment	Protects Environmental Features	6.3%	<ul style="list-style-type: none"> Use of large quantities of additional chemicals present increased risk of spills to environment Treatment alternative has a larger treatment footprint 	<ul style="list-style-type: none"> No additive chemicals are required Treatment alternative has a medium treatment footprint 	<ul style="list-style-type: none"> Use of additional chemicals present increase risk of spills to environment Treatment alternative has a small treatment footprint 
Natural Environment	Protects Wildlife and Species at Risk	6.3%	<ul style="list-style-type: none"> Large treatment site will impact wildlife habitats 	<ul style="list-style-type: none"> Medium treatment site will impact wildlife habitats 	<ul style="list-style-type: none"> Smaller treatment site will impact wildlife habitats 
Natural Environment	Protects Groundwater, Streams and Rivers	6.3%	<ul style="list-style-type: none"> Additional chemicals required and sludge lagoons present increased risk of spills 	<ul style="list-style-type: none"> Treatment process will have minimal impacts to the GRCA floodplain and local water sources 	<ul style="list-style-type: none"> Additional chemicals required present increased risk of spills 
Natural Environment	Minimizes Climate Change Impacts	6.3%	<ul style="list-style-type: none"> No relative difference between alternatives with respect to possible climate change impacts 	<ul style="list-style-type: none"> No relative difference between alternatives with respect to possible climate change impacts 	<ul style="list-style-type: none"> No relative difference between alternatives with respect to possible climate change impacts 
Overall Natural Environment Score					

Table 3.4: Evaluation of Alternative Solutions- Social Category






Evaluation Category	Criteria	Percentage	Alternative 4	Alternative 6	Alternative 8
			Lime or Soda Softening	Chlorine + Filtration	Membrane Filtration
Social	Minimizes Impacts to Residents Related to Noise, Odour, Traffic, and Aesthetics	4.2%	<ul style="list-style-type: none"> Facility will visually change the existing landscape with minimal noise and odour impacts Residents will be impacted due to additional chemical delivery trucks 	<ul style="list-style-type: none"> Facility will visually change the existing landscape with minimal noise and odour impacts 	<ul style="list-style-type: none"> Facility will visually change the existing landscape with minimal noise and odour impacts Residents will be impacted due to additional chemical delivery trucks 
Social	Minimizes Impacts to Businesses	4.2%	<ul style="list-style-type: none"> Treatment technology will improve water quality for local businesses 	<ul style="list-style-type: none"> Treatment technology will improve water quality for local businesses 	<ul style="list-style-type: none"> Treatment technology will improve water quality for local businesses 
Social	Manages and Minimizes Construction Impact	4.2%	<ul style="list-style-type: none"> Construction of lagoons may increase visual disturbances 	<ul style="list-style-type: none"> Construction of facility will have minimal impacts on surrounding area 	<ul style="list-style-type: none"> Construction of facility will have minimal impacts on surrounding area 
Social	Conserves Built Heritage Resources and/or Cultural Heritage Landscapes ⁸	4.2%	<ul style="list-style-type: none"> Cultural Heritage features will not be impacted by the treatment technology 	<ul style="list-style-type: none"> Cultural Heritage features will not be impacted by the treatment technology 	<ul style="list-style-type: none"> Cultural Heritage features will not be impacted by the treatment technology 

⁸ Revised in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.

Evaluation Category	Criteria	Percentage	Alternative 4	Alternative 6	Alternative 8
			Lime or Soda Softening	Chlorine + Filtration	Membrane Filtration
Social	Conserves Archaeological Resources ⁹	4.2%	<ul style="list-style-type: none"> Treatment facility has a potential for impact on archaeological features An archeological assessment will be conducted to identify any archeological features 	<ul style="list-style-type: none"> Treatment facility has a potential for impact on archaeological features An archeological assessment will be conducted to identify any archeological features 	<ul style="list-style-type: none"> Treatment facility has a potential for impact on archaeological features An archeological assessment will be conducted to identify any archeological features 
Social	Protects Health and Safety	4.2%	<ul style="list-style-type: none"> Operation with additional chemicals required will increase the health and safety hazards for operations staff. Public health and safety will not be impacted 	<ul style="list-style-type: none"> Operation will not have negative health impact on residents or Region staff. Public health and safety will not be impacted 	<ul style="list-style-type: none"> Operation with additional chemicals required will increase the health and safety hazards for operations staff. Public health and safety will not be impacted 
Overall Social Score					

⁹ Revised in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.

Table 3.5: Evaluation of Alternative Solutions- Financial Category

Evaluation Category	Criteria	Percentage	Alternative 4	Alternative 6	Alternative 8
			Lime or Soda Softening	Chlorine + Filtration	Membrane Filtration
Financial	Provides Low Lifecycle Costs	25%	<ul style="list-style-type: none"> Treatment technology has the highest estimated lifecycle cost of \$45,000,000 	<ul style="list-style-type: none"> Treatment technology has lowest estimated lifecycle cost of \$16,000,000 	<ul style="list-style-type: none"> Treatment technology has medium estimated lifecycle cost of \$26,000,000 
			Overall Financial Score		

3.2 Preferred Treatment Solution

Based on the detailed evaluation of the three alternatives as summarized in **Table 3.6**, the preferred alternative is the use of chemical oxidation using chlorine as pre-treatment for filters with catalytic media. It is recommended for the following reasons:

- It is a proven and effective technology.
- No additional chemicals are required.
- It has a relatively small footprint.
- It has lower costs and impacts than the other effective alternatives.

Table 3.6: Summary of Evaluation Criteria Technology Alternatives

Evaluation Category	Percentage	Alternative 4	Alternative 6	Alternative 8
		Lime or Soda Softening	Chlorine + Filtration	Membrane Filtration
Technical	25%			
Natural Environment	25%			
Social	25%			
Financial	25%			
Overall Score				

A sensitivity analysis was conducted following the first Public Consultation Centre. Different weightings of the categories were evaluated to determine if the outcome on the preferred alternative would change. Based on the PCC held on October 23, 2019, no preference was given to a specific category. The following four different scenarios were analyzed with increased weightings for each category:

1. Technical: 40%, Natural Environment: 20%, Social: 20%, Financial: 20%.
2. Technical: 20%, Natural Environment: 40%, Social: 20%, Financial: 20%.
3. Technical: 20%, Natural Environment: 20%, Social: 40%, Financial: 20%.
4. Technical: 20%, Natural Environment: 20%, Social: 20%, Financial: 40%.

In all four scenarios, the preliminary preferred treatment alternative was not impacted by the variation in weighting and remained Alternative 6.

3.3 Discussion of Residual Management Alternatives

Based on the selection of the treatment technology, an estimate of residual production (i.e. waste from the treatment process) was prepared, and a list of potential residual management alternatives was developed. The residual management alternatives were evaluated using the criteria identified in Section 2.0.

3.3.1 Residuals Produced

Residual management alternatives will be needed to manage the following residuals:

- Filter backwash
- Filter to waste
- Chlorine analyzers
- Turbidity analyzers

Table 3.7 summarizes the estimated process residuals wastewater volumes. Refer to Technical Memorandum #3 in **Appendix D** for more detail regarding the assumptions for estimating the total volume of waste streams.

Table 3.7: Estimated Residual Management Streams

Source	Backwash Rate per unit (m ³ /h)	Number of Units	Time (min/day)	Frequency (day/week)	Volume (m ³ /week)
Filter Backwash	310	4	10	1.4	290
Filter to Waste	190	4	5	1.4	89
Chlorine Analyzers	0.04	6	1440	7	40.3
Turbidity Analyzers	0.06	6	1440	7	60.5
Total					479.8

Waste stream sources that are not process residuals include:

- Sample Sink
- Eyewash Station
- Safety Shower
- Floor Drains
- Washrooms (if required)

3.3.2 Residual Management Alternatives

Following the pre-screening of treatment alternatives, the following residual management solutions were considered:

- **Alternative A** – Do Nothing
- **Alternative B** – Lagoon for backwash equalization and residual storage (all discharges) with supernatant decanting from the lagoon to the environment (i.e., a local ditch or watercourse)
- **Alternative C** – Backwash Equalization Tank (BET) with supernatant decanting to the environment and small lagoon for settled solids storage and dewatering, with supernatant to be discharged to the environment.
- **Alternative D** – BET with supernatant decanting to the environment, and settled solids haulage to septage receiving station by truck

- **Alternative E** – BET with recycling of supernatant to the raw water supply flowing into the filters, and a small lagoon for settled solids storage.
- **Alternative F** – BET with recycling of supernatant and settled solids haulage to septage receiving station
- **Alternative G** – BET with pumping of all solids and supernatant to an existing sanitary sewer.

Table 3.8 summarizes the preliminary assessment of the long list of residual management alternatives. Only the residual management alternatives that passed the pre-screening were evaluated further with the evaluation criteria outlined in Section 2.0. For the alternatives that were not carried forward to detailed evaluation, refer to Technical Memorandum #3 in **Appendix D** for more detail.

Table 3.8: Preliminary List of Residual Management Alternatives

Preliminary List of Residual Management Alternatives	Preliminary Assessment
<p>Alternative A – Do Nothing</p> <p>Alternative B – Lagoon for backwash equalization and residual storage (all discharges) with supernatant decanting from the lagoon to the environment (i.e., a local ditch or watercourse)</p> <p>Alternative C –BET with supernatant decanting to the environment and small lagoon for settled solids storage and dewatering, with supernatant to be discharged to the environment.</p> <p>Alternative D – BET with supernatant decanting to the environment, and settled solids haulage to septage receiving station by truck</p> <p>Alternative E – BET with recycling of supernatant to the raw water supply flowing into the filters, and a small lagoon for settled solids storage.</p>	<p>Alternatives A, B, C, D and E involve discharge of the supernatant to the environment. Pilot testing results indicate that copper levels in the supernatant exceed the PWQO, therefore, these alternatives were not considered feasible and will not be evaluated further.</p>

Preliminary List of Residual Management Alternatives	Preliminary Assessment
Alternative F – BET with recycling of supernatant and settled solids haulage to septage receiving station	Alternative F is a feasible solution and will be reviewed and evaluated in detail to identify a preferred solution.
Alternative G – BET with pumping of all solids and supernatant to an existing sanitary sewer.	Alternative G is a feasible solution and will be reviewed and evaluated in detail to identify a preferred solution.

Based on the review, the following short list of residual management alternatives were selected for detailed evaluation:

- **Alternative F** – BET + Recycling of Supernatant + Settled Solids Haulage
- **Alternative G** – BET + Pumping of Solids and Supernatant to Sanitary Sewer

Descriptions of the short-listed residual management alternatives are listed below:

Alternative F – BET + Recycling of Supernatant + Settled Solids Haulage

For this alternative, residual haulage to a septage receiving station would require one trip per week in truck traffic. Residuals would have high levels of iron and manganese. This alternative has been used extensively for other plants within the Region and elsewhere. Recycling of the supernatant may have minor impacts to the filter loading rate over time. This alternative was reviewed in the detailed evaluation process.

Alternative G – BET + Pumping of Solids and Supernatant to Sanitary Sewer

For this alternative, a pumping station and force main would be required to pump the supernatant and settled solids to a nearby sanitary system. Both the Kitchener and Baden collection system were considered, however, the Baden collection system was ruled out as the Baden Pumping Station does not have available capacity, as per the Region Wastewater Treatment Master Plan (CIMA, 2018). The Kitchener sanitary collection system is located approximately 9 km from the Shingletown Wells. It is estimated that a minimum of two pumping stations would be required based on the length and topography of the alignment. It can be noted that if this solution is selected as the preferred solution, additional investigation would be required to confirm the pumping station configuration, number of

pumping stations, and the available capacity of the downstream collection system. This alternative would involve a large capital cost and traffic would be disrupted during construction.







This alternative would have the advantage that sanitary wastewater generated from the site could be included in the flow, eliminating the need for any special management of these wastes. This alternative was considered in the detailed evaluation process.







3.3.3 Residual Management Evaluation

The short-listed residual management alternative solutions were evaluated as per the evaluation criteria outlined in Section 2.0 in **Table 3.9 to Table 3.12**.

For comparison of the lifecycle costs, a high-level cost projection was conducted based on historical data from similar projects. These values are not to be used as a construction cost estimate and are only for relative comparison of alternatives at this stage.

Table 3.9: Evaluation of Alternative Solutions- Technical Category

Evaluation Category	Criteria	Percentage	Alternative F	Alternative G
			BET + Recycling of Supernatant + Settled Solids Holding Tank + Settled Solids Haulage	BET + Pumping of Solids and Supernatant to Sanitary Sewer
Technical	Provides Reliable Service	3.6%	<ul style="list-style-type: none"> Alternative will reliably manage treatment residuals 	<ul style="list-style-type: none"> Alternative will reliably manage treatment residuals Multiple pumping stations increase complexity for operators 
Technical	Meets Existing and Future Needs	3.6%	<ul style="list-style-type: none"> Alternative will meet existing and future needs for residual management 	<ul style="list-style-type: none"> Alternative will meet existing and future needs for residual management 
Technical	Aligns with Existing and Planned Infrastructure	3.6%	<ul style="list-style-type: none"> Residual management strategy currently used in Region 	<ul style="list-style-type: none"> Existing sanitary sewer system and treatment plant not designed with spare capacity for this additional flow There is no existing sanitary network 

Evaluation Category	Criteria	Percentage	Alternative F	Alternative G
			BET + Recycling of Supernatant + Settled Solids Holding Tank + Settled Solids Haulage	BET + Pumping of Solids and Supernatant to Sanitary Sewer
Technical	Aligns with Existing and Future Land Use	3.6%	<ul style="list-style-type: none"> Alternative will have minimal potential impacts to existing land uses. 	<ul style="list-style-type: none"> Pumping stations requirements will have impacts to existing land uses 
Technical	Aligns with Approval and Permitting Process	3.6%	<ul style="list-style-type: none"> Standard permits and approvals for residual management are required 	<ul style="list-style-type: none"> Additional approvals are required for constructing within the roadway and for construction of new sanitary pumping stations 
Technical	Manages and Minimizes Construction Risks	3.6%	<ul style="list-style-type: none"> Alternative minimizes construction complexity 	<ul style="list-style-type: none"> Construction is complex due to construction within the roadway and connecting to the existing sanitary system 











Evaluation Category	Criteria	Percentage	Alternative F	Alternative G
			BET + Recycling of Supernatant + Settled Solids Holding Tank + Settled Solids Haulage	BET + Pumping of Solids and Supernatant to Sanitary Sewer
Technical	Ability to Adapt to Climate Change	3.6%	<ul style="list-style-type: none"> Residual management alternative is resilient to extreme weather events. 	<ul style="list-style-type: none"> Residual management alternative is resilient to extreme weather events. 
Overall Technical Score				

Table 3.10: Evaluation of Alternative Solutions- Natural Environment Category

Evaluation Category	Criteria	Percentage	Alternative F	Alternative G
			BET + Recycling of Supernatant + Settled Solids Holding Tank + Settled Solids Haulage	BET + Pumping of Solids and Supernatant to Sanitary Sewer
Natural Environment	Protects Environmental Features	6.3%	<ul style="list-style-type: none"> Alternative will have little impact on sensitive natural features 	<ul style="list-style-type: none"> Alternative will have a larger impact due to creek crossings which are likely required which could impact sensitive natural features 
Natural Environment	Protects Wildlife and Species at Risk	6.3%	<ul style="list-style-type: none"> Alternative will have little impact on wildlife 	<ul style="list-style-type: none"> Alternative will have an impact on wildlife due to construction 
Natural Environment	Protects Groundwater, Streams and Rivers	6.3%	<ul style="list-style-type: none"> Facility location will minimize impacts to the GRCA floodplain 	<ul style="list-style-type: none"> Facility location will minimize impacts to the GRCA floodplain Creek crossings are likely required which increases the risk of potential for force main breaks 















Evaluation Category	Criteria	Percentage	Alternative F	Alternative G
			BET + Recycling of Supernatant + Settled Solids Holding Tank + Settled Solids Haulage	BET + Pumping of Solids and Supernatant to Sanitary Sewer
Natural Environment	Minimizes Climate Change Impacts	6.3%	<ul style="list-style-type: none"> Trucking away settled solids would result in greenhouse gas emission 	<ul style="list-style-type: none"> Construction of force main will result in increase of greenhouse gas emissions 
Overall Natural Environment Score				

Table 3.11: Evaluation of Alternative Solutions- Social Category

Evaluation Category	Criteria	Percentage	Alternative F	Alternative G
			BET + Recycling of Supernatant + Settled Solids Holding Tank + Settled Solids Haulage	BET + Pumping of Solids and Supernatant to Sanitary Sewer
Social	Minimizes Impacts to Residents Related to Noise, Odour, Traffic, and Aesthetics	4.2%	<ul style="list-style-type: none"> Facility will visually change the existing landscape with minimal noise and odour impacts Residents will be impacted due to weekly haulage 	<ul style="list-style-type: none"> Facility will visually change the existing landscape Pumping stations increase risk of odour impacts 
Social	Minimizes Impacts to Businesses	4.2%	<ul style="list-style-type: none"> Alternative will have minimal impacts on local businesses 	<ul style="list-style-type: none"> Road construction and long-term maintenance will impact local businesses 
Social	Manages and Minimizes Construction Impact	4.2%	<ul style="list-style-type: none"> Construction of facility will have minimal impacts on surrounding area 	<ul style="list-style-type: none"> Construction of force main will have a large impact on surrounding area 

Evaluation Category	Criteria	Percentage	Alternative F	Alternative G
			BET + Recycling of Supernatant + Settled Solids Holding Tank + Settled Solids Haulage	BET + Pumping of Solids and Supernatant to Sanitary Sewer
Social	Conserves Built Heritage Resources and/or Cultural Heritage Landscapes ¹⁰	4.2%	<ul style="list-style-type: none"> Alternative will not impact cultural heritage features 	<ul style="list-style-type: none"> Alternative has greater potential to impact cultural heritage features 
Social	Conserves Archaeological Resources ¹¹	4.2%	<ul style="list-style-type: none"> Alternative has low potential for impact on archaeological features 	<ul style="list-style-type: none"> Alternative has greater potential for impact on archaeological features 

¹⁰ Revised in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.

¹¹ Revised in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.









Evaluation Category	Criteria	Percentage	Alternative F	Alternative G
			BET + Recycling of Supernatant + Settled Solids Holding Tank + Settled Solids Haulage	BET + Pumping of Solids and Supernatant to Sanitary Sewer
Social	Protects Health and Safety	4.2%	<ul style="list-style-type: none"> Construction and operation will have minimal impacts on residents or Region staff Public health and safety will not be impacted 	<ul style="list-style-type: none"> Construction and operation will have minimal impacts on residents or Region staff Public health and safety will not be impacted 
Overall Social Score				











Table 3.12: Evaluation of Alternative Solutions- Financial Category

Evaluation Category	Criteria	Percentage	Alternative F	Alternative G
			BET + Recycling of Supernatant + Settled Solids Holding Tank + Settled Solids Haulage	BET + Pumping of Solids and Supernatant to Sanitary Sewer
Financial	Provides Low Lifecycle Costs	25%	<ul style="list-style-type: none"> Alternative has lowest lifecycle cost of \$3,000,000 	<ul style="list-style-type: none"> Alternative has highest lifecycle cost of \$24,000,000 
Overall Financial Score				

3.4 Preferred Residual Management Solution

Based on the detailed evaluation of the two alternatives as summarized in **Table 3.13**, the preferred alternative is Alternative F. The residual management system will consist of a backwash equalization tank, recycling of the supernatant, and hauling of the settled residuals.

Table 3.13: Summary of Evaluation Criteria Residual Management Alternatives

Evaluation Category	Percentage	Alternative F	Alternative G
		BET + Recycling of Supernatant + Settled Solids Holding Tank + Settled Solids Haulage	BET + Pumping of Solids and Supernatant to Sanitary Sewer
Technical	25%		
Natural Environment	25%		
Social	25%		
Financial	25%		
Overall Score			

A sensitivity analysis was conducted following the first Public Consultation Centre. Different weightings of the categories were evaluated to determine if the outcome on the preferred alternative would change. Based on the PCC held on October 23, 2019, no preference was given to a specific category. The following four different scenarios were analyzed with increased weightings for each category:

1. Technical: 40%, Natural Environment: 20%, Social: 20%, Financial: 20%.
2. Technical: 20%, Natural Environment: 40%, Social: 20%, Financial: 20%.
3. Technical: 20%, Natural Environment: 20%, Social: 40%, Financial: 20%.

4. Technical: 20%, Natural Environment: 20%, Social: 20%, Financial: 40%.

In all four scenarios, the preliminary preferred residual management alternative was not impacted by the variation in weighting and remained Alternative F.

4.0 DEVELOPMENT AND EVALUATION OF ALTERNATIVE DESIGN CONCEPTS

4.1 Facility Requirements for the Preferred Treatment Technology and Residual Management Solution

The recommended treatment alternative was oxidation and filtration using chlorine as the oxidant with catalytic media. The recommended residual management solution for the facility included a backwash equalization tank with recycling of supernatant, a settled sludge holding tank with sludge being hauled offsite as required.

For purposes of determining the area of property required, as part of TM#4, RVA worked with the Region to develop a conceptual building size. Refer to Technical Memorandum #4 in **Appendix E** for more detail regarding the preliminary equipment and tankage assumptions.

Based on the preferred treatment approach, key facility components are summarized below:

- Provision for Two (2) Raw Water Reservoirs
- Two (2) Treated Water Reservoirs
- Filter and Pump Room
- Two (2) Backwash Equalization Tanks
- Provision for Clarifier
- Sludge Holding Tank
- Electrical Room
- Mechanical Room
- Chemical Room
- Provision for Office/Lab

Based on TM#4, the building is estimated to be 28 m by 55 m. Additional space on the site was included for building setbacks, parking and driveway access for deliveries, and a construction laydown area. On this basis, a site measuring 75 m by 75 m was determined to be required. It can be noted that stormwater management infrastructure will be selected based on the final facility design, the site layout and input from Township of Wilmot, the Region and the GRCA during detailed design.

The preliminary site layout is shown in **Figure 4.1**.

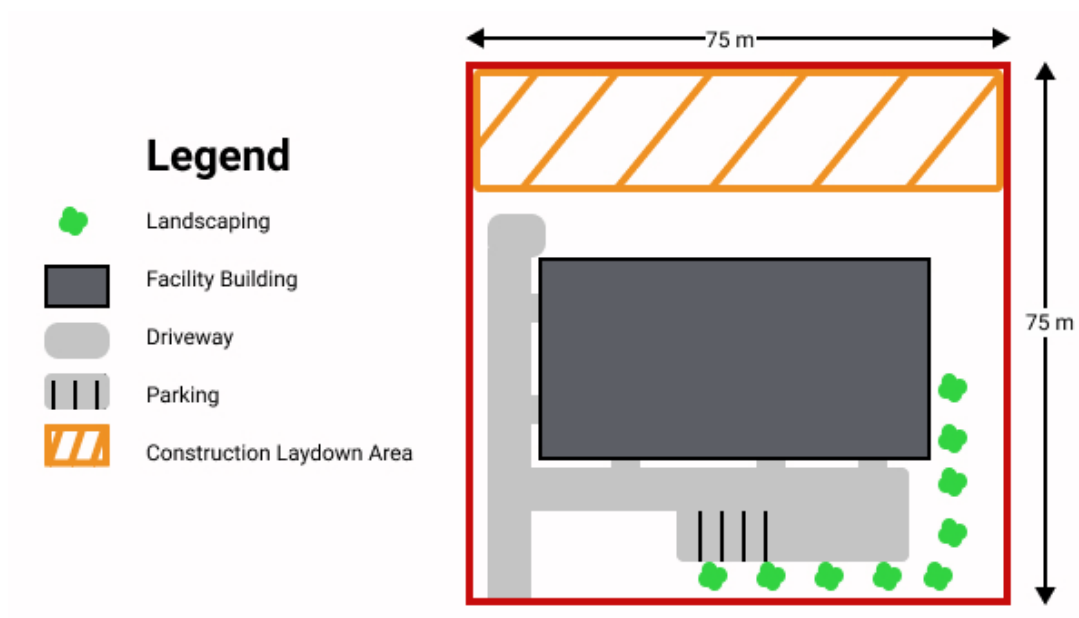


Figure 4.1: Preliminary Site Layout

4.2 Discussion of Location Design Concepts

Based on the preliminary site layout, three preliminary locations for the iron and manganese facility were identified as shown in **Figure 4.2**. The potential sites were identified based on considerations for:

- Land size available
- Vehicle Access
- Distance to the existing Shingletown wells and watermains
- Environmental features, culture heritage features and areas of archaeological potential
- Current and potential future land uses

The existing site of the Shingletown Wells was considered as a potential location, however, there was insufficient space for the new facility.

The three alternative facility locations to be evaluated were as follows:

- Location 1: Property to the west of the existing site
- Location 2: Property to the south of the existing site
- Location 3: Property to the east of the existing site



Figure 4.2: Preliminary Site Location Alternatives

4.3 Facility Location Alternatives Site Investigations and Considerations

As part of Technical Memorandum #1 Project Background and Existing Conditions (TM#1), natural environment and archaeological desktop studies were conducted within 1 km in all directions surrounding the Shingletown Wells site. Following the selection of the preliminary locations, field studies were conducted to provide further information regarding the natural environment. Considerations were also made regarding the archeological potential of the properties, Source Protection Policies in the area and supply of non potable water to the Eenkooren pond.

4.3.1 Natural Environment Existing Conditions Report

To supplement the natural environment existing conditions study, a Natural Sciences Report was completed including field visits on May 26, June 16, and July 29, 2020 at the location alternatives for a visual assessment of the habitat, flora, and fauna. The results were provided in the 'Iron and Manganese Treatment Upgrades for the Shingletown Wells Natural Sciences Report' included in **Appendix G**. Measures were recommended to mitigate environmental impacts during design and construction.

The wildlife and wildlife habitat at all three locations is considered tolerant to human disturbance given the proximity to, and ongoing influence of, rural/agricultural landscapes. No species at risk impacts were identified at any of the three locations.

The properties to the west and south (Locations 1 and 2) currently are used for row crops, while the property to the east (Location 3) is a pasture. Potential habitat may be available for sensitive (grassland) species if agricultural lands are used for pasture, though none were observed during the field visits.

For Location 1, the north end of the site is located inside the Grand River Conservation Authority (GRCA) Regulation Limit surrounding Hunsburger Creek. Location 2 is not located within the GRCA regulation limit. The south west corner of Location 3 is located within the GRCA regulation limit around a tributary that leads to the Hunsburger Creek (as is much of the existing well field site). Both Locations 1 and 2 would require piping to be built across the tributary to connect the existing site to the new facility.

LGL has confirmed that the locations have a low potential for a gravel driveway to attract nesting turtles or other wildlife but consideration for driveway substrates should be evaluated at the detailed design phase of this project.

4.3.2 Archeological Report

Based on the Stage 1 archeological assessment (AA) completed, all three locations were identified as retaining archeological potential and further archeological assessment is required through a Stage 2 AA. As part of the Stage 2 AA, any active or recently cultivated agricultural land must be ploughed before the site is visited by an archeologist.

Based on the potential disruption to landowners, it is recommended that a Stage 2 AA be completed in the detailed design stage, after a preferred site has been purchased. For the evaluation, it was assumed that all three sites are equal in archeological potential.

4.3.3 Source Protection Policies

Due to the proximity of the three (3) potential locations to the existing wells, certain activities under the Clean Water Act may be prohibited or require specific risk management measures. Different area designations related to travel time of groundwater to the wells determine what policies apply. All three locations and the study area shown in **Figure 4.3** are located within Well Head Protection Area (WHPA) B. Half of Location 2 and most of Location 3 are in the WHPA A. The extent of WHPA A is shown in **Figure 4.3**. Generally, the policies for land within the WHPA A are the most restrictive. These policies may impact the existing land use and consideration will need to be included in the design of the new facility to limit salt application and chemical storage.



Figure 4.3: Extent of Well Head Protection Area-A in Study Area

4.3.4 Connection to Eenkooren pond













Non potable water from the Shingletown Wells discharges to the Eenkooren pond located approximately 530 m west of the Shingletown Wells at 2428 Bleams Rd. As outlined in Technical Memorandum #1, the Region provided a letter agreement to the property owner to confirm Wells K50 and K51 will continue to be operated to provide a minimum flow of 6 L/s of water to the Eenkooren pond.

It will be determined during design if the connection point at the K50 and K51 Wells will need to be modified. For the evaluation, it was assumed the decision would be the same for all three location and will not impact the evaluation.

4.4 Facility Location Alternatives Evaluation

The alternative facility locations were evaluated following the evaluation criteria outlined in Section 2.0. The evaluation scoring is provided in **Table 4.1** to **Table 4.4** for technical, natural environmental, social, and financial categories. An overall summary of the evaluation is provided and summarized in **Table 4.5**.

Table 4.1: Evaluation of Location Alternatives - Technical Category

Evaluation Category	Criteria	Percentage	Location 1	Location 2	Location 3
Technical	Provides Reliable Service	3.6%	<ul style="list-style-type: none"> Distance of 250 m from wells may require more maintenance to maintain reliability Piping located in roadway more difficult to repair and replace 	<ul style="list-style-type: none"> Distance of 75 m to wells will minimize the risk of pipe leaks Piping located in roadway more difficult to repair and replace 	<ul style="list-style-type: none"> Distance of 50 m to wells will minimize the risk of pipe leaks Piping in grass area easier to repair 
Technical	Meets Existing and Future Needs	3.6%	<ul style="list-style-type: none"> Location meets existing and future needs for drinking water supply 	<ul style="list-style-type: none"> Location meets existing and future needs for drinking water supply 	<ul style="list-style-type: none"> Location meets existing and future needs for drinking water supply 
Technical	Aligns with Existing and Planned Infrastructure	3.6%	<ul style="list-style-type: none"> Location can connect with existing distribution system 	<ul style="list-style-type: none"> Location can connect with existing distribution system 	<ul style="list-style-type: none"> Location can connect with existing distribution system Location is adjacent to existing well site 
Technical	Aligns with Existing and Future Land Use	3.6%	<ul style="list-style-type: none"> Location is within existing agricultural land impacted by WHPA B Source Water Protection Policies 	<ul style="list-style-type: none"> Location is within existing agricultural land impacted by WHPA A and WHPA B Source Water Protection Policies 	<ul style="list-style-type: none"> Location is within existing agricultural land impacted by WHPA and WHPA B Source Water Protection Policies Due to the practice of organic farming principles, the future land use for this parcel is reduced due to source protection requirements. Potential future land use as a treatment facility to be beneficial for alignment with policy objectives 













Evaluation Category	Criteria	Percentage	Location 1	Location 2	Location 3
Technical	Aligns with Approval and Permitting Process	3.6%	<ul style="list-style-type: none"> Standard permits and approvals are required Location is partially located within the Grand River Conservation Area and consultation is required. 	<ul style="list-style-type: none"> Standard permits and approvals are required 	<ul style="list-style-type: none"> Standard permits and approvals are required Location is partially located within the Grand River Conservation Area and consultation is required. 
Technical	Manages and Minimizes Construction Risks	3.6%	<ul style="list-style-type: none"> Location would require construction in Bleams Road that would increase complexity 	<ul style="list-style-type: none"> Location would require construction in Bleams Road that would increase complexity 	<ul style="list-style-type: none"> Location does not require working within the roadway 
Technical	Ability to Adapt to Climate Change	3.6%	<ul style="list-style-type: none"> Location is resilient to high precipitation and flooding since it is not located within the flood plain 	<ul style="list-style-type: none"> Location is resilient to high precipitation and flooding since it is not located within the flood plain 	<ul style="list-style-type: none"> Location is resilient to high precipitation and flooding since it is not located within the flood plain 
Overall Technical Score					

Table 4.2: Evaluation of Location Alternatives - Natural Environment Category























Evaluation Category	Criteria	Percentage	Location 1	Location 2	Location 3
Natural Environment	Protects Environmental Features	6.3%	<ul style="list-style-type: none"> Building of facility at this location has minimal impacts to environmental features Part of location is on land regulated by the GRCA Piping crossing to this location will be built under tributary in land regulated by the GRCA 	<ul style="list-style-type: none"> Building of facility at this location has minimal impacts to environmental features Piping crossing to this location will be built under tributary in land regulated by the GRCA 	<ul style="list-style-type: none"> Building of facility at this location has minimal impacts to environmental features Part of location is on land regulated by the GRCA 
Natural Environment	Protects Wildlife and Species at Risk	6.3%	<ul style="list-style-type: none"> Removal of agriculture at this location has minimal impact on wildlife No Species at Risk impacts are anticipated 	<ul style="list-style-type: none"> Removal of agriculture at this location has minimal impact on wildlife No Species at Risk impacts are anticipated 	<ul style="list-style-type: none"> Removal of pasture at this location has a potential impact on wildlife habitat though none were observed No Species at Risk impacts are anticipated 
Natural Environment	Protects Groundwater, Streams and Rivers	6.3%	<ul style="list-style-type: none"> Location will require piping to cross local tributary 	<ul style="list-style-type: none"> Location will require piping to cross local tributary 	<ul style="list-style-type: none"> Location will have minimal impacts to the local water sources 
Natural Environment	Minimizes Climate Change Impacts	6.3%	<ul style="list-style-type: none"> No relative difference between locations with respect to possible climate change impacts 	<ul style="list-style-type: none"> No relative difference between locations with respect to possible climate change impacts 	<ul style="list-style-type: none"> No relative difference between locations with respect to possible climate change impacts 
Overall Natural Environment Score					

Table 4.3: Evaluation of Location Alternatives - Social Category







Evaluation Category	Criteria	Percentage	Location 1	Location 2	Location 3
Social	Minimizes Impacts to Residents Related to Noise, Odour, Traffic, and Aesthetics	4.2%	<ul style="list-style-type: none"> Location is closest to existing houses and will have largest potential for impact with respect to noise, traffic, and aesthetics No odour is expected for this facility 	<ul style="list-style-type: none"> Location is a medium distance from existing houses and will have a moderate potential for impact with respect to noise, traffic, and aesthetics No odour is expected for this facility 	<ul style="list-style-type: none"> Location is furthest from existing houses and will have smallest potential for impact with respect to noise, traffic, and aesthetics impact No odour is expected for this facility 
Social	Minimizes Impacts to Businesses	4.2%	<ul style="list-style-type: none"> Location will have minimal impact on local businesses 	<ul style="list-style-type: none"> Location will have minimal impact on local businesses 	<ul style="list-style-type: none"> Location has potential to have the least impact to business because of existing source water protection policies 
Social	Manages and Minimizes Construction Impact	4.2%	<ul style="list-style-type: none"> Piping required in roadway to get to this location has the largest construction impact 	<ul style="list-style-type: none"> Piping required in roadway to get to this location has a moderate construction impact 	<ul style="list-style-type: none"> No piping in roadway required to connect location to existing wells Location is furthest from existing houses 
Social	Conserves Built Heritage Resources and/or Cultural Heritage Landscapes ¹²	4.2%	<ul style="list-style-type: none"> Cultural heritage features will not be impacted by the location 	<ul style="list-style-type: none"> Cultural heritage features will not be impacted by the location 	<ul style="list-style-type: none"> Cultural heritage features will not be impacted by the location 

¹²Revised in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.

Evaluation Category	Criteria	Percentage	Location 1	Location 2	Location 3
Social	Conserves Archaeological Resources ¹³	4.2%	<ul style="list-style-type: none"> Location has archaeological potential 	<ul style="list-style-type: none"> Location has archaeological potential 	<ul style="list-style-type: none"> Location has archaeological potential 
Social	Protects Health and Safety	4.2%	<ul style="list-style-type: none"> Region staff and public health and safety will not be impacted by the location 	<ul style="list-style-type: none"> Region staff and public health and safety will not be impacted by the location 	<ul style="list-style-type: none"> Region staff and public health and safety will not be impacted by the location 
Overall Social Score					

¹³ Revised in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.

Table 4.4: Evaluation of Location Alternatives - Financial Category
















Evaluation Category	Criteria	Percentage	Location 1	Location 2	Location 3
Financial	Provides Low Lifecycle Costs	25%	<ul style="list-style-type: none"> Location has the highest estimated comparative lifecycle Location is the largest distance from existing wells resulting in highest costs for piping and duct bank between existing wells and new facility Excavation in the roadway increases installation cost 	<ul style="list-style-type: none"> Location has medium estimated lifecycle cost Location is the medium distance from existing wells resulting in medium costs for piping and duct bank between existing wells and new facility Small excavation in the roadway increases installation cost 	<ul style="list-style-type: none"> Location has lowest estimated lifecycle cost Proximity to existing wells result in lowest costs for piping and duct bank between existing wells and new facility
					
Overall Financial Score					

4.5 Preferred Location Design Solution

Based on the detailed evaluation of the three locations as summarized in **Table 4.5**, the location east of the existing well site, Location 3, is the preferred location since it is well aligned with the criteria in all four categories. It is recommended for the following reasons:

- Location does not require construction to take place in Bleams Rd.
- Location has closest proximity to existing wells, resulting in simpler connections, with less disturbance to the environment.
- Location does not require piping to be built across the local tributary.
- Location is furthest from existing houses resulting in less disturbances to locals during construction.
- Location has lower costs than the other design concepts.

Table 4.5: Summary of Evaluation Criteria Location Alternatives

Evaluation Category	Percentage	Location 1	Location 2	Location 3
Technical	25%			
Natural Environment	25%			
Social	25%			
Financial	25%			
Overall Score				

The four evaluation categories were presented to the public during Public Consultation Centre (PCC) #1 on October 23, 2019, to determine what is important to the public. During PCC#2 on March 5, 2020, the short-listed alternative locations were presented to the public. Based on PCC#1, no preference was given to a specific category. No comments were received regarding the three short-listed locations presented in PCC#2. A sensitivity analysis was conducted by evaluating the short-listed locations using different weighting of the categories. Different weightings of the categories were analyzed with increased weightings for each category:

1. Technical: 40%, Natural Environment: 20%, Social: 20%, Financial: 20%.
2. Technical: 20%, Natural Environment: 40%, Social: 20%, Financial: 20%.
3. Technical: 20%, Natural Environment: 20%, Social: 40%, Financial: 20%.
4. Technical: 20%, Natural Environment: 20%, Social: 20%, Financial: 40%.

In all four scenarios, the preliminary preferred location was not impacted by the variation in weighing. It was therefore determined that the recommended alternative was not sensitive to minor changes in scoring and remained Location 3.

5.0 PREFERRED SOLUTIONS AND DESIGN CONCEPT

This section summarizes the preferred alternative solutions and the preferred alternative design concept presented in Section 3.0 and Section 4.0.

5.1 Preferred Alternative Solutions

To reduce the manganese concentrations in the Shingletown Wells to meet the anticipated aesthetic objective of 0.02 mg/L, the preferred treatment solution was 'Alternative 6 - Oxidation and Filtration'. This solution consisted of chemical oxidation using chlorine as pre-treatment for filters with catalytic media. It was recommended for the following reasons:

- It is a proven and effective technology.
- No additional chemicals are required.
- It has a relatively small footprint.
- It has lower costs and impacts than the other effective alternatives.

Following the selection of the preferred alternative treatment solution, the preferred residual management solution was determined to be 'Alternative F- Backwash equalization tank+ Recycling of the supernatant + Settled solids holding tank+ Settled solids haulage'. It was recommended for the following reasons:

- It is a proven and reliable residual management solution.
- It minimizes the construction complexity.
- It has lower social and natural environment impacts than the other residual management alternatives.
- It has the lowest lifecycle cost.

5.2 Preferred Alternative Location Design Concept

Based on the preferred treatment and residual management solutions, a preliminary facility size and property size was determined, and three locations were short listed as the alternative design concepts. The preferred location was Location 3, the site located to the east of the existing well site. It was recommended for the following reasons:

- Location does not require construction to take place in Bleams Rd.

- Location has closest proximity to existing wells, resulting in simpler connections, with less disturbance to the environment.
- Location does not require piping to be built across local tributary.
- Location is furthest from existing houses resulting in less disturbances to locals during construction.
- Location has lower costs than the other design concepts.

A map showing the preferred location can be seen in **Figure 5.1**.

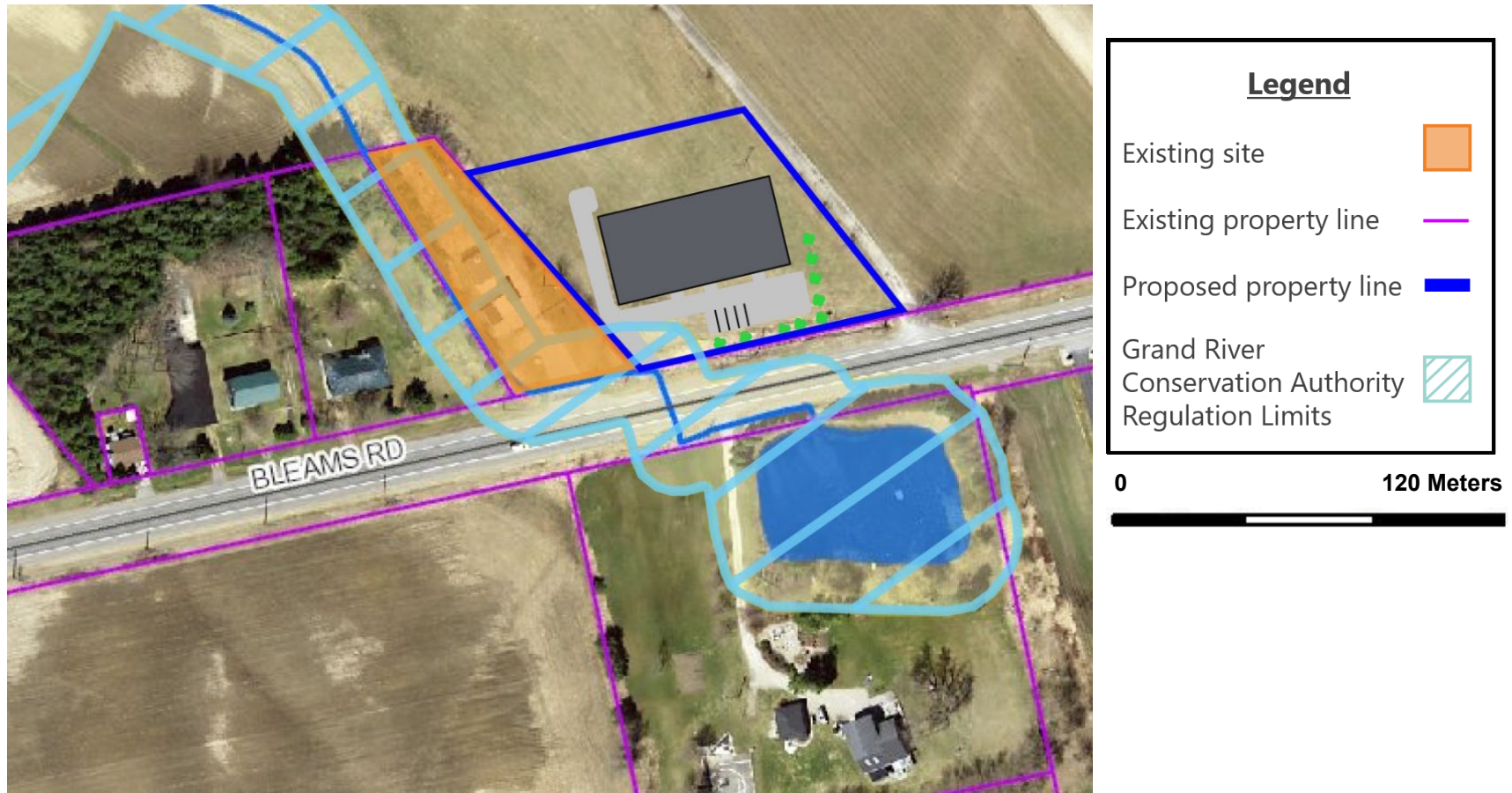


Figure 5.1: Preferred Location (Location 3)

6.0 MITIGATION MEASURES

The recommended mitigation measures to implement the preferred alternative solutions and preferred location design concept have been summarized in **Table 6.1** below. It discusses possible general, as well as specific, mitigation measures during design and construction to minimize the impacts to the public and environment. Refer to the Natural Sciences Report in **Appendix G** for further details on the natural environmental mitigation measures.

Table 6.1: Mitigation Measures During Design and Construction

Impacts	Mitigating Measures
Noise from Construction Equipment	Work should take place within the local noise bylaw requirements. Construct hoarding around noise generating stationary equipment wherever possible.
Dust and Mud from Construction Activities	Specify the need for street sweeping and the use of mud mats during construction.
Impacts to Residents Related to Traffic	On Bleams Road, one lane of traffic should be maintained in both directions. If not possible, one lane of traffic for shared use in both directions with traffic control should be maintained (i.e., flag persons, timed streetlights) Access for emergency response vehicles and personnel always should be maintained along with public access to private residences and businesses.
Disruption to Species at Risk, and/or Their Habitat	Minimize vegetation, tree removal and the construction area to the extent possible. Direct external facility lighting away from any significant natural heritage features where possible. Remove trees within the designated permitted period of September 30 th to April 15 th unless special permission and investigations are undertaken to confirm no impact to wildlife. Timing is weather dependent and should be confirmed by the MECP If required, removal of buildings/infrastructure will need to be screened for species at risk that may nest/roost there.

If construction takes place in 2025 or later, an updated Breeding Bird Survey should be conducted to determine if any Species at Risk have started living in the area.

Pasture, the vegetation existing at the preferred location is the preferred habitat for some SAR, specifically the Bobolink and the Eastern Meadowlark. Consultation with the MECP should be conducted during design to determine if an Endangered Species Act permit or authorization is required for removal of their habitat.

Damage to Existing
Trees

Appropriate tree protection measures should be installed within the project area to help protect trees to be retained.

Groundwater or
Surface Water
Contamination
(Through Construction
Activities)

The preferred location is located within WHPA-A. Design must comply with the Source Protection Plan. If certain activities are deemed necessary, an approved Risk Management Plan will need to be established.

Avoid refueling and cleaning of construction equipment within the wellhead protection area.

During construction, proper precautions are to be taken to prevent spills, and ensure any spills are reported and promptly cleaned up.

Noise from Diesel
Generator Under
Normal Operation

Silencing equipment to be included in the detailed design stage of the building to meet the MECP regulations. Air and Noise modeling will need to be undertaken during detailed design and Environmental Compliance Approval (ECA) submitted to MECP.

Impacts to Residents
Related to Aesthetics
of Facility/Building on
Surrounding
Residential
Neighbourhood

Design of the building to blend in with the surrounding residential community including landscaping to help screen the facility.

Design for landscaping using native vegetation where possible to provide natural habitat to wildlife and aesthetics.

Climate Change

The preferred location of the facility is not located within the local floodplain but consultation with the GRCA will be conducted to assess the flooding potential.

Design of facility infrastructure should be considered the impact of more severe winds and storms and extreme temperature ranges.

Potential Impacts to
Archeological
Resources¹⁴

The preferred location (Location 3) is in an area of archaeological potential as identified in the Stage 1 archaeological assessment. A Stage 2 archaeological assessment (and any further stages, if recommended) will be undertaken by a licensed archaeologist as early as possible in the detailed design phase and prior to any ground disturbing activities.

The recommendations of the archaeological assessment(s) will inform the detailed design phase.

If archaeological resources are impacted by EA project work, notify the MHSTCI at archaeology@ontario.ca. All activities impacting archaeological resources must cease immediately, and a licensed archaeologist is required to carry out an archaeological assessment in accordance with the Ontario Heritage Act and the Standards and Guidelines for Consultant Archaeologists.

If human remains are encountered, all activities must cease immediately and the local police as well as the Registrar, Burials of the Ministry of Government and Consumer Services (416-326-8800) must be contacted. In situations where human remains are associated with archaeological resources, MHSTCI should also be notified to ensure that the site is not subject to unlicensed alterations which would be a contravention of the Ontario Heritage Act.

¹⁴ Impacts and Mitigation Measures for Archaeological Resources revised in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021.

Potential Impacts to Known or Potential Built Heritage Resources and/or Cultural Heritage Landscapes ¹⁵	No known or potential built heritage resources will be impacted. None were identified at the preferred location. For more information, see Appendix I.
Sediment and Erosion	Follow all applicable regulations and by-laws concerning erosion and sedimentation control, noise, environmental controls, vibration, and public safety. Site plan should clearly identify stockpiling and staging areas. See below for a more detailed discussion.

Erosion and sedimentation are a primary concern during construction. Mitigating measures for erosion and sedimentation control include:

- Erosion and sediment controls may be achieved with sediment control fencing around the perimeter of the work area(s). Sediment control and construction silt fences should be installed prior to the start of construction and removed following the restoration of vegetation during the construction period.
- All dewatering of the work area(s) by pumping will need to discharge flows through a filter bag and disperse the flow through a vegetated area at least 10 m from the watercourse, or as per regulations.
- Other sediment control measures such as temporary sedimentation basins or swales will be used on an “as required basis” to supplement the other mitigation measures.

The temporary erosion and sediment controls are to be maintained in good working condition throughout the construction period and until the erosion control measures have taken hold.

¹⁵ Impacts and Mitigation Measures for Potential Impacts to known or potential Built Heritage Landscapes were revised in response to a letter received by the MHSTCI on August 5, 2021, after the Notice of Completion was filed on June 23, 2021

7.0 PUBLIC CONSULTATION

7.1 Stakeholders

Stakeholder correspondence and communication was a key component of this Schedule C Class EA Study. There were multiple agencies, municipalities, stakeholder groups, and members of the public within 1 km of the existing well site that were invited to participate and comment on this study. A full list of the stakeholders is presented in **Appendix A-1**:

7.2 Notice of Study Commencement

A “Notice of Study Commencement” was advertised in the Kitchener Post on August 15 and August 22, 2019, and the New Hamburg Independent on August 14 and August 21, 2019. It was posted on the Region’s website and mailed to a list of potentially interested groups and agencies on August 14, 2019. The notice advised that the Class EA for this project was commencing and that any questions or comments on this project should be submitted to the Region or RVA.

Copies of the notice and advertisements are provided in **Appendix A-3**. **Appendix A-2** contains the responses to the Notice of Commencement that were received. For privacy reasons, personal information has been redacted from the comments received.

7.3 Public and Agency Consultation

Three formal Public Consultation Centres (PCCs) were held on October 23, 2019, March 5, 2020, and between February 10, 2021 to March 1, 2021. The first and second PCC were held at Wilmot Recreation Complex and the third was held online due to the COVID-19 pandemic. Copies of the display boards and information regarding the PCCs, as well as summary of correspondence received, and project team responses are provided in **Appendices A-2 to A-9**.

7.3.1 Comment and Input Received

Appendix A-2 contains a summary of the comments received before, during, and after the PCCs and throughout the study. For privacy reasons, personal information has been redacted from the comments received.

Comments were accepted until March 1, 2021. All comments received from the public or other stakeholders prior to March 2, 2021, are addressed in this report.

7.3.2 PCC #1

On October 9, 2019, a Notice of Public Consultation Centre (PCC) was sent out to the stakeholder list advising that a PCC was planned to provide further information to the public on this Class EA, and to receive input and comments from interested parties. A Notice of PCC was published in the New Hamburg Independent on October 9 and October 16, 2019 and the Waterloo Record on October 15 and October 22, 2019. The notice was also posted on the Region website. Copies of the notices are provided in **Appendix A-4**.

A PCC was held on October 23, 2019, from 5 – 7 pm at the Wilmot Recreation Complex in Baden. At this PCC, representatives of RVA and the Region provided information regarding the problem/opportunity statement. A copy of the display materials is provided in **Appendix A-5**.

Staff from the Region and members of the consulting team were available to answer questions at the PCC. Eight (8) members of the public signed the PCC attendance form, and no comments were submitted but ten (10) comments were submitted by email after the PCC. The PCC display boards were also posted on the Region's website for review. **Appendix A-2** contains the correspondence related to PCC #1.

7.3.3 PCC #2

On February 27, 2020, a Notice of PCC#2 was sent out to the stakeholders list advising that a PCC was planned to provide further information to the public on this Class EA, and to receive input and comments from interested parties. A Notice of PCC was published in the New Hamburg Independent on February 19 and February 26, 2019, and the Waterloo Record on February 21 and February 25, 2020. The notice was also posted on the Region website. Copies of the notices are provided in **Appendix A-6**.

A PCC was held on March 5, 2020 from 5 – 7 pm at the Wilmot Recreation Complex in Baden. At this PCC, representatives of RVA and Region presented information regarding the list of treatment and residual management alternative solutions and the evaluation criteria. The preferred solutions were presented along with the short-listed location alternatives. A copy of the display materials is provided in **Appendix A-7**.

Staff from the Region and members of the consulting team were available to answer questions. Fourteen (14) members of the public signed the PCC attendance form. No comments were submitted at the PCC, but five (5) comments were submitted by email after the PCC. The PCC display boards were also posted on the Region's website for review. **Appendix A-2** contains the correspondence related to PCC #2.

7.3.4 PCC #3

On February 5, 2021, a Notice of Public Consultation Centre (PCC) was sent out to the stakeholders list advising that a PCC was planned to provide further information to the public on this Class EA, and to receive input and comments from interested parties. A Notice of PCC was published in the New Hamburg Independent January 27 and February 3, 2021 and the Waterloo Record on February 5 and February 8, 2021. The notice was also posted on the Region website. Copies of the notices are provided in **Appendix A-8**.

A virtual PCC was held between February 10 to March 1, 2021 on the Region of Waterloo website. At part of this virtual PCC, a narrated video, the transcript of the video and the slides were provided on the Region of Waterloo's website. The virtual PCC presented the list of location design concepts and the preferred design concept. A comment sheet was also provided for interested parties to fill out and submit. A copy of the display materials is provided in **Appendix A-9**.

The virtual PCC video received 19 views. No completed comment sheets were submitted but ten (10) comments were submitted by email between February 10 and March 1, 2021. The virtual PCC display boards were also posted on the Region's website for review. **Appendix A-2** contains all the correspondence related to PCC #3.

7.3.5 Notice of Completion

On July 6, 2021, a Notice of Completion was mailed to the stakeholders list advising that the project had been filed for the 30-day review period. The notice invited interested parties to submit comments to the Region of within the allotted public review period. The Notice of Completion was also published in the New Hamburg Independent, the Waterloo Record and posted on the Region's website.

On August 5, the MHSTCI provided a letter response to the Notice of Class EA Completion with comments for revising the ESR to provide more clarity, and requests for additional due diligence documentation to be included into the report. A copy of the MHSTCI's letter is provided in **Appendix A-10**¹⁶.

On November 16, 2021, the MHSTCI confirmed with the project team that the Stage 1 AA completed for this project had been entered into the Ontario Public Register of Archaeological Reports.¹⁷

¹⁶ This paragraph was added in response to a letter received by the MHSTCI on August 5, 2021, after Notice of Completion was filed on June 23, 2021

¹⁷ This paragraph was added in response to the letter received from the MHSTCI on November 16, 2021 stating the Stage 1 AA had been entered into the Ontario Public Register of Archaeological Reports.

8.0 APPROVALS, PERMITS AND OTHER REQUIREMENTS¹⁸

The following summarizes some of the anticipated approvals, permits and other requirements that will be required for this project during design and/or construction. The specific list of approvals, permits and requirements, will be confirmed during detailed design for the project. The timing of some of these approvals, permits and requirements will depend on when the project is undertaken.

- Breeding Bird Survey if construction takes place in 2025 or later
- Building Permit
- Drinking Water Works Amendment
- Endangered Species Act permit or authorization if required
- Grand River Conservation Authority Approval
- Municipal Drinking Water License update
- Permit to Take Water if required or Environmental Activity and Sector Registry (EASR) for construction dewatering, depending on the calculated dewatering requirements during construction
- Site Plan Approval
- Stage 2 Archaeological Assessment for the preferred location – Location 3 study area¹⁹ Early consultation with the approval agencies during the design stage is recommended. Additional approvals may be required as the project progresses with further investigations, detailed design, and construction.

¹⁸ This Section Title was revised in response to a letter received by the MHSTCI on August 5, 2021, after Notice of Completion was filed on June 23, 2021

¹⁹ This bullet point was revised in response to a letter received by the MHSTCI on August 5, 2021, after Notice of Completion was filed on June 23, 2021

9.0 NEXT STEPS AND SCHEDULE

Following the 30-day public review period, if there are no concerns, then the proponent may proceed to implementation.

To implement the preferred treatment and residual management solutions and the preferred location, the next steps include property acquisition, detailed design, and construction.

Since the preferred location for the new facility is on lands that are privately owned, the Region will need to enter discussions with the landowners to acquire the necessary property.

After the Region acquires the property, it is estimated that detailed design will take place between 2023 and 2026. Construction is estimated to take place between 2027 and 2029.

As part of detailed design, the next steps for the project include:

- Stage 2 AA is required to be completed for the proposed site.
- Complete Subsurface Utility Engineering (SUE) and topographic survey
- Meeting with the GRCA to discuss approval requirements for building within a GRCA regulated area.
- Meeting with MECP regarding the SAR habitat requirements
- Completion of the equipment preselection, pre-design, and detailed design
- Since construction is taking place after 2025, an updated bird survey should be conducted of the preferred location.

10.0 APPENDICES