

ERO Number 026-0597

Ministry Reference Number 5404-DTFK5M

Site Address 1441 Beachburg Road, Whitewater Region ON K0J 1C0

Samuel David McCrea operating as McCrea Equipment Rentals

On behalf of the Township of Whitewater Region, we request that the following comments be considered as part of the Ministry of the Environment, Conservation and Parks (MECP) review of the proposal for the issuance of an Environmental Compliance Approval for the aforementioned hauled sewage disposal site:

Official Plan

The County of Renfrew Official Plan provides General Development Policies relating to Hauled Septage Disposal which is summarized as follows:

- (a) Hauled septage means waste removed from a septic tank. Hauled septage disposal sites may be located in the Rural or Agricultural designations on Schedule 'A' in accordance with the policies below.
- (b) All new hauled septage disposal sites shall require an amendment to the implementing Zoning By-law.
- (c) The local municipality, shall establish minimum distance separation requirements in the implementing zoning by-law for the location of new hauled septage disposal sites from existing or proposed residential, commercial, institutional and recreational uses and associated wells as well as public roads and surface waters. Requirements for the location of new residential uses from existing hauled septage disposal sites shall also be established in the implementing zoning by-law.
- (d) Hauled septage disposal sites shall be located so that pollution of any watercourse or ground water does not occur.
- (e) Hauled septage disposal sites shall be adequately screened, fenced and posted and such screening, fencing and posting shall apply to all open storage areas and disposal site operation.
- (f) The operation, maintenance and closing of a hauled septage disposal site shall be in accordance with the standards and regulations of the Ministry of the Environment and Climate Change.

There are also General Development Policies relating to Nutrient Management and the land application of septage as regulated by the Nutrient Management Act and the Environmental Protection Act.

The concerned parcel is primarily situated within the Rural designation with a portion located within the Mineral Aggregate designation.

Zoning By-law

The Township of Whitewater Region Zoning By-law No. 24-01-1655 establishes the following separation distances:

Section 3.32 b) vi)

The minimum setback distance between a sensitive land use and a hauled sewage disposal site shall be 200 metres, unless it is the owner's dwelling, in which case the required separation distance shall be 60 metres.

Section 3.32 c)

No disposal of hauled sewage shall be permitted unless the disposal site has been approved by the Ministry of the Environment, Conservation and Parks, and no disposal site shall be located within:

- i 200 metres of any dwelling on another lot;
- ii 750 metres of any subdivision or land zoned for residential development;
- iii 150 metres of any uncased well;
- iv 75 metres of any well with a casing depth of 6.0 metres or less;
- v 180 metres of any surface water;
- vi 60 metres of the right-of-way of any road;
- vii 60 metres of any land used for livestock pasturing.

We would also like to bring to the attention of the MECP's Client Services and Permissions Branch that in 2022 the Township of Whitewater Region undertook a Water Quality Threats Assessment for Beachburg and Haley Townsite, which identified a Wellhead Protection area for these sites. The hauled sewage site subject to this ECA approval is close to the border of this protection area. The study is included with these comments.

Additionally, staff presented a report to Council at its Regular Meeting held on June 16, 2021, which provides a background of the existing sites in the Township, a summary of the inquiries received and the Provincial, regional and local land-use policies. After receiving the report, Council passed the following motion:

"That Council of the Township of Whitewater Region ask that MOE to not allow septage trucks from outside of the township to dump in our region."

A copy of the report and motion are attached.

We hope that you will consider this information and would be glad to correspond further. Thanks in advance for your time and consideration.

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Final Report Prepared for:

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1. INTRODUCTION

Geocentric Environmental Inc. in association with subconsultant Aqua Insight Inc. were retained by the Township of Whitewater Region to complete the Wellhead Protection Areas (WHPA) Delineation for Beachburg and Haley Townsite, as outlined in the Request for Proposal 2021-29 issued on November 8, 2021. The work was completed under Resolution of Council #2021-4651 dated December 15th, 2021.

In the fall of 2005, Bill 43, the Clean Water Act (the “Act”) was introduced by the Ontario government to protect drinking water at the source, representing the first step in a multi barrier approach to ensure the quality and sustainability of our drinking water supplies.

The legislation aimed to create locally developed, science-based Assessment Reports developed by Source Protection Authorities within local Source Protection Regions. The Assessment Reports include watershed characterization, water budget, groundwater and surface water vulnerability assessment, threats assessment and issues evaluation, and water quality and quantity risk assessment studies. Communities across the Province completed these technical assessments and developed plans that outline the risk management measures that act to reduce or to prevent the threats placed on the quality and quantity of the drinking water supplies.

This report documents the results of a Source Water Protection study completed to delineate the Wellhead Protection Areas (WHPAs) for four drinking water supply wells located in Beachburg and Haley Townsite, characterize the relative vulnerability of the municipality’s supply aquifers, assignment vulnerability scores, and evaluate the potential water quality threats.

1.1 Study Area

Beachburg and Haley Townsite are both in the Whitewater Region township in the Ottawa Valley, Ontario.

Beachburg has a population of approximately 1,000 (Statistics Canada, 2022) and is located approximately 100 km northwest of Ottawa, and 20 km east of Pembroke. Beachburg lies south of the Ottawa River, and northeast of Muskrat Lake. Notable surface water features within the Beachburg area include Jackson Lake, a small lake within the community and a wetland complex located south of Beachburg. Most of the land uses surrounding the community of Beachburg are agricultural (See Figure 1).

Haley Townsite is small community of approximately 92 residents (OCWA, 2021b) that lies approximately 17 kilometres south of Beachburg and 90 km west of Ottawa. Haley Townsite lies approximately 1.5 km northeast of Jeffreys Lake, and approximately 6 km southwest of the Ottawa River. Land use surrounding the Haley Townsite area is dominated by forested or natural lands with some agricultural land uses (See Figure 2).

1.2 Study Objectives and Scope of Work

The main objectives for this project were to delineate the capture zones and WHPAs for the municipal drinking water supply wells, assess the vulnerability of the municipal groundwater

aquifers, and identify drinking water threats that have the potential to impact the water quality of the municipal supply aquifer.

The following steps were undertaken to complete this work:

- Assemble available hydrogeologic data in the study areas and develop a Conceptual Model of the hydrostratigraphic layers and properties, and the areas contributing flow towards the water supply wells.
- Create two three-dimensional numerical groundwater flow models that align with the Conceptual Model and calibrate those models to available water level data.
- Apply the calibrated groundwater flow models to delineate time of travel capture zones and WHPAs for the four municipal wells.
- Evaluate the groundwater vulnerability of the municipal supply wells.
- Identify the potential water quality threats or activities within the WHPAs.

1.3 Data Sources

Various data sources were used to inform the technical work undertaken in this project including:

- Lithological and water levels data was obtained from the Ontario Ministry of the Environment, Conservation and Parks (MECP) water well database (accessed in January 2022).
- Surficial geology and bedrock geology maps (OGS, 2010 and 2011) were used in conjunction with MECP lithology logs to develop the geological conceptual models of the areas surrounding the two communities.
- Municipal well construction information was sourced from the MECP Well Inspection Reports for Beachburg (MECP, 2022a) and Haley Townsite (MECP, 2022b).
- Municipal pumping data for Beachburg and Haley Townsite were provided in Annual Water Reports by Whitewater Region (Ontario Clean Water Agency (OCWA) 2021a, 2021b).
- Monthly measurements of raw water quality data collected in the municipal wells for Beachburg, and Haley Townsite was provided by the Ontario Clean Water Agency.

The previous hydrogeological and wellhead protection area (WHPA) delineation study of the Beachburg and Haley Townsite areas was reviewed (Intera Engineering Ltd. 2003).

2. PHYSICAL SETTING

2.1 Ground Surface Topography and Surface Water Features

Beachburg lies west of Ottawa and south of the Ottawa River. Topography in the area declines slightly from a high of 170 m southwest of the study area to a low of 120 m asl in the east along the Ottawa River (See Figure 1). Key surface water features in the Beachburg area include a wetland complex southwest of the municipal wells, and Jackson Lake adjacent to the municipal wells.

Ground surface topography in the area surrounding Haley Townsite also declines from a high of 200 m asl in the southwest to a low of 140 m asl in the northeast. Southwest of Haley Townsite lies a series of lakes, including Olmstead Lake, Jeffreys Lake and Pumphouse Lake (See Figure 2).

2.2 Municipal Wells

Drinking water for the community of Beachburg is supplied by two municipal wells (Table 1) that are located northeast of Jackson Lake, on the south side of Robertson Drive. One of the municipal wells is a 7.6 m deep Dug Well that has a diameter of 3.6 m and lies within a building on the south side of the water treatment plant. The Dug Well installation date is unknown; however, it is reported that upgrades were made throughout the 1980s and 1990s (McIntosh Hill, 2000). The current Permit to Take Water (PTTW) for the Dug Well lists a maximum pumping rate of 882.7 m³/day (MECP, 2012a), which is well below the average monthly 2020 pumping rate at the Dug well of 176.3 m³/day.

The second Beachburg municipal water supply well is a 30.5 m deep Drilled Well (water well record [WWR] 5510412), also located south of the water treatment plant near the treeline approximately 60 m from Jackson Lake. The Drilled Well was drilled in 1991. The current PTTW for the Drilled Well lists a maximum pumping rate of 973.0 m³/day (MECP, 2012b), which is also well below the average monthly 2020 pumping rate of 224.7 m³/day. The Drilled and Dug wells are pumped alternatively, with an interlock device that ensures only one well can pump at a time (OCWA, 2021a).

Table 1: Municipal Water Supply Wells

Well Name	MECP Water Well Number	Coordinates NAD83, ZONE 18		Screened Interval (m bgs)	Aquifer Unit	2020 Pumping Rate (m ³ /d)
		Easting	Northing			
Beachburg Drilled Well				27.4 –	Gravel	
Beachburg Dug Well	n/a			6.6 –	Gravelly Sand	176.3
Haley Townsite Well 1				–	Bedrock	

Well Name	MECP Water Well Number	Coordinates NAD83, ZONE 18		Screened Interval (m bgs)	Aquifer Unit	2020 Pumping Rate (m ³ /d)
		Easting	Northing			
Haley Townsite Well 2				6.1 –	Bedrock	

Haley Townsite is serviced by two municipal wells that are located less than 10 m from one another on the Heather Place residential road. The municipal wells are referred to as Well 1 and Well 2 are both open hole bedrock wells. Well 1 (WWR 5516401) was completed to a depth of 61 metres below ground surface (m bgs) in 2005, and Well 2 (WWR 7040897) was completed to a depth of 103 m bgs in 2006. The Inspection Report (MECP, 2022a) states that Well 2 may be under the direct influence of surface water with adequate in-situ filtration.

2.3 Geologic Setting

Within the Beachburg area, the geologic units present beneath the study areas were interpreted using a combination of the lithologic descriptions in water well records, and geological maps (OGS, 2010 and 2011). The following sections outline the interpreted overburden and bedrock geologic units in the Beachburg and Haley Townsite areas.

2.3.1 Beachburg

Bedrock beneath the Beachburg area consists of Precambrian bedrock that consists of igneous intrusive and metamorphic rocks such as granodiorite, tonalite, monzogranite and gneiss.

Less than 500 m east of Beachburg, Precambrian bedrock is overlain by a thin unit (less than 15 m based on limited water well record data) of dolostone and limestone. This sedimentary rock is mapped to extend from just east of Beachburg to the Ottawa River.

Overburden thickness in the Beachburg area ranges from 5 m southwest of Beachburg to over 60 m northeast of Beachburg. Many of the overburden sediments in the Beachburg area were laid down approximately ten thousand to twelve thousand years ago at the bottom of a shallow saline to brackish sea (Champlain Sea) that infilled the St. Lawrence Lowland and the Ottawa River Valley. The Beachburg area was inundated by these shallow waters, and the oldest overburden sediment laid down in the Beachburg area was a sandy gravel. This sandy gravel is noted in water well records in the area, including the municipal Drilled Well where the gravel was logged to be 4 m thick. The continuity of the gravel is interpreted to be continuous across the Beachburg area, but the thickness and lateral extent is not well mapped due to the lack of data points (water wells) in the area. Sandy gravel was not observed in well records northeast of Beachburg.

Overlying the discontinuous sandy gravel unit is a glaciomarine silty sand that is exposed at ground surface surrounding the community. North and northeast of Beachburg, glaciomarine silty sands are overlain by a marine silty clay, interpreted to be deposited as water levels in the Champlain Sea increased over time depositing progressively finer-grained sediments. In the

Beachburg area, the youngest sediments in the area are glaciofluvial gravelly sands (See Figure 3) interpreted to have been laid down in a meltwater stream after the Champlain Sea sediments drained.

2.3.2 Haley Townsite

Bedrock in the Haley Townsite area consists of Precambrian carbonate metasedimentary bedrock. Like the Beachburg area, the areas north and east of Haley Townsite, are mapped to have a thin layer of limestone and dolostone present overlying the Precambrian bedrock. A dolomite mine (Timminco Limited) operated two rock quarries that closed in 2008 approximately 4 km north of Haley Townsite.

Bedrock in Haley Townsite is covered by a thin veneer of overburden and many areas have bedrock exposed at ground surface (See Figure 4). Where overburden exists, the dominant material is the same glaciomarine silty sand found in Beachburg.

2.4 Hydrogeologic Setting

Hydrostratigraphic units are defined based on their ability to transmit or inhibit groundwater flow. Based on the conceptual understanding of groundwater flow in Beachburg and Haley Townsite, Table 2 outlines the hydrostratigraphic units present in these areas with near surface sediments at the top of the table.

Table 2: Hydrogeological Unit Descriptions

Hydrogeological Unit	Geologic Unit	Description	Production Aquifer
Surficial Aquitard	Organic Deposits	Bog and swamp deposits of much, peat, and marl.	
Aquifer	Gravelly Sand	Glaciofluvial ice-contact stratified deposits.	Beachburg Dug Well
Aquitard	Silty Clay	Glaciomarine deep-water deposits.	
Aquifer	Silty Sand and Sandy Gravel	Glaciomarine shallow water deposits.	Beachburg Drilled Well
Bedrock Aquifer	Limestone/Dolostone Bedrock	Middle Ordovician aged Ottawa Group, Simcoe Group, Shadow Lake Formation.	
	Precambrian Bedrock	Precambrian granodiorite and undifferentiated carbonate metasedimentary rock.	Haley Townsite Wells

Figures 5 and 6 are regional cross sections illustrating the interpreted thickness of the Beachburg and Haley hydrostratigraphic units. The Beachburg cross-section is approximately six kilometres long and cuts through Beachburg from southwest to northeast. The area is underlain by variable thicknesses of coarse-grained aquifer sediments in the area underlying the town, and finer-grained aquitard sediments northwest and east of the town. The Beachburg Drilled Well screen

extends across the silty sand Lower Aquifer interpreted to be discontinuous beneath Beachburg, and absent east and southwest of the town. In the eastern portions of the study area, a limestone/dolostone aquifer underlies the overburden and overlies Precambrian bedrock (Figure 5).

At the Haley Township wells, a cross-section was created from southwest to northeast (See Figure 6). The area is underlain by a thin overburden layer of finer-grained aquitard and silty sand materials followed by a shallow weathered bedrock aquifer and more competent bedrock at depth. The Haley wells are screened into the Precambrian Bedrock with Well #2 completed at a deeper depth.

2.4.1 Aquifer Properties

2.4.1.1 Beachburg

The Beachburg Dug Well intercepts a Gravelly Sand aquifer unit that is present at surface in the Jackson Lake area. A 3-hour pumping test completed on the Beachburg Dug Well, by Intera in 2002 indicate an average hydraulic conductivity of 4.0×10^{-4} m/s (Intera, 2003). Similarly, interpreted water level responses collected during a two-hour drawdown test completed by Intera (2002) on the Beachburg Drilled Well estimated the sandy gravel production aquifer has a hydraulic conductivity of 5×10^{-3} m/s (Intera 2003; Golder Associates Ltd., 1991).

The upper 10 m of limestone/ dolostone and weathered Precambrian bedrock beneath Beachburg a semi-regional aquifer, and Intera (2003) estimated this unit to have an average hydraulic conductivity of 1×10^{-6} m/s based on interpretation of short-term pumping test data recorded in the MECP water well records.

The average hydraulic conductivity of the lower competent bedrock in the Beachburg area was estimated to be 1×10^{-7} m/s based on review of short-term pumping tests in the MECP water well records, as well as hydraulic bedrock testing at Chalk River, Ontario (Intera, 2003; Raven Beck Environmental Ltd., 1994).

2.4.1.2 Haley Townsite

In the Haley Townsite area, hydraulic testing was completed in shallow (5 to 8 m below surface) monitoring wells screened in the upper weathered bedrock at the Haley Industries Well located 800 m northeast of the town. Results estimated the upper weathered bedrock unit to have a hydraulic conductivity value of 1×10^{-5} m/s (Water and Earth Science Associates Ltd., 1995; 1996).

Beneath the upper weathered bedrock lies a zone of moderately fractured rock that has an estimated hydraulic conductivity value of 2×10^{-6} m/s (Water and Earth Science Associates Ltd., 1995). Pumping test conducted in this intermediate bedrock unit at the nearby Heather Street and Sullivan Street wells estimated hydraulic conductivity values of 2×10^{-5} m/s and 1×10^{-7} m/s, respectively (Morey Houle Engineering Consultants Ltd., 1993). The variability is interpreted to be due to local variations in the Precambrian bedrock and the degree of fracturing.

The hydraulic conductivity of the lower bedrock (40 to 100 m below ground surface) is lower than the overlying bedrock units due to reduced weathered and fracturing relative to the shallow bedrock units. Pumping tests completed in this lower competent bedrock at the nearby Haley

Industries supply wells estimated hydraulic conductivity values to vary from 7×10^{-7} to 5×10^{-7} m/s (Intera, 2003).

3. GROUNDWATER FLOW MODELLING

Two numerical models were developed (version 7.5; DHI WASY, 2021) to simulate groundwater flow in the areas surrounding Beachburg and Haley Townsite using the FEFLOW code. The model domains for each model were selected to extend far enough away from the municipal wells that boundary conditions applied on the perimeter of the model would not influence the predictions at the municipal wells being evaluated.

The following paragraphs summarize the model construction and calibration with a more detailed summary of the modelling found in Appendix A (Beachburg) and B (Haley Townsite).

3.1 Groundwater Flow Model Construction

The Beachburg model extends approximately six kilometres from west to east, and six kilometres from north to south (see Figure 7). The model is subdivided into prisms (elements) that together form the model mesh. Water level elevations are calculated at the interfaces between the triangles called nodes, and hydraulic properties such as hydraulic conductivity or porosity values are assigned to the elements based on available data summarized in Section 2.4.1. The model was designed to have smaller elements in areas where it was important to capture changes in water level elevations, such as the area immediately surrounding municipal wells or surface water features that interact with the groundwater flow system. Elements in the Beachburg model had a length of approximately 8 m and increased to approximately 40 m in other areas of the model (see Figure 7).

Vertically, the groundwater flow model was divided into twenty-five layers. These layers or surfaces were generated to represent a) the top of bedrock, b) top of silty clay aquitard and c) the base of the model, which was defined as a constant thickness (65 m) below the top of bedrock, a value guided by the water well depths in the area.

The model surfaces were inputted into the groundwater flow model. The remaining model layers were subdivided in FEFLOW, and hydraulic conductivity values were assigned based on our understanding of the thickness and continuity of the hydrostratigraphic units (Figure 5; Table 3).

Table 3: Model Layer Structure in the Beachburg Area

Model Layer	Hydrostratigraphic Unit Description
1 - 4	Gravelly Sand; Glaciofluvial Ice-contact Stratified Deposits
1 - 8	Silty Clay; Marine Deeper Water Deposits
1 - 8	Organics; Bog and Swamp Deposits
1 - 14	Silty Sand; Marine Shallow Water Deposits
13 - 14	Sand and Gravel; Glaciofluvial
13 - 18	Limestone Bedrock
15 - 18	Upper Bedrock; Fractured Undifferentiated Precambrian Metasediments and Granites
18 - 25	Lower Bedrock; Undifferentiated Precambrian Metasediments and Granites

The Haley Townsite model is approximately five kilometers from west to east and five kilometers from north to south (see Figure 8). Like Beachburg, the Haley Townsite model was designed to have smaller elements surrounding municipal wells (4 m) or surface water features that interact with the groundwater flow system and larger elements (35 m) in areas where less refinement was needed.

Vertically, the groundwater flow model was divided into twenty-nine layers. A surface was interpreted to represent the top of bedrock and the base of the model, which was defined as a constant thickness (110 m) below the top of bedrock, a value guided by the water well depths in the area.

The model surfaces were inputted into the groundwater flow model, and the remaining model layers were subdivided in FEFLOW, and hydraulic conductivity values were assigned based on our understanding of the thickness and continuity of the hydrostratigraphic units (Figure 6; Table 4).

Table 4: Model Layer Structure in the Haley Townsite Area

Model Layer	Hydrostratigraphic Unit Description
1 - 8	Silty Sand; Marine Shallow Water Deposits
1 - 7	Silty Clay; Marine Deeper Water Deposits
1 - 8	Organics; Bog and Swamp Deposits
1 - 8	Weathered Bedrock
9 - 11	Upper Bedrock; Fractured Carbonate Metasedimentary Rocks
11 - 29	Lower Bedrock; Carbonate Metasedimentary Rocks

Within the groundwater flow model, zones with unique values were assigned within each model layer to represent the hydraulic conductivity and porosity values for the overburden and bedrock units (see Appendices A and B for details). Boundary conditions were assigned in the groundwater flow model to represent areas where groundwater is simulated to enter or leave the model (see Figure 7 and 8). These features include groundwater recharge into the top surface of the model, groundwater wells that simulate the municipal pumping wells, surface water features such as Jackson Lake and Jeffreys Lake that simulate the interaction between groundwater and surface water features.

Groundwater recharge was estimated based on literature values; in Beachburg, 250 mm/year of recharge was applied on the sands, and 25 to 50 mm/year was applied on the silts and clays (see Figure 7). In Haley Townsite, as overburden is thin and the underlying bedrock is mostly lower conductivity Precambrian bedrock, lower recharge rates were conceptualized; 30 mm/year of recharge was assigned to the sands, and 12 mm/year of recharge was assigned in areas where clay is mapped at, or just below the surface (see Figure 8). Recharge applied on the glaciomarine clays is consistent with recharge values applied by Intera (2003) and estimates of recharge on Champlain Sea clays (18 mm/year) in the Perth area (Novakowski et al., 2007).

See Appendices A and B for additional details regarding the construction and inputs applied in the groundwater flow model.

3.2 Groundwater Flow Model Calibration

Once the two groundwater flow models were built, the input parameters and boundary conditions within the models were modified until model simulated water levels in the model were a reasonable match to observed water levels in the area. Observed water levels were obtained from the MECP water well information system database (see Figures 7 and 8 for locations and MECP well numbers). The aim of the model calibration is for the groundwater flow model inputs to align with the conceptual understanding of the hydrogeologic system, and for the model simulated water level elevations values to reasonably match the observed water levels reported in the MECP water well database.

Surface water features such as Jackson Lake and Jeffreys Lake were represented in the model with boundary conditions that simulated the interaction between groundwater and the surface water system. These two lakes were interpreted to be surficial expressions of the water table and groundwater water levels in the model were simulated to be higher than the lake levels, allowing water to flow from the groundwater system into the surface water features.

Appendix A and B contain the calibration statistics for the model, but in general, the calibration for the Beachburg and Haley Townsite was considered reasonable. The Beachburg and Haley Townsite models have normalized root mean square error values of 8.7% and 9.7%, respectively, and groundwater flow models are generally considered calibrated when the NRMS is less than or equal to 10% (Spitz and Moreno, 1996) and there are no clusters of simulated water levels that are much higher or lower than observed. Additional measures of statistical calibration are provided in Appendix A and B.

Overall, the models are considered calibrated and can be used as tools to predict groundwater flow directions and gradients. The error based on the difference between observed and simulated water levels was minimized, and there are no spatial trends in this error that are expected to impact the model predictions. The simulated heads at most monitoring wells are close to observed values.

4. CAPTURE ZONE AND WHPA DELINEATION

The two calibrated FEFLOW models were applied to delineate wellhead protection areas for the municipal wells in Beachburg and Haley Station. The term “wellhead protection area” (WHPA) is a planning term used to describe scientifically based capture zones that are delineated around drinking water supply wells. Capture zones are areas of land surrounding a groundwater pumping well where water located at and below the ground surface may travel toward that well within a defined period.

The Ontario MECP Technical Rules (MECP, 2021) requires that the following WHPAs be delineated for each active municipal drinking water supply well:

- WHPA-A: the surface and subsurface area centred on the well with an outer boundary identified by a radius of 100 m.
- WHPA-B: the surface and subsurface areas within which the time-of-travel to the well is less than or equal to 2 years but excluding WHPA-A.
- WHPA-C: the surface and subsurface areas within which the time-of-travel to the well is greater than 2 years, but less than or equal to 5 years.
- WHPA-D: the surface and subsurface areas within which the time-of-travel to the well is greater than 5 years, but less than or equal to 25 years.
- WHPA-E: for any groundwater wells that are classified as Groundwater Under Direct Influence of surface water (GUDI), WHPA-E is delineated as the area of land that drains into the surface water body measured from the high-water mark and the area must not exceed 120 metres.

WHPA-A to -D zones and capture zones are projections to ground surface and do not indicate that a contaminant released or spilled on the ground surface will travel to the municipal supply well within the specified period (e.g., two years). The time for a drop of water released at surface to reach a municipal well screened at depth, or beneath a confining layer, may be much longer than the capture zone time-of-travel suggests, because the vertical time-of-travel from surface to the top of the aquifer is not incorporated into the time-of-travel capture zones. Despite the level of conservatism, the time-of-travel methodology is appropriate as improperly abandoned boreholes or surface excavations have the potential to allow surficial contaminants to quickly migrate from surface to the municipal water supply aquifer.

4.1 Methodology

4.1.1 WHPA-A to -D

Fictitious particles of water were assigned in the groundwater flow models around each of the municipal well screens (and open hole bedrock wells) and tracked backward in time towards their source area until reaching a boundary condition, such as a stream or the water table. The pathline that the fictitious particles of water take through the subsurface is mapped by their travel times

and then classified according to the Ministry's Technical Rules (2021). To delineate the WHPA-B, for example, a polygon envelope is drawn around all the 2-year particle pathlines (excluding the WHPA-A zone). Similarly, the WHPA-C and -D zones are delineated around the 5-year and 25-year zones.

To be protective of the current and future water supply needs, future pumping rates were applied to the municipal wells in the steady-state calibrated flow models. The Whitewater Region is expected to experience a 19% growth between 2020 and 2039 (WSP, 2020). To support this growth in population, the municipal demand in the Region may also grow at the same rate. In the absence of detailed information that partitions the growth to the various growth centres, the future groundwater pumping rate in Beachburg and Haley Station were assumed to each increase by 19% between 2020 and 2039. Table 5 outlines the future pumping rates used as WHPA delineation rates for each of the municipal wells.

Table 5: Municipal Water Supply Wells

Well Name	MECP Water Well Number	2020 Pumping Rate (m ³ /d)	WHPA Pumping Rate (m ³ /d)
Beachburg Drilled Well	5510412	224.7	267.4
Beachburg Dug Well	n/a		
Haley Townsite Well 1	5516401	11.6	12.6
Haley Townsite Well 2	7040897	10.2	12.1

The particles described above were released in rings around the top, middle and bottom of the well screen for the Beachburg Drilled Well, and the open hole portion of the bedrock wells in Haley Townsite. Particles were tracked backwards from the base of the Dug Well as water was conceptualized to primarily flow into the Dug Well along the base of the well, and this configuration would produce a more conservative capture zone. Twenty-five particles were released at 25 m radiuses around each municipal well and tracked backwards in time. WHPA- B, -C and -D zones were derived by drawing envelopes around the 2-, 5- and 25-year particle pathline results in the base case and uncertainty case models (See Section 4.1.1.1 for details) and projecting this envelope to ground surface (See Figures 9 and 10).

4.1.1.1 Uncertainty Assessment

An uncertainty assessment was completed for both the Beachburg and Haley Townsite models to evaluate how uncertainty in the values applied in the model impact the WHPA size and shape. The uncertainty assessment was completed by creating ten additional model scenarios with varying groundwater recharge rates hydraulic conductivity, and porosity values of key hydrogeologic units that are within the range of expected values. Specifically, two scenarios evaluated increased and decreased groundwater recharge rates (10% of calibrated rates) and two scenarios evaluated increased and decreased porosity values (10% of the values in the calibrated model). Six scenarios evaluated subtle changes in the hydraulic conductivity values of the gravelly sand, silty sand and sand and gravel units in the Beachburg model, and units representing the weathered and competent bedrock and overburden in the Haley Station model.

The level of calibration in each of the uncertainty case models was checked to ensure the modelled solution was reasonable and as well calibrated as the base case model. As each of the uncertainty cases is considered plausible the particle pathline results of all the uncertainty

scenarios were overlain and envelopes were drawn around the outer limits of the time of travel pathlines. The WHPAs illustrated on Figures 9 and 10 are the result of this assessment.

4.1.1.2 WHPA-E

The delineation of WHPA-A to -D zones are conducted using calibrated groundwater flow and are based on travel time through the subsurface from a source area to a well. In contrast, for municipal wells that are GUDI, the WHPA-E zone is defined as:

- 1) The area within each surface water body that may contribute water to the intake where the time of travel to the intake, subject to rule 66, is equal to or less than the time that is sufficient to allow the operator of the system to respond to a spill or other event that may impair the quality of the water at the intake and where the area abuts land, a setback that is the greater of,
 - a the area of land that drains into the surface water body measured from the high-water mark and the area must not exceed 120 metres, and
 - b) if a Conservation Authority Regulation Limit is in effect in the IPZ-2, only the area of land located within the Conservation Authority Regulation Limit that drains into a surface water body that is located in the IPZ-2. (MECP, 2021)

In the Beachburg, the Drilled Well, the Dug Well and the Well 2 in Haley Townsite are classified as GUDI wells (MECP, 2022a and 2022b), and as such the WHPA-E for these wells was delineated.

In the Beachburg, Jackson Lake lies 80 m from the Dug Well and 60 m from the Drilled Well, and this is the surface water feature that is interpreted to be hydraulically connected to the municipal aquifer. As Beachburg lies outside a conservation authority jurisdiction, the WHPA-E is defined as the 120 m setback limit from Jackson Lake (see Figure 9). There does not appear to be a channel or stream flowing to Jackson Lake that would necessitate increasing the size of the WHPA-E to include potential upstream inputs.

The Haley Townsite wells lie on a local topographic high where ground surface falls in a radial direction away from the wells. The closest surface water feature to the municipal wells is an unnamed creek that lies 160 m south of the municipal wells (see Figure 10). This creek extends through a forested area south of the municipal wells and runs parallel to Mine View Road with two headwaters tributaries extending from the east. In addition, there is a wetland located 250 m east of the Haley Townsite municipal wells. As the wells lie on a topographic high, it is not clear which of the surface water features is interpreted to be hydraulically connected to the groundwater aquifer at the municipal well, so the WHPA-E for Well 2 was conservatively defined as the 120 m setback limit from the surface water features and their upstream catchment areas (see Figure 10).

4.2 Results and Comparison to Previous WHPAs

The Beachburg WHPAs delineated in this study extend outward from the wells, beneath Jackson Lake to the wetland area that lies approximately 800 south of the well on a topographic high (see Figure 9). These results are comparable to the previous WHPA delineations by Intera (2003). The WHPA-B zone in the current study extends further south than the two-year capture zone delineated by Intera (2003), and the difference are attributed to variations in hydraulic conductivity and porosity values applied to the production aquifer in the updated calibrated model.

The Haley Townsite WHPAs delineated in this study extend in a radial direction outward from the wells as the wells lie on a local topographic high and a groundwater flow divide (see Figure 10). There is a topographic high at the Haley Townsite wells (see Figure 1) that coincides with a groundwater high in this area as well, and groundwater is interpreted to flow westward toward Jeffreys Lake and eastward toward the Ottawa River. The Haley Station WHPAs delineated in this study are like the previous WHPAs (Intera, 2003) but are interpreted to be slightly smaller in the southwesterly direction due to the lower municipal pumping rate applied in this project (25 m³/d) as compared to the previous study (80 m³/d; Intera, 2003).

5. GROUNDWATER VULNERABILITY ASSESSMENT

5.1 WHPA-A to -D

The vulnerability of a municipal aquifer to surficial sources of contamination can be defined as the likelihood that a surficial source of contamination will reach an underlying aquifer of interest. Aquifers that are unconfined or have little protective cover are more vulnerable to surficial sources of contamination than aquifers that are overlain by thick, fine-grained confining units as fine-grained soils can attenuate or retard the downward migration of contaminants from the surface to underlying aquifers.

One method of evaluating the vulnerability of an aquifer is the Intrinsic Susceptibility Index (ISI) method. The premise of this method is that the vulnerability of an aquifer decreases with increasing distance and time of travel to the aquifer. The ISI value reflects the degree of protection overlying a municipal aquifer of interest is based on the thickness and properties of the soil materials overlying the aquifer. Using the ISI method, a higher ISI value denotes greater protection and lesser vulnerability.

5.1.1 Methodology

ISI values are calculated at discrete well locations on wells that are screened above or within an aquifer of interest. The ISI ranking value is calculated using the following formula.

$$ISI = \sum b \times K_f$$

where b is the thickness of a given geological unit overlying an aquifer, and K_f is a dimensionless number called the K-factor. The K-factor identifies the degree of protection offered by the geologic materials overlying an aquifer of interest. ISI values are calculated at each well that intersects a particular aquifer, and are interpolated and classified according to the relative categories defined by the MECP (2021):

- low intrinsic susceptibility values (more protection, lower vulnerability) correspond to ISI values that are greater than 80
- moderate intrinsic susceptibility values correspond to ISI values that are between 30 and 80, inclusive
- high intrinsic susceptibility values (less protection, higher vulnerability) correspond to ISI values that are less than 30

The product is a map of the intrinsic susceptibility rating (high, moderate, and low) for each aquifer of interest.

5.1.1.1 Municipal Production Aquifers

Groundwater vulnerability is calculated from ground surface to the top of the municipal aquifer. The depth to the top of municipal production aquifer for each well is summarized in Table 6.

Table 6: Municipal Production Aquifer

Well Name	Production Aquifer	Depth to Top of Aquifer (m)
Beachburg Drilled Well	Unconfined Sandy Gravel Aquifer	
Beachburg Dug Well	Unconfined Sand Aquifer	
Haley Townsite Well 1	Unconfined/ Semi-confined Precambrian Bedrock Aquifer	3.4
Haley Townsite Well 2	Unconfined/ Semi-confined Precambrian Bedrock Aquifer	2.7

5.1.1.2 K-Factors

The vertical hydraulic conductivity values of the materials overlying the production aquifer are translated into a K-factor using the values in Table 7, and were obtained from the K-factor table provided in the Groundwater Vulnerability guidance module (MOE, 2001), which is listed in Appendix C.

Table 7: K-factors Applied in the Vulnerability Assessment

Unit	Lithology	K-Factor
Overburden	Organic Deposits	3
	Gravel	1
	Sands	2
	Silty Sand	3
	Silty Clay	4
Bedrock	Fractured Precambrian Bedrock	

5.1.1.3 ISI Calculations

The intrinsic susceptibility values were calculated from ground surface to the top of each municipal aquifer regardless of the water table elevation or the saturated aquifer thickness. Within the Beachburg area, the sand and gravel and silty sand aquifers are present at surface throughout the WHPA area, so the ISI calculations would be less than 30 at any borehole present in the WHPA.

Depth to bedrock at the Haley Townsite wells is also small (Table 6), which also leads to an ISI value that is less than 30 and a high vulnerability rating. For example, at Well 1, there is 0.6 m of brown clay overlying 2.8 m of grey sand that overlies the bedrock aquifer. Using the equation and K factors in Table 7, this equates to an ISI value of 16 at Well 1. The municipal wells are the only data points available to estimate the ISI values within the WHPAs, so the project team conservatively assumed the depth to bedrock lies close to surface across the Haley Townsite WHPA area. During the field visit to the Haley Townsite area, bedrock outcrops were seen along Magnesium Road supporting this assumption.

5.1.2 Vulnerability in WHPA-A to -D Results

The intrinsic susceptibility ratings (i.e., high, moderate, low) to the top of the two municipal production aquifers of interest were mapped and are illustrated on Figures 11 and 12. As

expected, the groundwater vulnerability for the Dug and Drilled Wells in Beachburg are defined as high as these wells are screened in an unconfined sand and gravel aquifer and as such, are susceptible to surficial sources of contamination.

The groundwater vulnerability for the upper and lower bedrock aquifers in Haley Townsite that are intercepted by Well 1 (61 m below surface) and Well 2 (103 m below surface) is also high because the top of bedrock is defined as the top of the production aquifer. In fractured rock settings such as this one, contaminants can quickly move from ground surface to deeper bedrock aquifers along interconnected fractures. Well 2 in Haley Station is designated as GUDI with adequate in-situ filtration (MECP, 2022b), which supports the interpretation of a high vulnerability rating at the well.

Both municipal wells in Beachburg are designated as GUDI wells (with effective in situ filtration; MECP, 2022a), and both wells draw from a shallow unconfined aquifer; however, the MECP 2020 inspection report notes that additional monitoring should be completed to confirm the GUDI status. In the interim, disinfection with chemically assisted filtration is the current minimum treatment requirement (MECP, 2020). Well 2 in Haley Station is also designated as GUDI, and previous investigations found there is adequate in-situ filtration at this location as well (MECP, 2022b).

5.2 Groundwater Vulnerability Scoring

5.2.1 WHPA-A to -D

Following the groundwater vulnerability rating assessment within the WHPAs, groundwater vulnerability scores were assigned based on the Technical Rules (MECP, 2021). The scoring method is outlined in Table 8 and the vulnerability scores are illustrated on Figures 13 and 14.

Table 8: Wellhead Protection Area Vulnerability Scores

Groundwater Vulnerability Rating	WHPA-A	WHPA-B	WHPA-C	WHPA-D
High	10	10	8	6
Moderate	10	8	6	4
Low	10	6	4	2

The Technical Rules (2021) also note that an uncertainty rating of either “high” or “low” must be assigned to the vulnerability rating in each WHPA. The uncertainty rating applied should consider the uncertainty associated with quantity and quality of data used to assess the vulnerability, with delineating the time-of-travel capture zones, and with the assessment of the vulnerability of the WHPAs. Given the poor coverage of water well data in the area surrounding the wells, and the lack of recent water level data with which to calibrate the groundwater flow model, the uncertainty is considered high.

5.2.2 WHPA-E

The relative vulnerability scores also need to be assigned to the WHPA-E in accordance with the Technical Rules (MECP, 2021). The vulnerability within the WHPA-E is assigned according to the following equation:

$$VS = B \times C$$

Where B is an area vulnerability factor and C is a source vulnerability factor.

5.2.2.1 Area Vulnerability Factor

The Technical Rules (MECP, 2021) note that the area vulnerability factor varies between 7 and 9 based on the vulnerability of the area; higher factors correspond to higher vulnerability. Rule 92 of the Technical Rules note the area vulnerability factor considers:

1. Percentage of the area is composed of land.
2. Land cover, soil type, permeability of the land and slope of any setbacks.
3. Hydrological and hydrogeological conditions of the area where the transport pathway is located.

The WHPA-E for Beachburg and Haley Townsite were assigned an area vulnerability factor of 8 as the GUDI wells are in an area mapped as having unconfined sands at surface, but overland runoff to the lake will be minimal given the coarse-grained nature of the sands in the area.

5.2.2.2 Source Vulnerability Factor

Source Vulnerability factors are assigned between 0.8 to 1.0 depending on the depth of the wells below surface, the confining unit overlying the aquifers, and the distance between the surface water features and the well. Using these metrics, a value of 0.9 was assigned as the source vulnerability factor for the Beachburg and Haley Townsite wells.

5.2.2.3 Vulnerability Results

Given the area vulnerability rating and the source vulnerability factor, the resulting vulnerability score for the WHPA-E for Beachburg and Haley Townsite were given a vulnerability score of 7.2.

6. WATER QUALITY THREATS ASSESSMENT

Groundwater aquifers may become contaminated from a wide range of activities that include improper waste disposal, leaky underground storage tanks, industrial sites, road salt or other contaminant sources that are improperly managed. WHPAs are delineated to identify the land area where surficial sources of contamination may be introduced into the municipal drinking water well. Water quality threats are then identified, and mitigation measures are put in place within those WHPAs to reduce the risk associated with the water quality threats.

Using the results of the WHPA delineation and vulnerability assessment outlined in Section 5, potential water quality threats were identified as per the MECP's Technical Rules (2021). Threats can be subdivided into point source threats such as underground fuel storage tanks associated with a gas station or non-point source threats that may include fertilizer application on a golf course. The following sections outline the water quality threats identified in the Beachburg and Haley Townsite WHPAs.

6.1 Methodology

A windshield survey of the area within the WHPAs on April 4th, 2022, to identify point or non-point source threats. Staff from Whitewater Region accompanied the Project Team on the windshield survey to provide insight into historical and current land uses in the area. A desktop assessment was also conducted using aerial photos and land use maps to identify activities that may impact the water quality at the municipal wells.

6.1.1 Managed Lands Evaluation

An evaluation of Agricultural and Non-agricultural "Managed Lands" (lands that receive nutrients) was completed. Professional judgement was used to assess whether land areas may receive nutrients and therefore be considered Managed Lands. This judgement was guided by the following principles:

- Agricultural Managed Lands were identified where there were cropland, fallow, and similar lands and where there was the potential that these lands may receive agricultural source material (ASM) or fertilizer.
- Non-agricultural Managed Lands were identified where there were golf courses residential lawns, or turf and where there was the potential that these lands may receive non-agricultural source material (NASM) or fertilizer.
- Lands that were interpreted to be maintained were identified to potentially receive nutrients and conservatively included as Managed Lands.

Agricultural and non-agricultural Managed Lands were mapped using land use mapping, aerial imagery, and information collected during the windshield survey. The percentage of Managed Lands was calculating by intersecting the Managed Lands polygons with the WHPA. This was completed in areas where the vulnerability score is 6 or higher for WHPAs, and 4.4 or higher for the WHPA-E zones, as these are areas defined at the MECP (2021) as being a potential threat to drinking water.

To identify the potential that nutrient application will impact the water quality within the municipal aquifer, the mapping was classified as follows:

- Low – total managed lands are less than 40% of the vulnerable area
- Moderate – greater than 40% but less than 80% of vulnerable area
- High – greater than 80% of the vulnerable area

6.1.2 Livestock Density Evaluation

Livestock density is mapped to quantify the potential for water quality impacts due to the storage, generation, and application of ASM within a defined area and to assess the potential threats related to these activities using the Source Water Protection Tables of Threats and Circumstances (MOE 2009; MOECC and UTRCA 2017). Livestock density was assessed within the WHPA areas using the project GIS, aerial photography, and the windshield survey to identify barns that had the potential to house livestock.

To evaluate the water quality threat associated with over-application of agricultural source material, the thresholds defined in the Technical Rules (MECP, 2021) are as follows:

- Low potential for nutrient application to exceed crop requirements - livestock density in the vulnerable area is less than 0.5 Nutrient Unit (NU)/ acre
- Moderate potential for nutrient application to exceed crop requirements – livestock density in the vulnerable area is greater than 1.0 NU/acre less than 0.5 NUs/acre
- High potential for nutrient application to exceed crop requirements - livestock density in the vulnerable area is greater than 1.0 NUs/acre

6.1.3 Impervious Surfaces

The percentage of impervious surface area (i.e., roads, parking lots, etc.) was completed to assess the potential threats related to winter road salt application. The percentage of impervious area within the WHPA-A, -B and -C zones was estimated using the project GIS by multiplying the total road length within the WHPAs by an estimated road width (12 m in Beachburg and 9 m in Haley Townsite as the residential roads are narrower). As outlined in the Technical Rules (MECP, 2021), the potential for water quality impacts due to road salting on the following impervious areas are classified as follows:

- Less than 1%
- 1 to 8%
- 8% to 30%
- Greater than 30%

For WHPA-E zones, the thresholds are as follows:

- Less than 1%
- 1% to 8%
- Greater than 8%

6.1.4 Activity Based Threats Assessment

The Province of Ontario (MECP, 2021) identified twenty drinking water threats that under certain circumstances could impair the quality of drinking water sources. The activities deemed to be drinking water quality threats are related to the following:

- Waste disposal sites – their establishment, operation, or maintenance
- Sewage systems – their establishment, operation, or maintenance (including Septic Systems)
- Agricultural source material – application to land
- Agricultural source material – storage
- Agricultural source material – management
- Non-agricultural source material – application
- Non-agricultural source material – handling and storage
- Commercial fertilizer – application
- Commercial fertilizer – handling and storage
- Pesticide – application
- Pesticide – handling and storage
- Road salt – application
- Road salt – handling and storage
- Snow – storage
- Fuel – handling and storage
- Dense non-aqueous phase liquid – handling and storage
- Organic solvent – handling and storage
- Chemicals used to de-ice aircraft – management of runoff
- Land associated with livestock – use of for grazing, pasturing, confinement, or as a yard
- Establishment and operation of a liquid hydrocarbon pipeline

The Project Team made assumptions regarding the presence of potential threats for some land use types within parcels supplied by Whitewater Region. Where there was uncertainty about the presence of a threat, the Project Team assumed the potential threat was present. As the WHPAs lie within rural communities, the threat activities are primarily associated with rural residential and vacant land use practices (e.g., presence of septic systems). The Project Team did not consider incidental water quality threats located on residential properties such as the application and storage of fertilizers and pesticides, the handling and storage of fuel or gasoline for domestic use. In addition, the project team made the following assumptions:

- all rural residential properties that have a single family detached home have a septic system,
- farm properties without any buildings or structures were assumed to be subject to the application of agricultural source material, commercial fertilizer, and pesticides.
- farm properties with residence or secondary structures were assumed to have a septic system, storage of commercial fertilizer, storage, and handling of fuel, and be subject to the application of agricultural source material, and application and storage of pesticides.

6.2 Results

6.2.1 Beachburg

6.2.1.1 Managed Lands Evaluation

As illustrated on Figure 15, there are no agricultural land uses within the Beachburg WHPAs (including the WHPA-E area), so the total managed lands are less than 40% of the vulnerable area, which is classified as a low threat. There is potential for fertilizers to be applied in the residential lots; however, the full extent of the residential lots within the WHPA-D and WHPA-E are less than 25% and 29%, respectively, so the potential for threats due to managed land is still considered low (less than 40%). There are no moderate or significant drinking water threats associated with Managed Lands in the Beachburg area.

6.2.1.2 Livestock Density Evaluation

No barns or livestock were present, and no agricultural land uses were identified in any of the Beachburg WHPAs. Therefore, there is a Low potential for nutrient application to exceed crop requirements, and there are no Moderate or Significant drinking water threats associated with Livestock Density in the Beachburg area.

6.2.1.3 Impervious Cover Evaluation

The percentage of impervious surface areas was calculated within the cumulative aerial extent of the WHPA-A, -B and -C zones for Beachburg, where most of the roads were present. A total area of 1,084 m of road network was mapped in the WHPA-A and -B zones, which equates to 13,008 m² of impervious road network. The total area of the WHPA-A and -B is approximately 198,610 m², which yields an impervious value of 6.5%. Consequently, the percentage impervious cover is classified in the 1 to 8% category. When the individual vulnerability scores in the WHPAs (Figure 13) are combined with the impervious cover percentage within the WHPAs, the Application of Road Salt is classified as a *Low Drinking Water Threat* in the WHPA-A and -B zones.

There are 1,157 m of linear road (impervious cover) where road salt could be applied in the WHPA-A to WHPA-C zones (13,884 m² of impervious area) which translates to an impervious value of 4.5%, which classifies the Application of Road Salt within the WHPA-C (with a vulnerability score of 8) as a *Low Drinking Water Threat*.

The WHPA-E has an area of 234,920 m² and within this area, the road network has a total length of 2,107 m² (and assumed width of 12 m), which yields an impervious value of 10.3%. When the vulnerability score in the WHPA-E (7.2) is combined with the impervious cover percentage of 10.3%, the Application of Road Salt in the WHPA-A is classified in the MECP Technical Rules circumstances tables as a *Moderate Drinking Water Threat*.

6.2.1.4 Activity Based Threats Assessment

Land use in the Beachburg WHPAs consists primarily of residential and vacant land uses, and the parcel of land where the treatment plant is located is classified as industrial land use. Through the windshield survey and in discussion with Township of Whitewater staff, the main potential

water quality threats identified in the WHPAs were the operation and maintenance of septic systems. Septic systems are assumed to be used at all rural residential lots in the Beachburg area. Septic systems that are not properly maintained can contribute to pathogen and chemical contamination in groundwater aquifers. Septic effluent disposal systems may contribute nitrate and bacteria such as *E. coli* to the groundwater system, and septic systems that are new or well maintained are less likely to contaminate as compared to those that are older.

Under the Technical Rules (MECP, 2021), septic systems fall under the establishment, operation or maintenance of a system that collects, stores, transmits or disposes of sewage. Septic systems are identified as Significant Water Quality Threats where they lie within WHPA zones that have a vulnerability score of 10 (Figure 13). As such, the fifteen septic systems located in the WHPA-A and eighteen septic system located in the WHPA-B are classified as *Significant Water Quality Threats*. Septic systems located in the WHPA-C and D are classified as *Moderate Water Quality Threats*. As the exact location of the septic systems within the individual parcels was not known, any parcel lying within the WHPA was assumed to have a septic system that may impact the water quality at the drinking water well.

Elevated levels of *E. coli* and total coliforms are present in the raw water quality samples collected from both Beachburg wells and are interpreted to be derived from septic systems located within the WHPA-A and -B.

During the Site Visit there did not appear to be any storage or handling of fuel, pesticides, dense non-aqueous phase liquids or storage, handling, or application of commercial fertilizers; however, these potential water quality threats would be flagged as Significant Drinking Water Threats if any are found to be present.

6.2.2 Haley Townsite

6.2.2.1 Managed Lands Evaluation

Table 9 summarizes the total WHPA area, Managed Land area, and percentage Managed Lands for the Haley Townsite WHPA zones with vulnerability scores greater than 6 (i.e., WHPA-A, -B, -C and -E). The WHPA area and total managed land area are cumulative areas, so the WHPA-B area includes the area for WHPA-A and WHPA-B and the WHPA-C area is the total area for WHPA-A, -B and -C (as per MECP and UTRCA, 2017).

Table 9: Wellhead Protection Area Vulnerability Scores

WHPA	WHPA Area (m ²)	Agricultural Managed Land Area (m ²)	Non- Agricultural Managed Land Area (m ²)	Total Managed Land Area (m ²)	% of WHPA with Managed Lands
WHPA-A	32,420	0	0	0	0
WHPA-B	152,018	2,623	0	2,623	2%
WHPA-C	194,191	12,393	0	12,393	6%
WHPA-E	519,177	10,403	0	10,403	2%

The percentage of Managed Lands to total land area within the WHPAs are less than 40%, so the area is considered to have a Low potential for nutrient application to be causing contamination

of drinking water sources. There are no Moderate or Significant drinking water threats associated with Managed Lands in the Beachburg area.

6.2.2.2 Livestock Density Evaluation

One potential livestock barn was noted during the windshield survey outside the WHPAs but is associated with an area of land use zoned as “agricultural” on the northwestern side of the intersection between Magnesium Road and Mine View Road (see Figure 16). The type of animals hosted inside were not known, and Whitewater staff believe the farm is no longer operational. To be conservative, the barn was interpreted to contain swine, as they produce the most nutrient units per unit area of all livestock. The nutrient units generated by the animals were estimated using the size of the barn (179 m²), estimated in GIS using an aerial photograph, and the square metres per nutrient units (NU) generated by swine (7 m²/NU; Table 1 of MECP and UTRCA, 2017). The agricultural managed land for the parcel (when removing areas covered by forest or ponds) was estimated to be approximately 151,400 m², which yields a NU/acre value of 0.69. This is greater than 0.5 but less than 1.0, so this agricultural land area is considered to have a Moderate potential for nutrient application exceeding crop requirements.

In the MECP’s table of circumstances, the Managed Lands percentage for the area is less than 40%, and the Livestock Density is Moderate (Circumstance 3.1.2), so the Application of Agricultural Source Material is classified as a Moderate Drinking Water Threat in the WHPA-B where the vulnerability score is 8, and a Low Drinking Water Threat in the WHPA-C where the vulnerability score is 6.

6.2.2.3 Impervious Cover Evaluation

The percentage of impervious surface areas was calculated within the cumulative aerial extent of the WHPA-A, to -D zones and the WHPA-E for Haley Townsite. Table 10 illustrates the impervious area (i.e., area where road salt may be applied), the cumulative WHPA area, and the resulting Impervious cover percentage for the WHPAs in Haley Townsite.

Table 10: Impervious Cover Percentages in the Haley Townsite WHPAs

Vulnerable Area	Cumulative Road Length (m)	Road Area (m ²)	WHPA Area (m ²)	Cumulative WHPA Area (m ²)	Percent Imperviousness
WHPA-A	294	2,650	36,240	36,240	7.3%
WHPA-B	974	8,766	119,598	155,838	24.2%
WHPA-C	1,144	10,298	42,173	198,011	5.2%
WHPA-D	2,004	18,035	208,747	406,758	4.4%
WHPA-E	1,332	11,992	519,177	519,177	2.3%

The percentage impervious cover for the WHPA-A, -C and -D zones is classified as having a Low potential for water quality impact, as the imperviousness value is less than 8%. The percentage impervious cover for the WHPA-B has a Moderate potential for water quality impact but when the WHPA vulnerability scores (10) are combined with the impervious cover percentage, the Application of Road Salt is classified as a *Moderate Drinking Water Threat* in the WHPA-A and -B, and a *Low Drinking Water Threat* in the WHPA-C and -D. Sodium concentrations at the Haley Townsite wells are elevated above the Ontario Drinking Water Standards (ODWS; 45 mg/l

compared to ODWS of 20 mg/l; MECP, 2022b) and are interpreted to be derived from local winter road salting activities.

When the vulnerability scores in the WHPA-E (7.2) is combined with the impervious cover percentage of 2.3%, the Application of Road Salt in the WHPA-A is classified in the circumstances tables in the Technical Rules (MECP, 2021) as a *Low Drinking Water Threat*.

6.2.2.4 Activity Based Threats Assessment

Land use in the Haley Townsite WHPAs consists primarily of residential and natural (vacant) land uses, a small area of agricultural land use and the parcel of land where the treatment plant is located is classified as industrial land use. Through the windshield survey and in discussion with Township of Whitewater staff, the main potential water quality threats identified in the WHPAs were the operation and maintenance of septic systems. Septic systems are assumed to be used at all rural residential lots in the Haley Townsite area. As noted in Beachburg, septic systems that are not properly maintained can lead to elevated nitrate and bacteria in the groundwater flow system.

Under the Technical Rules (MECP, 2021), septic systems fall under the establishment, operation or maintenance of a system that collects, stores, transmits or disposes of sewage. Septic systems are identified as *Significant Water Quality Threats* where they lie within WHPA zones that have a vulnerability score of 10 (see Figure 14). As such, the nine septic systems located in the WHPA-A and sixteen septic system located in the WHPA-B are classified as *Significant Water Quality Threats*. As the exact location of the septic systems within the individual parcels was not known, any parcel lying within the WHPA was assumed to have a septic system that may impact the water quality at the drinking water well.

Elevated levels of *E. coli* and total coliforms are present in the raw water quality samples collected from both Haley Townsite water supply wells and are interpreted to be derived from septic systems located within the WHPA-A and -B.

During the Site Visit there did not appear to be any storage or handling of fuel, pesticides, dense non-aqueous phase liquids or storage, handling, or application of commercial fertilizers; however, these potential water quality threats would be flagged as Significant Drinking Water Threats if any are found to be present.

6.2.2.5 Summary

The intent of the threats assessment is to rank or prioritize drinking water threats located within WHPAs according to their potential to negatively impact the water quality of the municipal drinking water sources. The overlying sections classified and identified potential threats into Low, Moderate and Significant based on the Tables of Circumstances in the Technical Rules (MECP, 2021).

A total of 33 and 25 Significant Drinking Water Threats (i.e., septic systems) were identified in Beachburg and Haley Townsite, respectively, and their locations are located on Figures 15 and 16. These septic systems should be prioritized as the water quality threats of greatest concern.

Moderate drinking water threats were also identified, and these included the application of road salt, and the potential agricultural land use in the Haley Townsite WHPAs. While these water quality threats are not currently a concern, changes in onsite practices or changes in land use in the WHPA areas may escalate these land uses from Moderate to Significant.

The Project Team recommends additional information be gathered from property owners where possible to evaluate the threats, including the agricultural land use in Haley Station. This information will help guide the selection of appropriate risk management plans or best management practices to help safeguard the water supplies.

For this assessment, the project team used the Technical Rules and circumstances tables to identify the vulnerable areas and identify and map potential water quality threats in Beachburg and Haley Station. There is an elevated level of uncertainty associated with the threats assessment as there is a general lack of well and water level data in the vicinity of the drinking water supply wells with which to confidently characterize the local groundwater flow directions and gradients close the wells. However, land uses in the area surrounding the wells are primarily residential and vacant lands, so the most significant water quality threats are likely captured in this assessment. As Whitewater Region collects additional hydrogeologic information over time, the uncertainty related to the WHPAs, and associated threats will decline.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Summary and Conclusions

This report documents the results of a Source Water Protection study completed to delineate the Wellhead Protection Areas (WHPAs) for four drinking water supply wells located in Beachburg and Haley Townsite, characterize the relative vulnerability of the municipality's supply aquifers, assignment vulnerability scores, and evaluate the potential water quality threats.

The methods used to create two groundwater flow models used to delineate WHPAs for the towns of Beachburg and Haley Townsite were presented based on a detailed understanding of the local hydrogeological framework. These WHPAs were based on capture zones delineated using backward particle tracking methods in two groundwater flow models.

The impact of uncertainty in the hydraulic conductivity values, groundwater recharge, municipal pumping rates, non-municipal pumping rates and effective porosity were assessed; the resultant WHPAs encompassed all particle traces for each time-of-travel zone.

The groundwater vulnerability was evaluated within the newly delineated WHPAs to determine vulnerability scores for each WHPA area. A water quality threats assessment was completed to identify Significant Drinking Water Threats and included an assessment of Managed Lands, Livestock Density, Impervious cover, and point source threat activities.

A total of 33 and 25 Significant Drinking Water Threats (i.e., septic systems) were identified in Beachburg and Haley Townsite, respectively. These septic systems should be prioritized as the water quality threats of greatest concern. A hydrogeological assessment could be completed to further prioritize the septic systems that may be having the greatest impact on the water quality at the drinking water wells.

Moderate drinking water threats were also identified, and these included the application of road salt, and the potential agricultural land use in the Haley Townsite WHPAs. While these water quality threats are not currently a concern, changes in onsite practices or changes in land use in the WHPA areas may escalate these land uses from Moderate to Significant.

7.2 Recommendations

Bacteria (*E. coli*) and total coliforms are collected on a regular basis within the communities, and Whitewater Region collects general chemistry and other parameters on a regular basis in the treated water. It is recommended that Whitewater Region assemble the historic and current data to evaluate if there are any increasing trends in the water quality data, such as nitrate, sodium, and chloride that Whitewater Region may wish to address via risk management measures or best management practices before they become water quality issues.

Refinements to the understanding of groundwater recharge rates, aquifer, or aquitard continuity; and hydraulic conductivity or porosity may result in modifications to the predicted WHPAs. Whitewater Region can update the WHPAs as they collect additional data refine the understanding of the subsurface geology and hydrogeology, or change the operation of the wells or pumping rates in the future.

8. CLOSURE

Please contact the undersigned with any questions or comments.

Aqua Insight Inc.



Patricia Meyer, P. Geo.
Senior Hydrogeologist

Geocentric Environmental Inc

A handwritten signature in black ink, appearing to read "S. Livingstone".

Reviewed by
Stephen Livingstone, M.Sc., P.Geo
Senior Hydrogeologist

9. REFERENCES

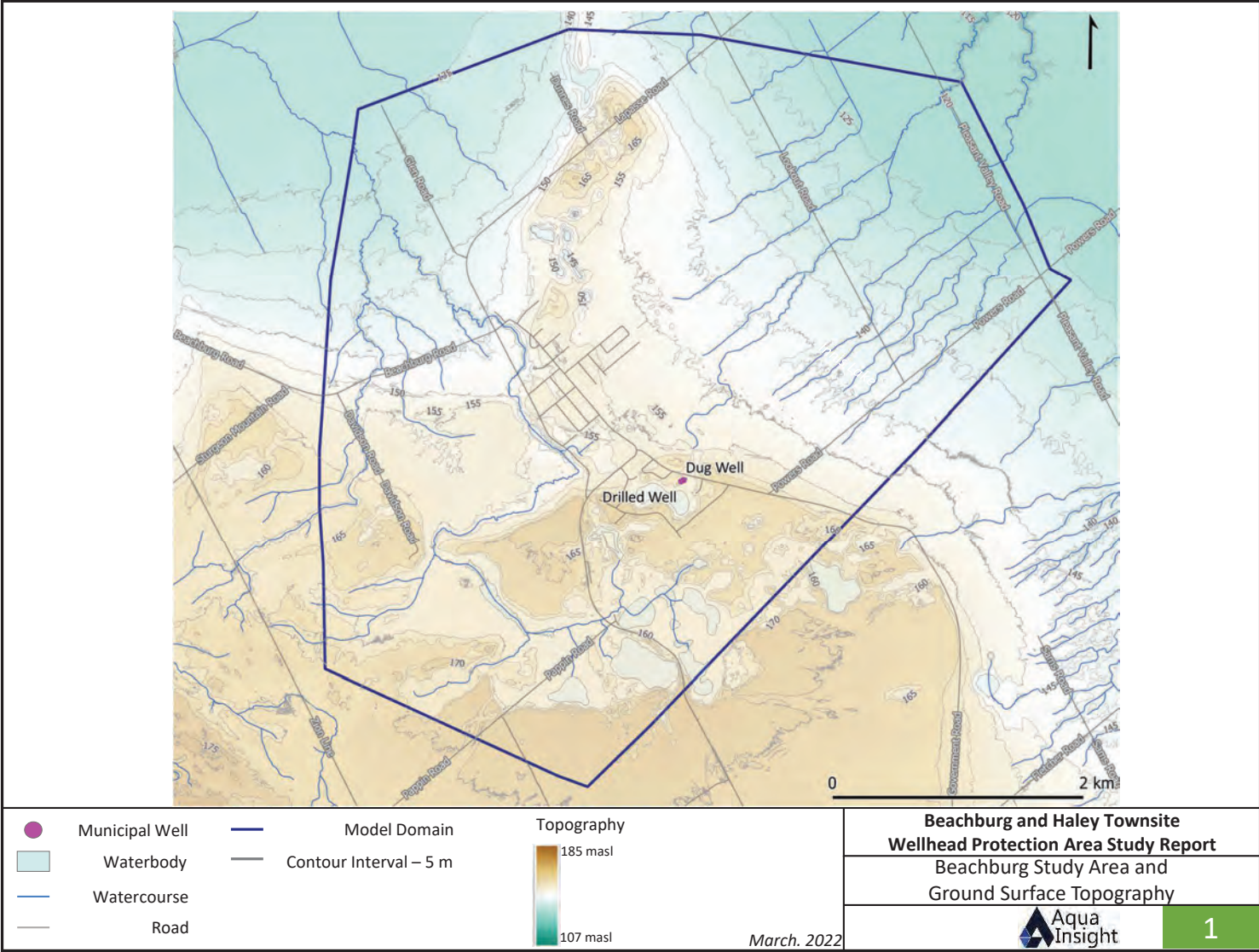
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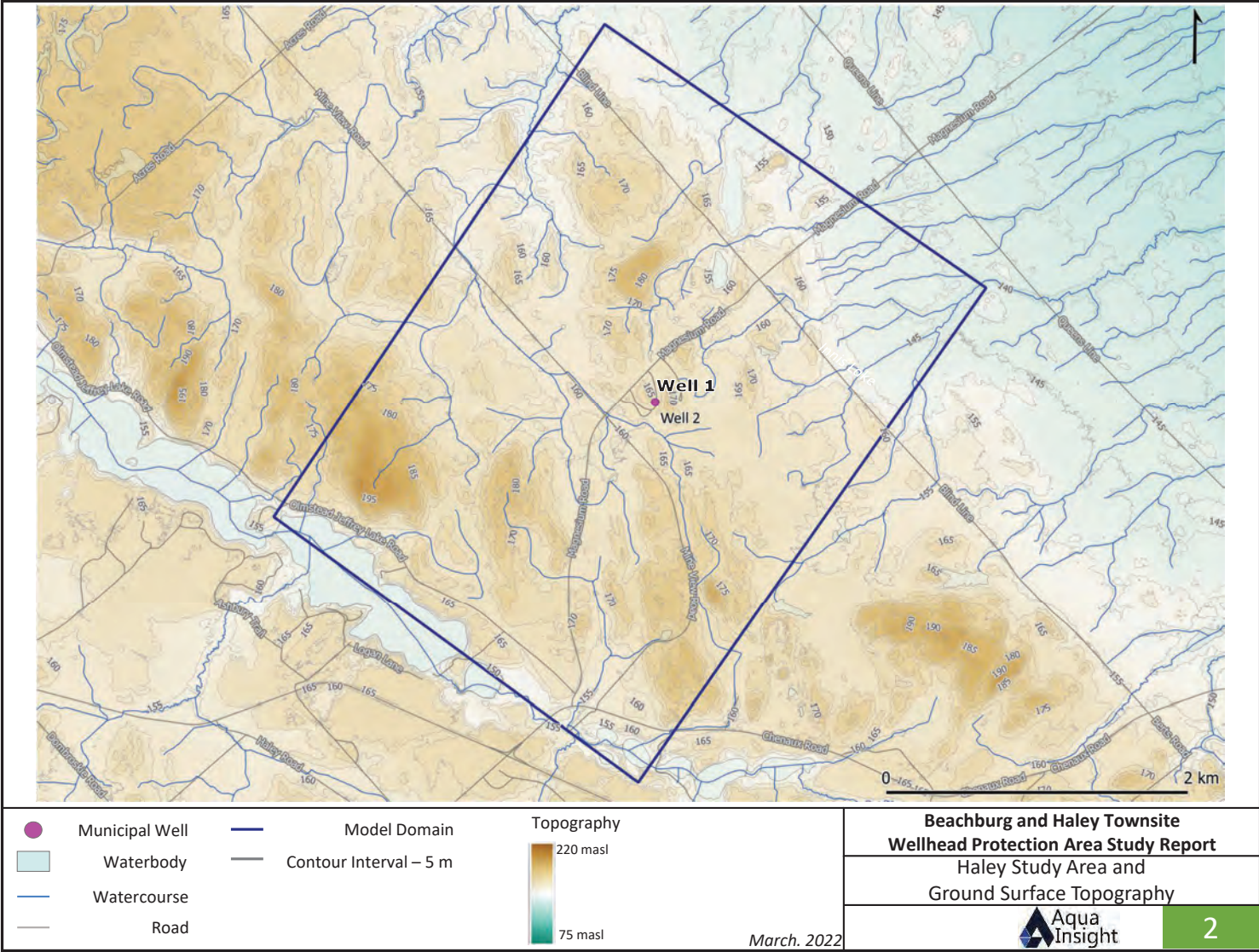
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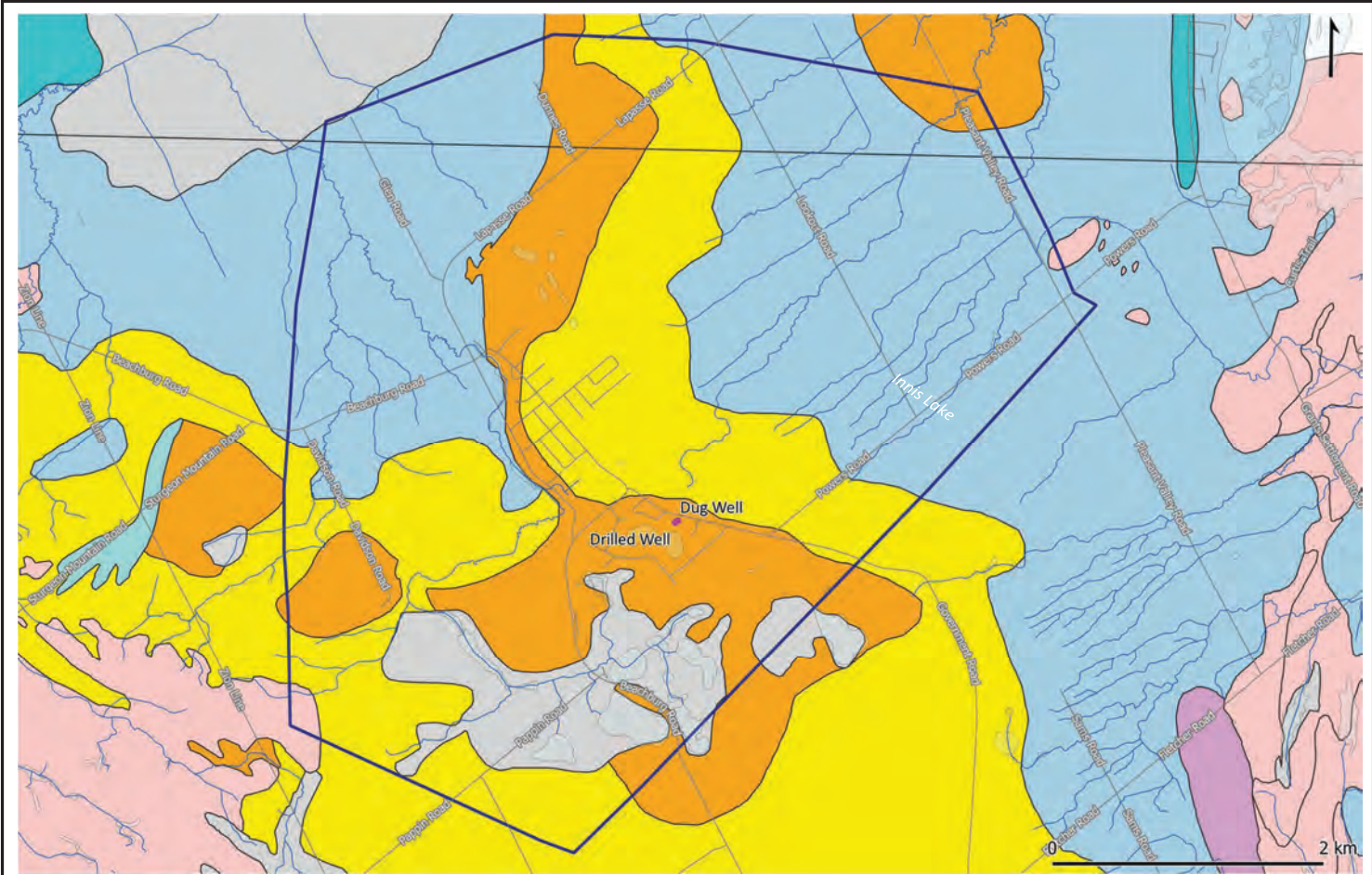
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Figures







- Municipal Well
 - Waterbody
 - Watercourse
 - Road
 - Model Domain
- Surficial Geology:**
- Organic Deposits
 - Silty Sand
 - Gravelly Sand
 - Silty Clay
 - Bedrock

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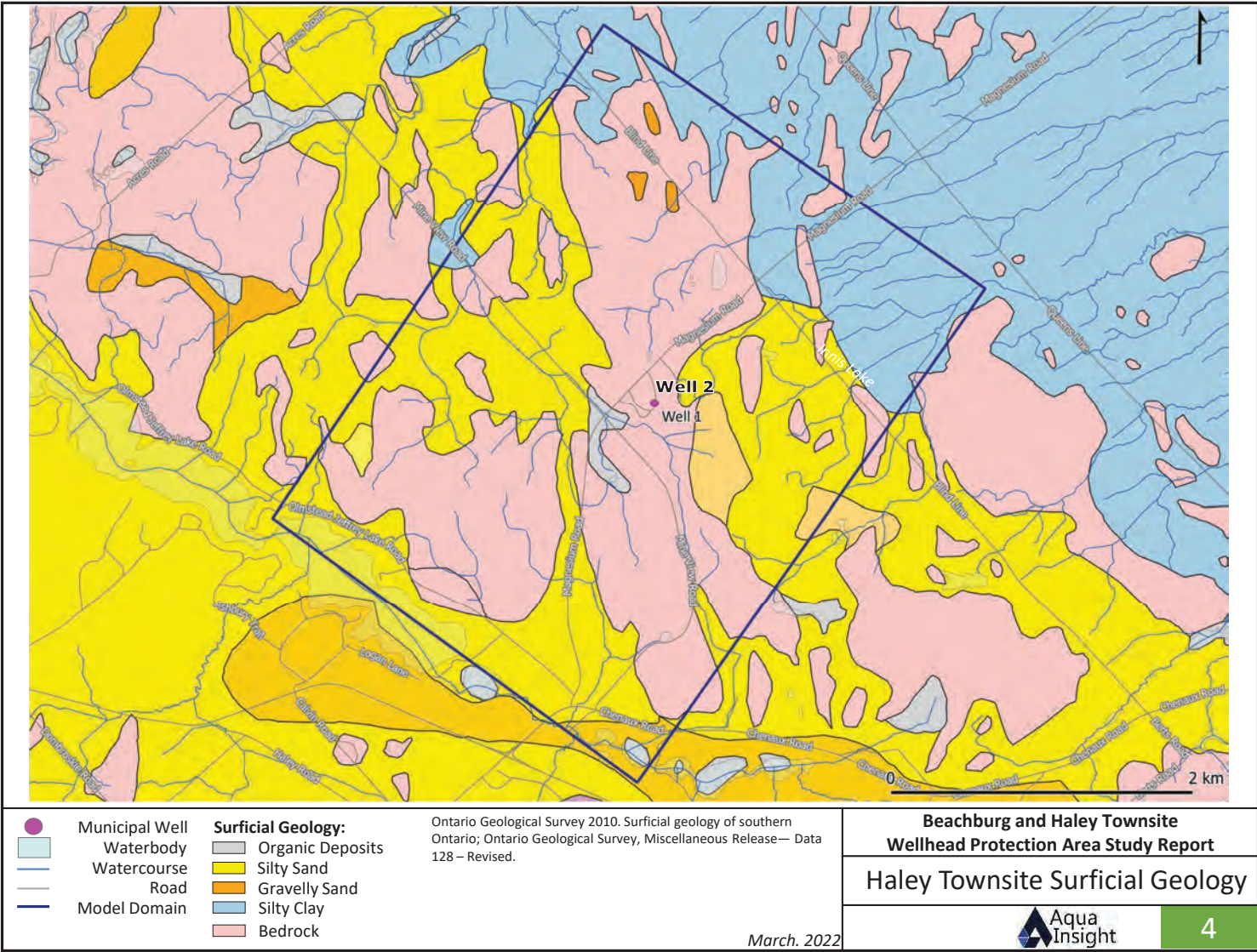
**Beachburg and Haley Townsite
Wellhead Protection Area Study Report**

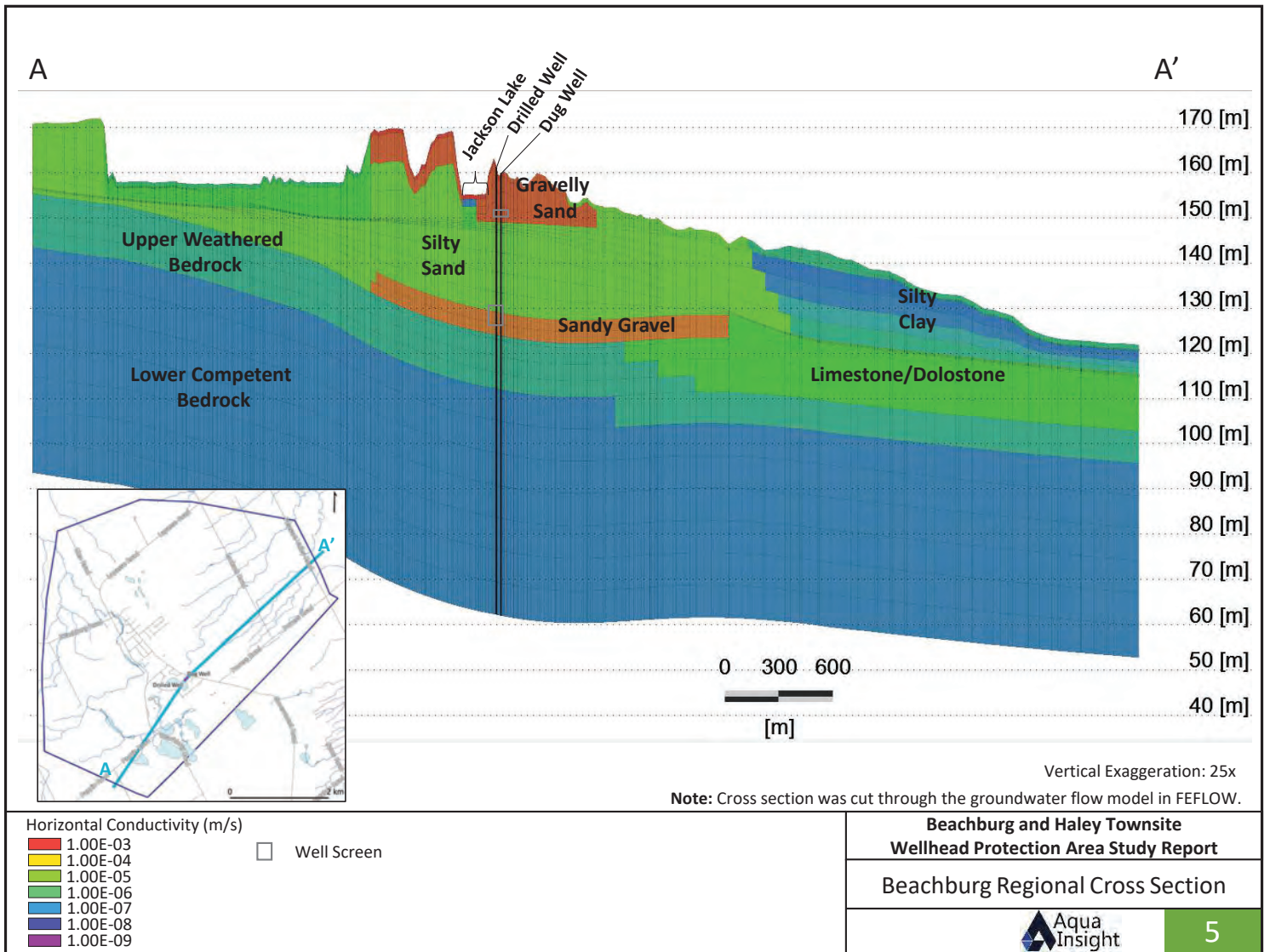
Beachburg Surficial Geology

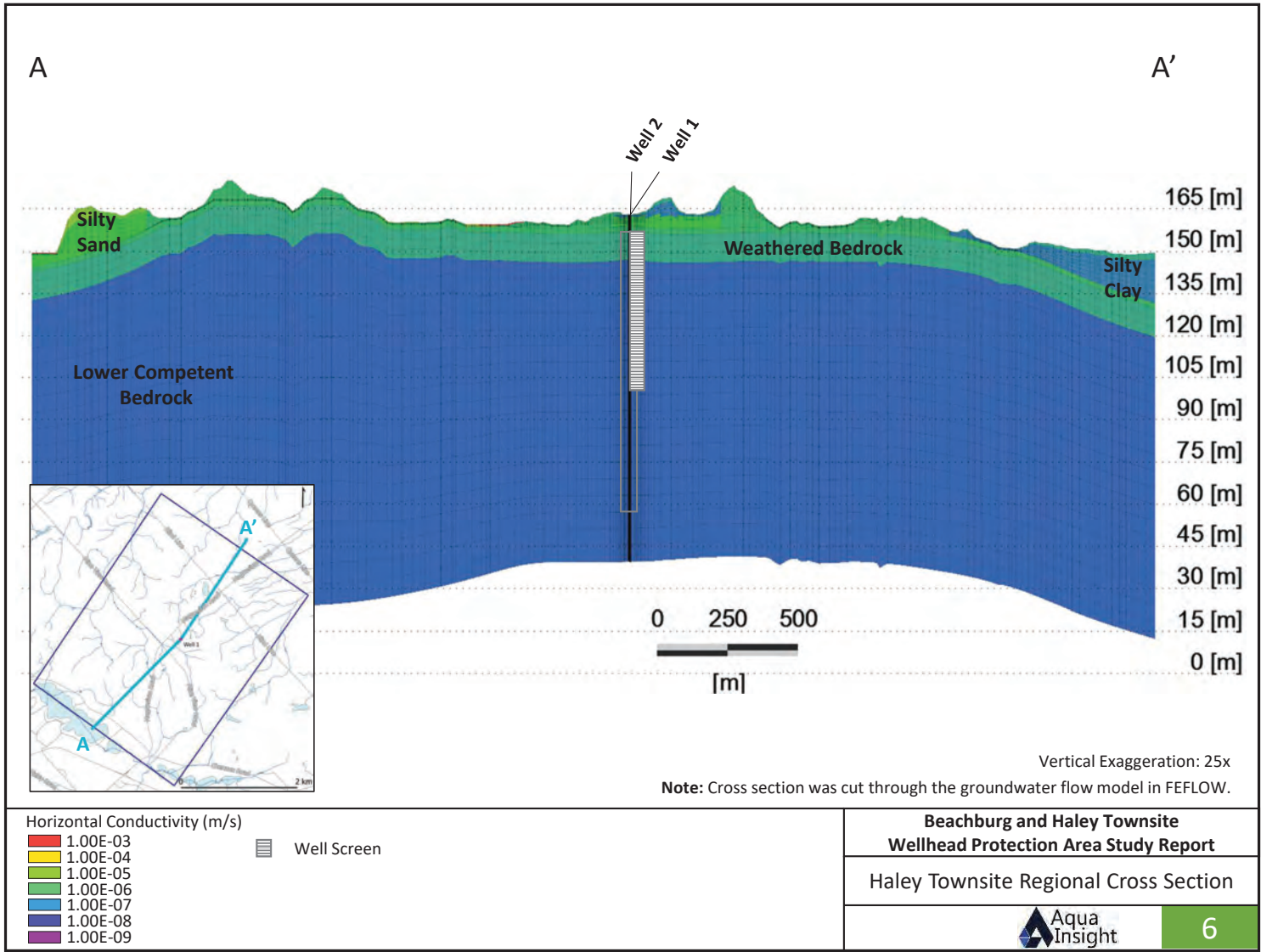


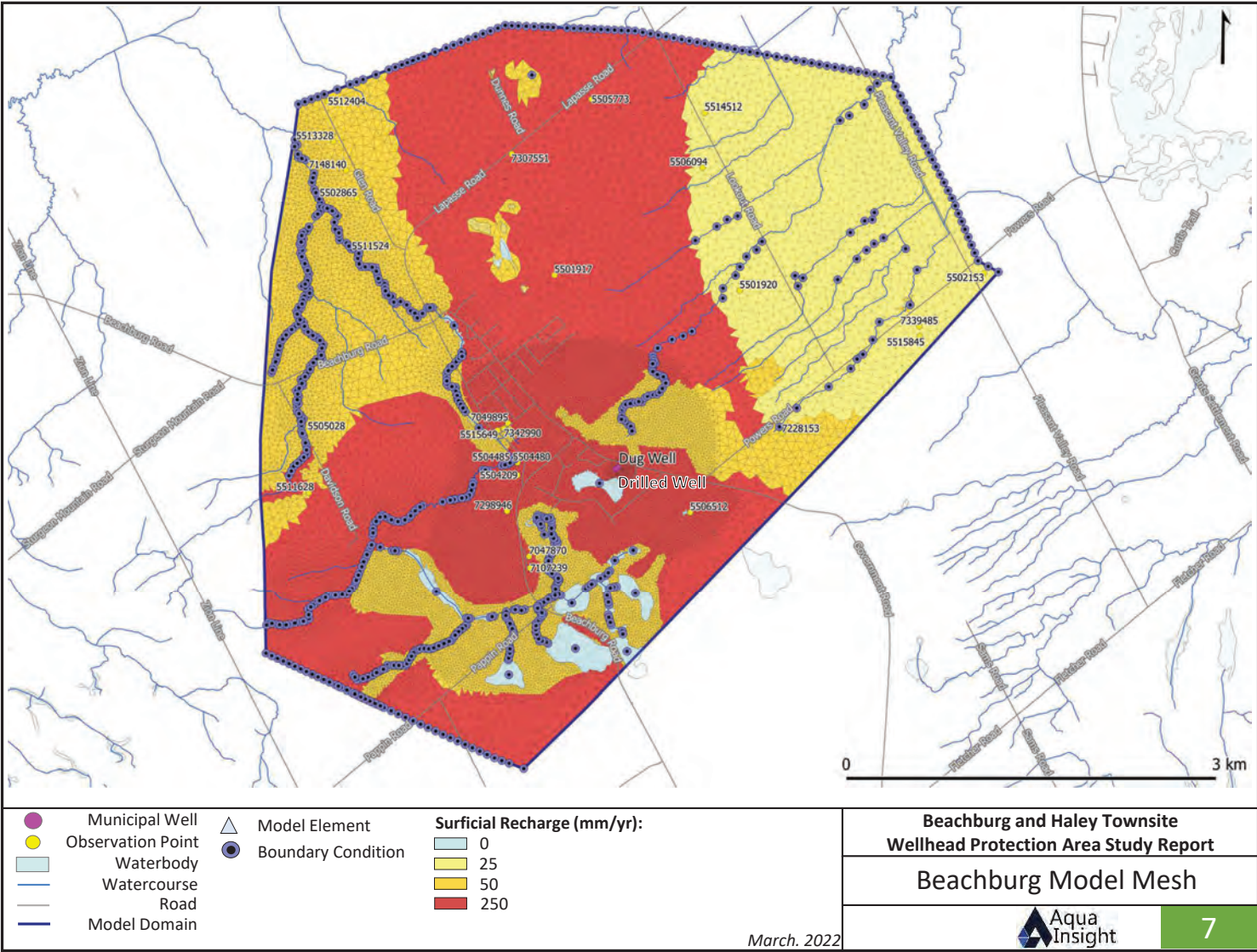
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March, 2022

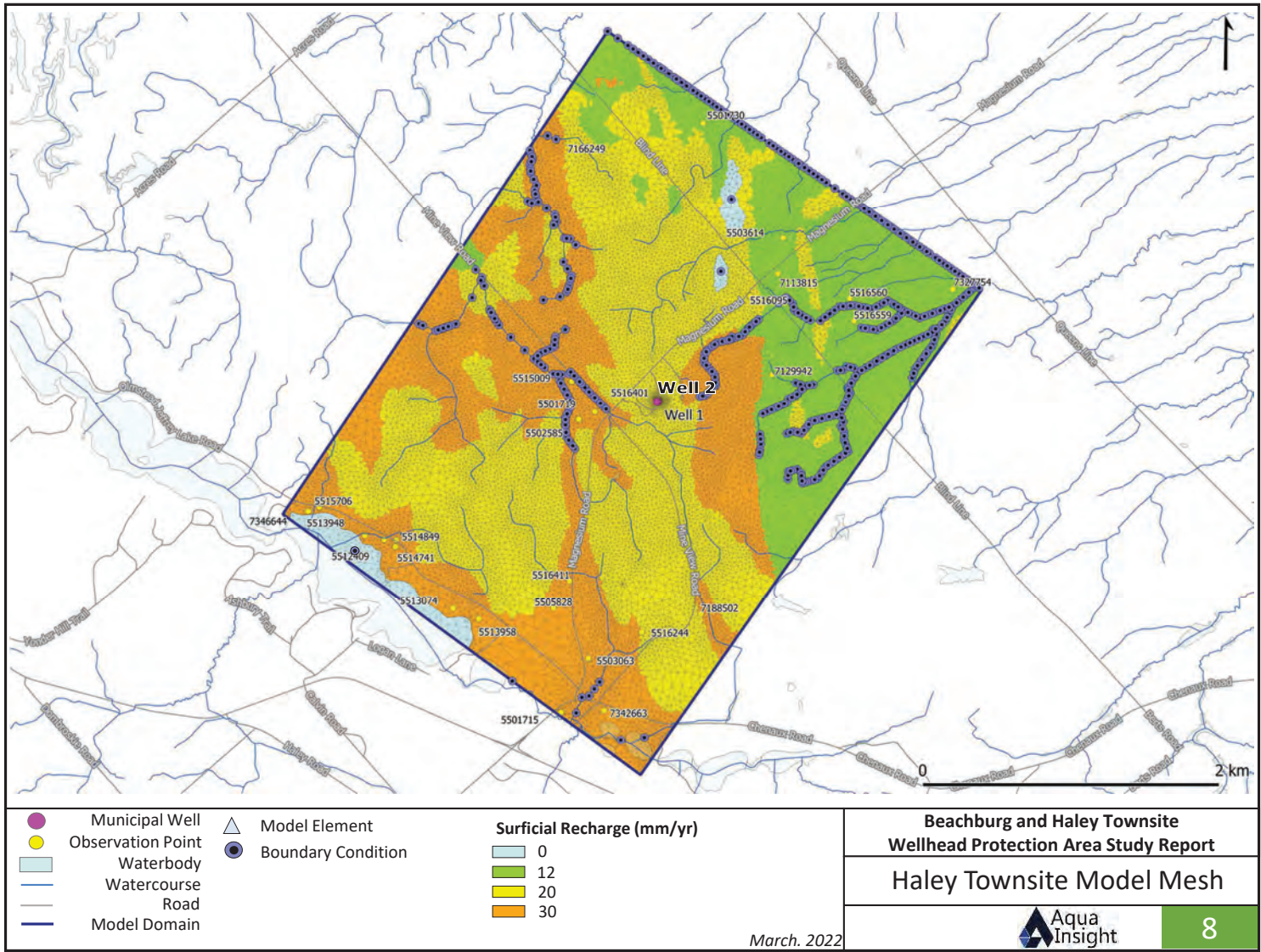


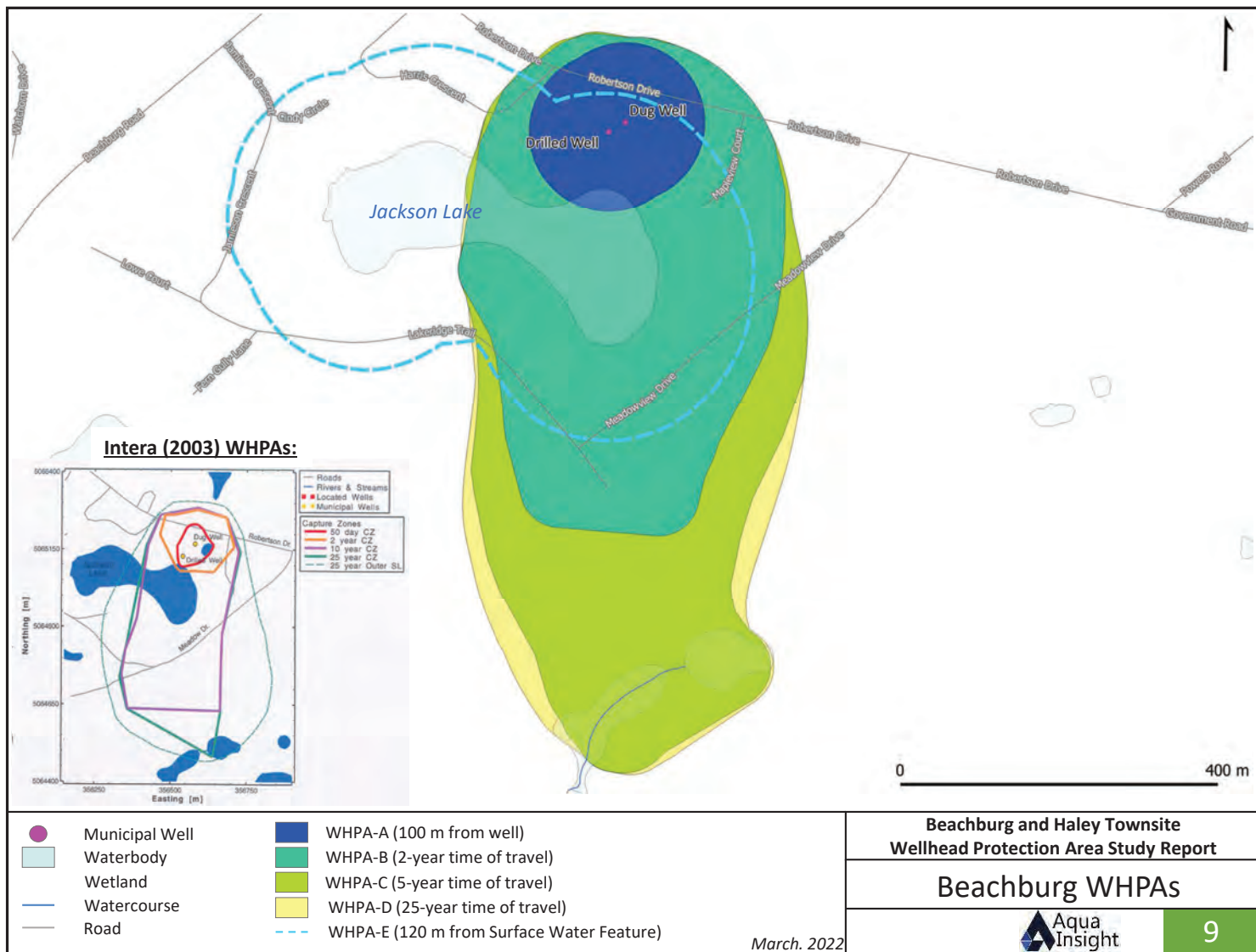


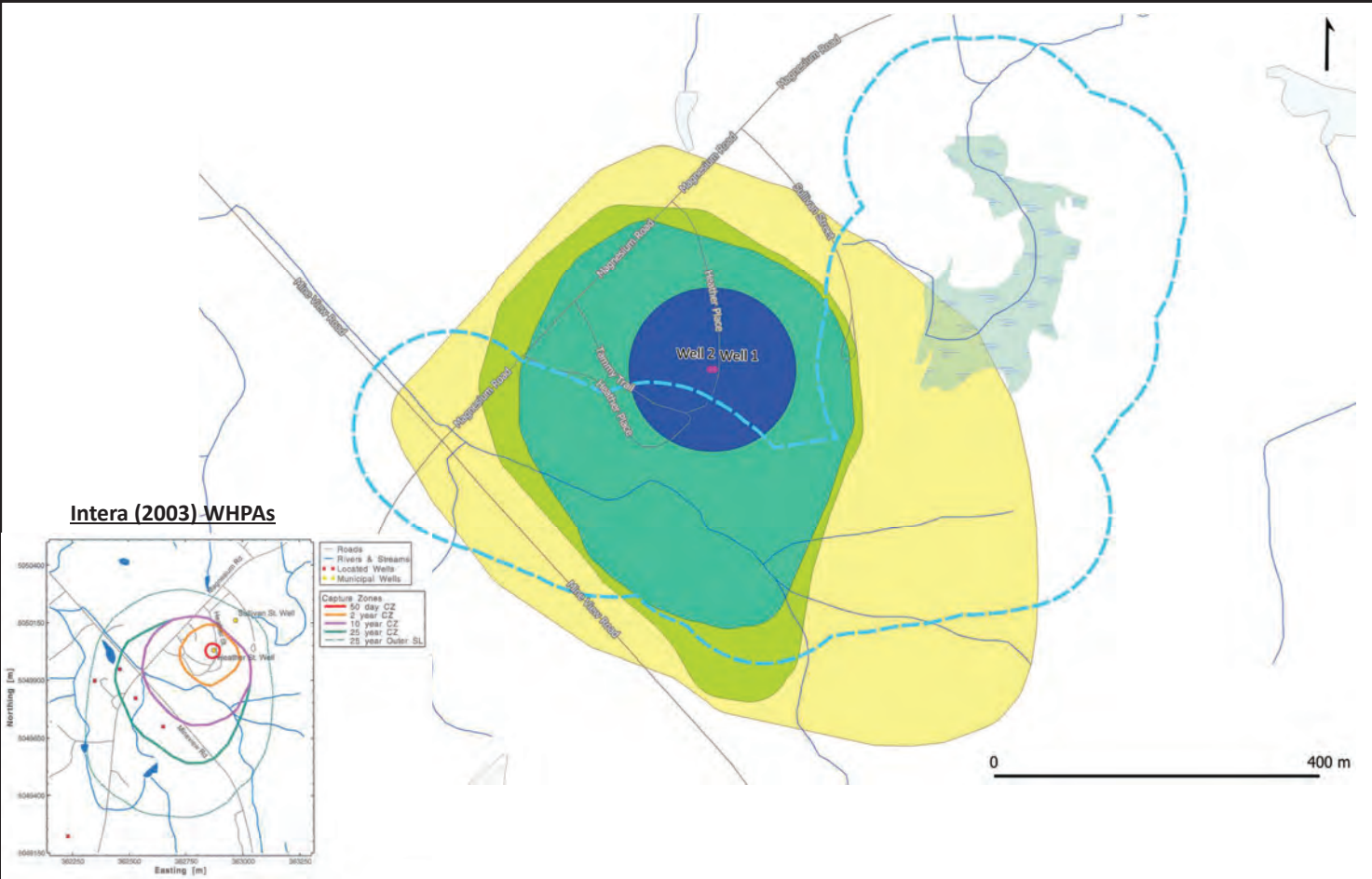




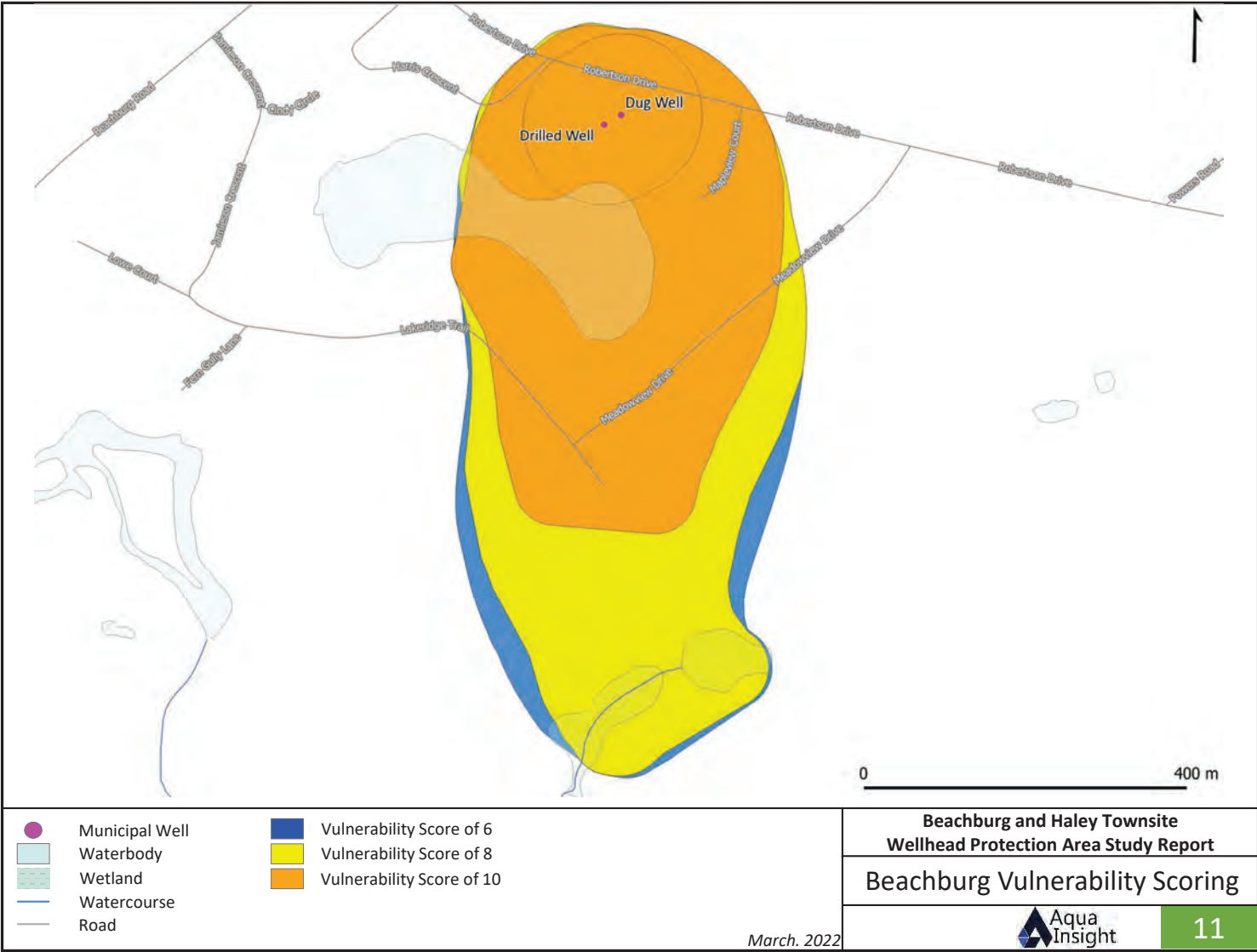
March, 2022

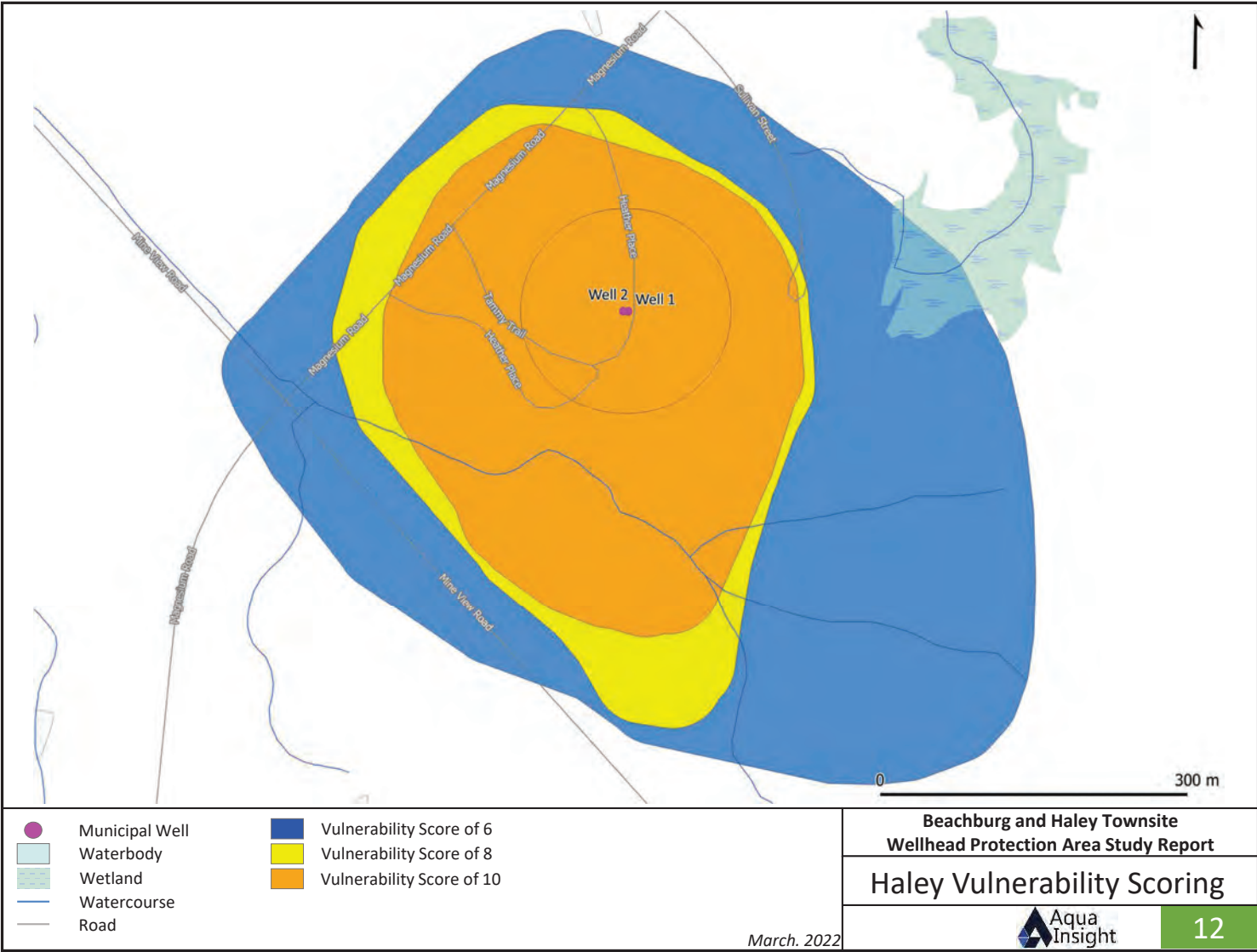


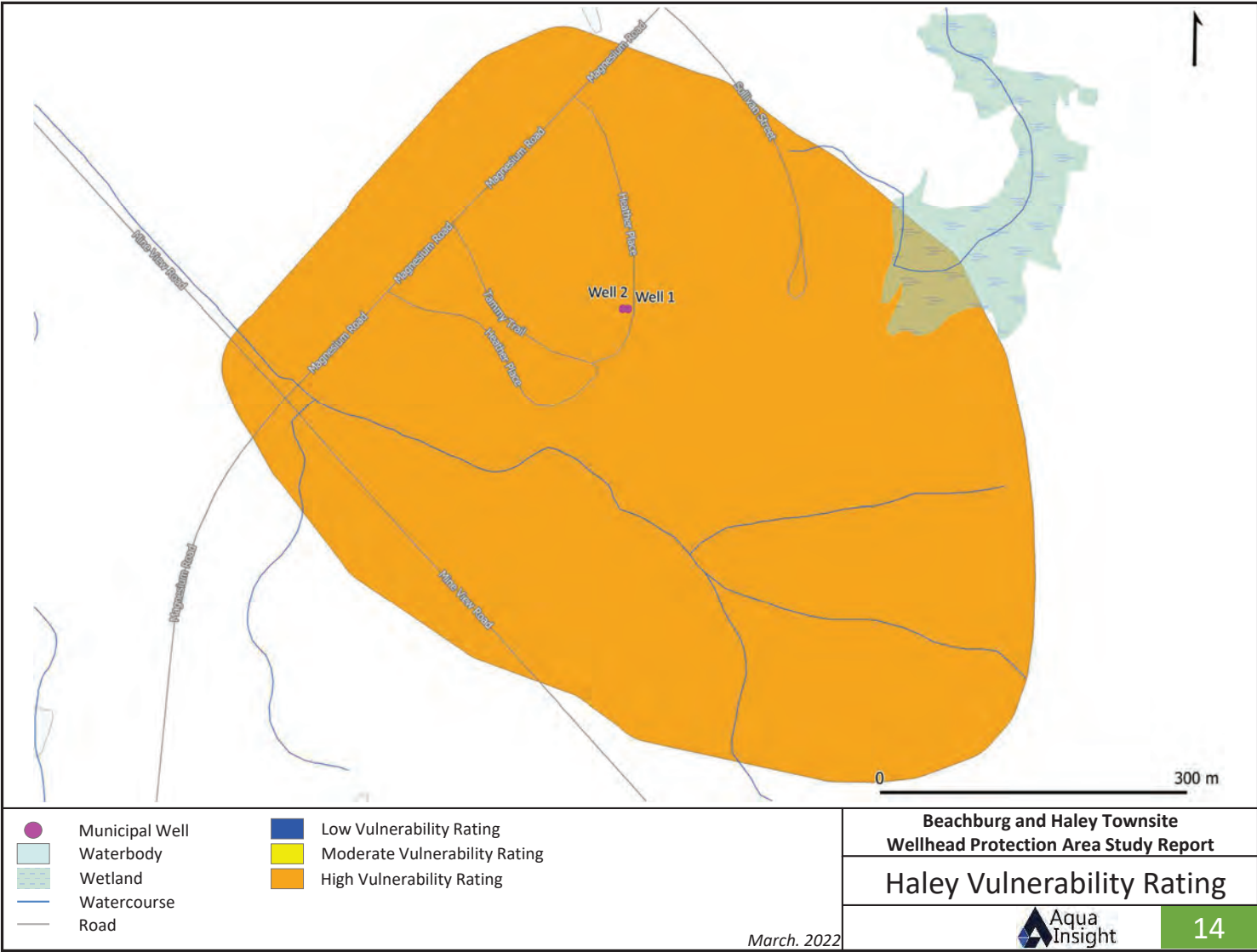




● Municipal Well Waterbody Wetland Watercourse Road	WHPA-A (100 m from well) WHPA-B (2-year time of travel) WHPA-C (5-year time of travel) WHPA-D (25-year time of travel) WHPA-E (120 m from Surface Water Feature)	Beachburg and Haley Townsite Wellhead Protection Area Study Report Haley WHPAs Aqua Insight March. 2022 10
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Appendix A

Beachburg Model Details

Groundwater Flow Modelling Details

Table A1: Simulation Approach

Structural Element	Value
Flow Saturation State	Saturated
Simulations	Steady-State

Table A2: Model Dimensions

Structural Element	Value
Model Extent	6.0 km East-West by 6.0 km North-South
Area	24.7 km ²
Number of Elements	942,900
Number of Nodes	494,936
Element Diameter	Statistic
	Prediction Area
	Background Area
	Average
	Range

Table A3: Boundary Conditions

Hydrogeologic Unit	Feature	Flow	
		Type	Value
Silty Clay	Recharge	Source	¹
Gravelly Sand/Silty Sand	Recharge	Source	¹
Organics	Recharge	Source	¹
Gravelly Sands	Western Watercourse ²	Specified Head	.8 –
Gravelly Sands	South-Western Watercourse ²	Specified Head	157.8 – 161.4
Silty Clay	North-Western Watercourse ²	Specified Head	7.7 –
Silty Clay	Eastern Watercourse ²	Specified Head	.4 –
Upper Bedrock	Lateral Groundwater Inflow ³	Specified Head	165
Lower Bedrock	Lateral Groundwater Outflow ³	Specified Head	117 - 128

Note: ¹ Calibrated values applied, conceptual range was 30 - 300 mm/y.

² Boundary condition values derived from LiDAR elevation data.

³ Boundary condition values derived from regional bedrock water level data.

Table A4: Fluid Flow Material Properties

Hydrogeologic Unit and Material	Zone Id	Hydraulic Conductivity			Vertical Anisotropy
		Conceptual Range ¹ (m/s)	Observed Range ² (m/s)	Calibrated Value ³ (m/s)	
Gravelly Sand	300	5x10 ⁻⁵ to 1x10 ⁻³	4x10 ⁻⁴	5.0x10 ⁻⁴	100
Silty Clay	100, 101, 102, 103, 110	1x10 ⁻⁸ to 1x10 ⁻⁶		8.0x10 ⁻⁸ to 7.0x10 ⁻⁷	5

Hydrogeologic Unit and Material	Zone Id	Hydraulic Conductivity			Vertical Anisotropy
		Conceptual Range ¹ (m/s)	Observed Range ² (m/s)	Calibrated Value ³ (m/s)	
Organics	400	1x10 ⁻⁷ to 1x10 ⁻⁵		3.0x10 ⁻⁶	50
Silty Sand	200	5x10 ⁻⁷ to 1x10 ⁻⁵		8.0x10 ⁻⁶	50
Sand and Gravel	500	1x10 ⁻⁵ to 1x10 ⁻³	5x10 ⁻³	6.0x10 ⁻⁴	1
Limestone Bedrock	700	1x10 ⁻⁷ to 1x10 ⁻⁵		5.0x10 ⁻⁶	1
Weathered Upper Precambrian Bedrock	600	1x10 ⁻⁷ to 1x10 ⁻⁶		5.0x10 ⁻⁷	1
Lower Precambrian Bedrock	650	1x10 ⁻⁸ to 5x10 ⁻⁷		1.0x10 ⁻⁷	1

Note: ¹ Derived from literature Freeze and Cherry (1979) and refined for site specific assessment.

² Observed range derived from various pumping test values

³ Calibrated value of base case model (Section 3).

⁴ Fine-grained materials have a companion zone at surface (depth = 1 m bgs) whereby the hydraulic conductivity value was increased by one order magnitude to represent effects of weathering and macropores.

Table A5: Storage Properties

Hydrogeologic Unit	Effective Porosity
Gravelly Sand	0.25
Silty Clay	0.15
Organics	0.20
Silty Sand	0.25
Sand and Gravel	0.30
Limestone Bedrock	0.05
Upper Bedrock	0.05
Lower Bedrock	0.01

Note:

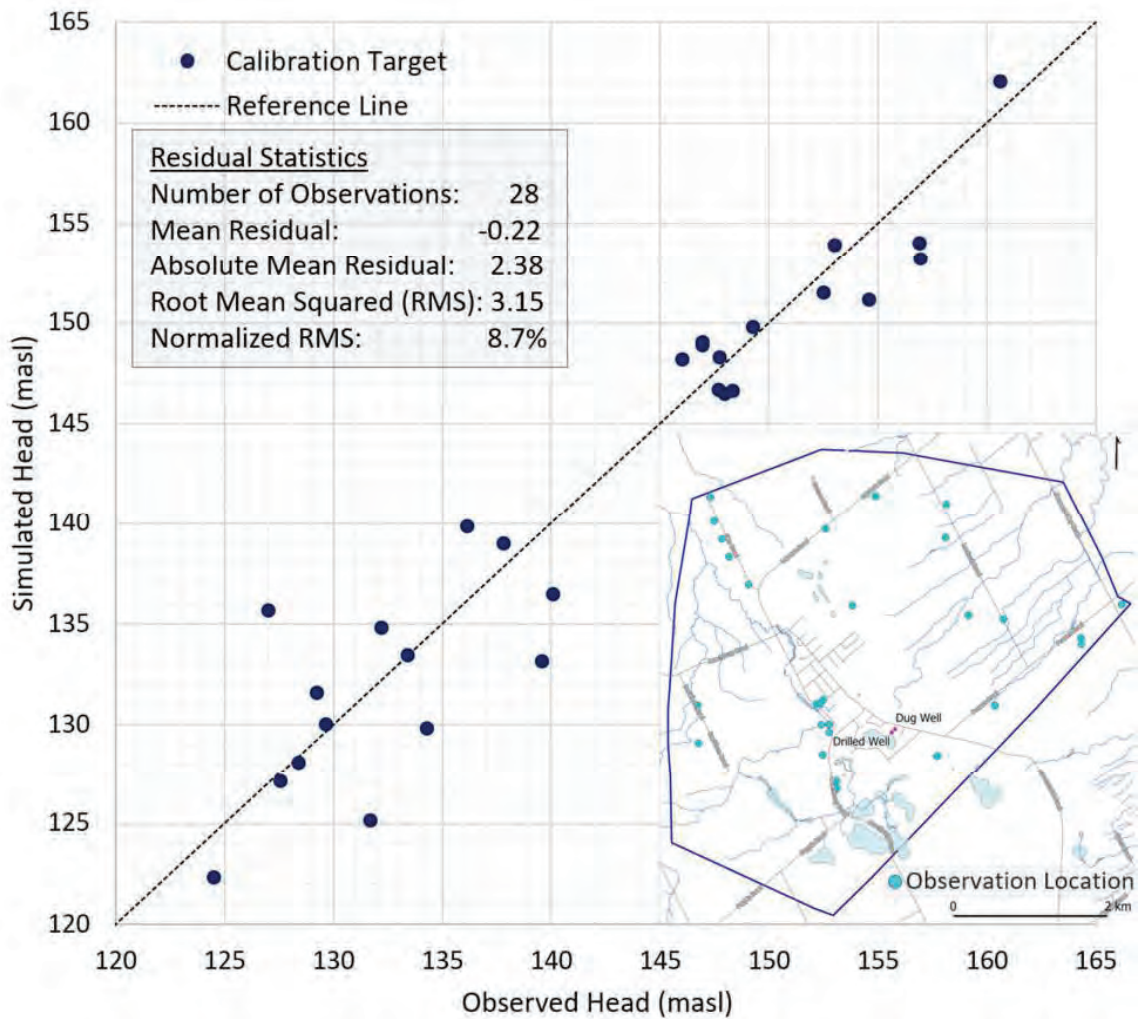


Figure A1: Scatter plot comparing Observed to Simulated Head for Beachburg Base Case Calibrated Model

Table A6: Groundwater Head Residuals for Calibrated Base Case Model

MECP Well Name	Easting	Northing	Elevation of Screen Midpoint (m asl)	Groundwater Head (m)		
				Measured	Simulated	Residual ¹
5505773	356330.1	5068173.0	95.5	127.6	127.1	-0.4
5515845	358989.0	5066252.0	94.0	127.0	135.7	8.7
5506512	357129.1	5064822.0	112.8	149.2	149.8	0.6
5502865	354430.1	5067373.0	108.4	133.4	133.5	0.1
5501920	357530.1	5066623.0	116.7	136.2	139.8	3.6
5502153	359510.2	5066763.0	114.3	124.5	122.3	-2.1

MECP Well Name	Easting	Northing	Elevation of Screen Midpoint (m asl)	Groundwater Head (m)		
				Measured	Simulated	Residual ¹
5512404	354194.0	5068156.0	107.0	128.4	128.1	-0.3
5506094	357230.1	5067623.0	115.4	134.3	129.8	-4.5
7307551	355682.0	5067734.0	140.2	139.6	133.2	-6.4
7339485	358985.0	5066331.0	110.6	132.2	134.8	2.6
5513328	354239.0	5067834.0	110.0	129.6	130.0	0.4
7148140	354343.0	5067601.0	116.0	129.3	131.6	2.3
5511524	354690.0	5067019.0	115.4	140.1	136.5	-3.6
5515649	355569.0	5065486.0	121.1	148.3	146.6	-1.7
5501917	356030.1	5066748.0	122.0	137.8	139.0	1.2
7342990	355619.0	5065498.0	120.4	147.7	146.7	-1.0
7298946	355646.0	5064833.0	149.6	154.6	151.1	-3.4
7049895	355654.0	5065543.0	124.8	148.0	146.5	-1.5
7228153	357872.0	5065465.0	90.0	147.7	148.3	0.6
5514512	357247.0	5068066.0	104.4	131.7	125.1	-6.5
5505028	354030.1	5065473.0	136.2	153.0	153.9	0.9
5504485	355630.1	5065223.0	137.2	146.0	148.2	2.2
7107239	355831.0	5064374.0	141.8	156.9	154.0	-2.9
5504483	355730.1	5065223.0	139.6	146.9	148.9	2.0
5504480	355730.1	5065224.0	141.1	146.9	149.1	2.2
7047870	355824.0	5064467.0	139.1	156.9	153.2	-3.7
5511628	354041.0	5064982.0	123.2	160.6	162.1	1.5
5504209	355730.1	5065123.0	153.1	152.5	151.5	-1.0
5505773	356330.1	5068173.0	95.5	127.6	127.1	-0.4

Note: ¹ Residual calculated as simulated value less measured value.

Table A7: Fluid Balance for Base Case Calibrated Model

Element	Input (m³/d)	Output (m³/d)	Net (m³/d)
Specified Head ¹	2,556	-12,328	-9,646
Source/Sink ²	9,771		9,771
Storage Change ³			
Imbalance ⁴			0.0002 (<0.1%)

Note: ¹ Specified Head boundary conditions represent lateral groundwater inflow from upgradient areas and groundwater discharge to streams.

² Source/Sink boundary conditions represent groundwater recharge applied to the top of the model.

³ No storage component for steady-state simulation.

⁴ Percent imbalance calculated as SumNet/SumInput*100. Percent imbalance of less than 0.1% indicates conservation of fluid.



Appendix B

Haley Townsite Model Details

Groundwater Flow Modelling Details

Table B3: Simulation Approach

Structural Element	Value
Flow Saturation State	Saturated
Simulations	Steady-State

Table B4: Model Dimensions

Structural Element	Value		
Model Extent	4.7 km East-West by 5.0 km North-South		
Area	12 km ²		
Number of Elements	887,777		
Number of Nodes	465,060		
Element Diameter	Statistic	Prediction Area	Background Area
	Average	m	m
	Range	−2.9-6.8 m	m

Table B3: Boundary Conditions

Hydrogeologic Unit	Feature	Flow	
		Type	Value
Silty Clay	Recharge	Source	1
Silty Sand	Recharge	Source	1
Bedrock	Recharge	Source	1
Silty Sands	North-Western Watercourse ²	Specified Head	7.2 –
Silty Clay	North-Eastern Watercourse ²	Specified Head	.3 –
Silty Sand	South-Western Lakes ²	Specified Head	149.2 – 152.0
Bedrock	Lateral Groundwater Outflow ³	Specified Head	143

Note: ¹ Calibrated values applied, conceptual range was 10 - 30 mm/y.

² Boundary condition values derived from LiDAR elevation data.

³ Boundary condition values derived from regional bedrock water level data.

Table B4: Fluid Flow Material Properties

Hydrogeologic Unit and Material	Zone Id	Hydraulic Conductivity			Vertical Anisotropy
		Conceptual Range ¹ (m/s)	Observed Range ² (m/s)	Calibrated Value ³ (m/s)	
Silty Sand		x10 ⁷ to 1x10 ³	n/a	x ⁻⁶	10
Silty Clay	200	1x10 ⁻⁸ to 1x10 ⁻⁶	n/a	1.0x1 ⁻⁷	5
Organics	300	1x10 ⁻⁶ to 1x10 ⁻⁴	n/a	5.0x1 ⁻⁵	50
Weathered Bedrock	400	1x10 ⁻⁷ to 1x10 ⁻⁴	2x10 ⁻⁶ to 1x10 ⁻⁵	5.0x10 ⁻⁶	1
Upper Bedrock	550	1x10 ⁻⁸ to 1x10 ⁻⁶	1x10 ⁻⁷ to 1x10 ⁻⁵	1.0x10 ⁻⁶	10
Lower Bedrock	500	1x10 ⁻⁸ to 5x10 ⁻⁷	1x10 ⁻⁸ to 7x10 ⁻⁷	1.0x10 ⁻⁷	10

Note: ¹ Derived from literature Freeze and Cherry (1979) and refined for site specific assessment.

² Observed range derived from various pumping tests values

Hydrogeologic Unit and Material	Zone Id	Hydraulic Conductivity			Vertical Anisotropy
		Conceptual Range ¹ (m/s)	Observed Range ² (m/s)	Calibrated Value ³ (m/s)	

³ Calibrated value of base case model (Section 3).

⁴ Fine-grained materials have a companion zone at surface (depth = 1 m bgs) whereby the hydraulic conductivity value was increased by a one order magnitude to represent effects of weathering and macropores.

Table B5: Storage Properties

Hydrogeologic Unit	Effective Porosity
Silty Clay	0.15
Organics	0.20
Silty Sand	0.25
Upper Bedrock	0.05
Lower Bedrock	0.01

Note:

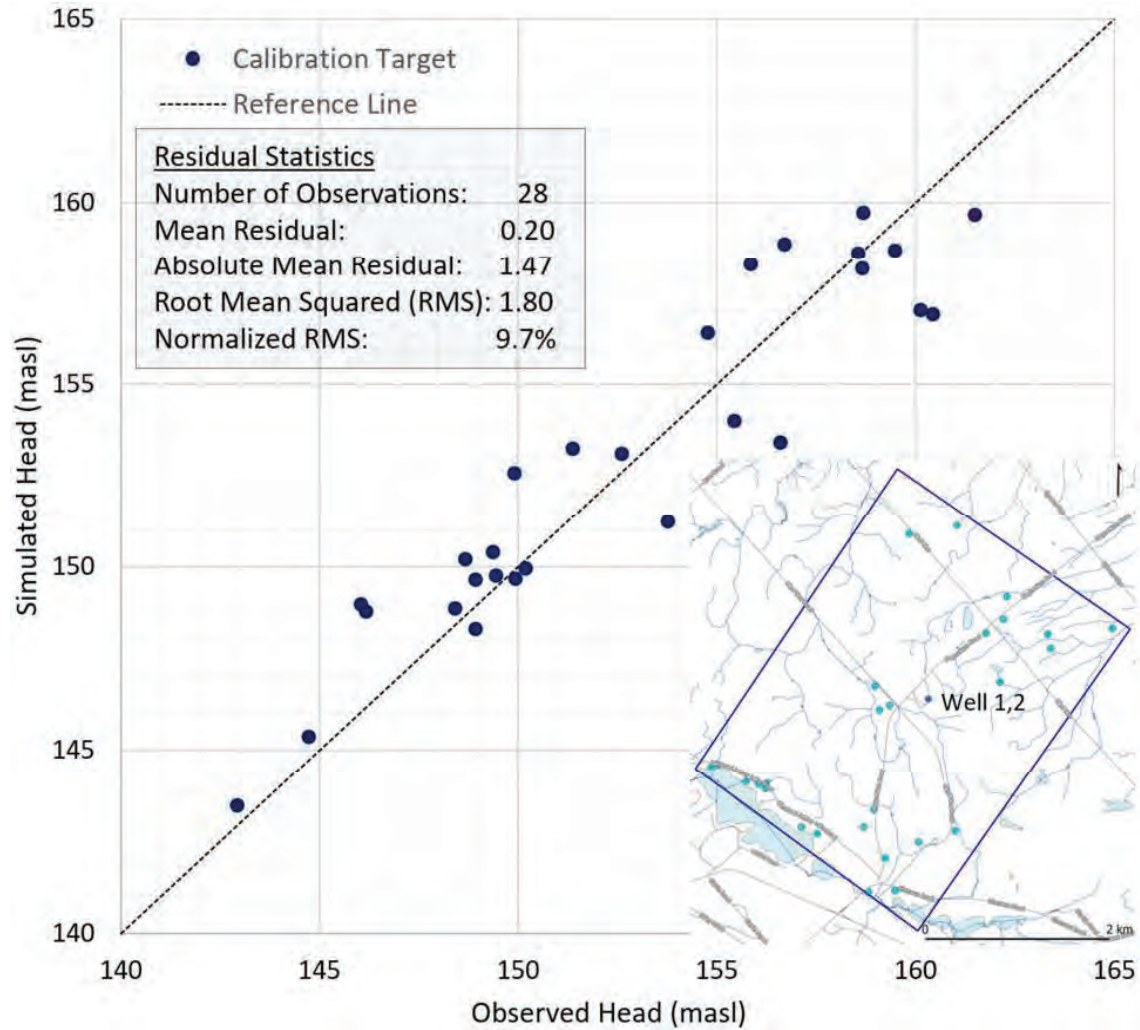


Figure B1: Scatter plot comparing Observed to Simulated Head for Haley Townsite Base Case Calibrated Model

Table B6: Groundwater Head Residuals for Calibrated Base Case Model

MECP Well Name	Easting	Northing	Elevation of Screen Midpoint (m asl)	Groundwater Head (m)		
				Measured	Simulated	Residual ¹
5516411	362289.0	5048806.0	155.0	158.2	158.7	-0.5
7342663	362521.0	5047936.0	147.7	153.3	151.4	1.9
5516559	364206.0	5050562.0	124.8	148.9	148.4	0.5
5516560	364178.0	5050714.0	126.1	148.3	148.9	-0.6
5515009	362303.7	5050154.0	145.8	158.3	155.9	2.4
7188502	363174.0	5048582.0	152.0	159.7	161.5	-1.8
5513958	361676.0	5048550.0	140.6	153.4	156.6	-3.2
5503063	362414.3	5048286.0	143.8	156.4	154.7	1.7
5502585	362350.3	5049898.0	142.3	158.7	159.5	-0.8
5505828	362180.3	5048623.0	145.4	156.9	160.4	-3.5
5514741	361114.0	5049038.0	139.6	150.2	148.7	1.5
5516244	362775.0	5048460.0	143.1	158.6	158.6	0.1
5501715	362230.3	5047923.0	135.0	153.1	152.6	0.5
5501719	362460.3	5049948.0	137.6	158.9	156.7	2.2
7166249	362673.8	5051807.5	126.2	149.0	146.0	3.0
5503614	363730.3	5051123.0	124.9	148.8	146.2	2.6
5512409	361037.0	5049085.0	129.3	150.0	150.2	-0.2
5513948	360908.0	5049113.0	125.7	149.7	149.9	-0.3
5516095	363506.0	5050730.0	127.3	154.0	155.4	-1.4
5516401	362882.0	5050016.0	132.1	159.7	158.7	1.1
7346644	360527.0	5049276.0	121.9	149.7	148.9	0.7
5515706	360601.0	5049305.0	121.4	149.8	149.5	0.3
5501730	363190.3	5051898.0	110.6	145.4	144.7	0.7
7129942	363653.0	5050199.0	116.1	157.0	160.1	-3.1
5513074	361504.0	5048621.0	120.2	152.6	149.9	2.7
7113815	363694.0	5050880.0	113.3	151.2	153.8	-2.5
5514849	361119.8	5049084.0	113.7	150.4	149.4	1.1
7327754	364873.0	5050777.0	84.4	143.5	142.9	0.5
5516411	362289.0	5048806.0	155.0	158.2	158.7	-0.5

Note: ¹ Residual calculated as simulated value less measured value.

Table B7: Fluid Balance for Base Case Calibrated Model

Element	Input (m³/d)	Output (m³/d)	Net (m³/d)
Specified Head ¹	46	-734	-688
Source/Sink ²	688		688
Storage Change ³			
Imbalance ⁴			0.00003 (<0.1%)

Note: ¹ Specified Head boundary conditions represent lateral groundwater inflow from upgradient areas and groundwater discharge to streams.

² Source/Sink boundary conditions represent groundwater recharge applied to the top of the model.

³ No storage component for steady-state simulation.

⁴ Percent imbalance calculated as $\text{SumNet}/\text{SumInput} \times 100$. Percent imbalance of less than 0.1% indicates conservation of fluid.



Appendix C

K-Factors Applied in Vulnerability Assessment

Generic Representative Permeability (K-Factor) Table

Geomaterial	Representative K-Factor (dimensionless)*	K-Value (m/s) @75% range**	Highest K- Value (m/s)
gravel	1	1.00E-01	0.1
weathered dolomite/limestone		1.00E-06	
karst		1.00E-03	
permeable basalt		1.00E-03	
sand	2	0.01	1.00E-02
peat (organics)	3	1.00E-03	1.00E-03
silty sand		1.00E-04	
weathered clay (<5m below surface)		1.00E-04***	
shrinking/fractured & aggregated clay		1.00E-04***	
fractured igneous metamorphic rock		1.00E-05	
weathered shale		1.00E-05***	
Silt	4	1.00E-06	1.00E-06
loess		1.00E-06	
limestone/dolomite		1.00E-06	
weathered/fractured till	5	1.00E-07	1.00E-07
diamicton (sandy, silty)		1.00E-07***	
diamicton (silty, clayey)		1.00E-08***	
sandstone		1.00E-07	
clay till	8	1.00E-09***	1.00E-09
clay (unweathered marine)		1.00E-10	
unfractured igneous and metamorphic rock	9	1.00E-13	1.00E-13

* Representative K-Factors are relative numbers and do not correspond directly to the exponent or index of the observed K-Values for the geomaterial in the group.

** Correspondence with descriptors of observed K-Values in Freeze & Cherry 1979, Prentice-Hall. Derived using the length of the line to determine the 75% value and rounding to the highest K-Value.

*** Estimated value based on field studies in Ontario

From MOE, 2001



Final Report Prepared for:

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January 30, 2023



Beachburg and Haley Townsite
Source Water Protection Plan



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1. Introduction

Geocentric Environmental Inc. in association with Aqua Insight Inc., (subconsultant) were retained by the Township of Whitewater Region to complete the Wellhead Protection Areas (WHPA) Delineation for Beachburg and Haley Townsite, as outlined in the Request for Proposal 2021-29 issued on November 8, 2021. The work was completed under Resolution of Council #2021-4651 dated December 15th, 2021.

As part of the study, an updated Source Water Protection evaluation (Geocentric, 2022, referred to herein as the WHPA report) was completed to delineate the Wellhead Protection Areas (WHPAs) for four drinking water supply wells located in Beachburg (2) and Haley Townsite (2), characterize the relative vulnerability of the municipality's supply aquifers, assignment vulnerability scores, and evaluate the potential water quality threats. Based on the outcomes of this first phase of work, a Source Water Protection Plan (Planning Phase) report, as described herein, was developed to establish an overall management plan and framework.

The overarching goals of this study are to map the sources of municipal drinking water, identify any potential risks or threats to the quality or quantity of those drinking water sources and identify ways to manage those risks to help protect the health of the citizens, the community's drinking water, and the local economy.

1.1. Background

The Clean Water Act and associated Source Protection Planning in Ontario was introduced to ensure that all Ontarians have access to safe drinking water. Source water is the untreated water in lakes and rivers, and in underground aquifers, that people use for drinking water. Clean water is often considered an environmental issue, but it is also a public health and economic priority because people, businesses and communities need clean water to survive.

The Clean Water Act was initiated in 2006 after the drinking water system within the Town of Walkerton was contaminated with E. Coli in 2000, resulting in thousands of illnesses and several deaths. Following this incident, an in-depth review of drinking water safety was undertaken and a multi-barrier approach to source water protection was introduced (Figure 1). The Clean Water Act is part of the multi-barrier approach to ensure clean (quality), safe (quality) and sustainable (quantity) drinking water for Ontarians, by protecting sources of municipal drinking water. Under the Cleaning Water Act, the Drinking Water Source Protection Program was established, which resulted in the development of science-based assessment reports and local source protection plans (Conservation Ontario 2022).



Figure 1: Multi barrier approach of the Clean Water Act

1.2. Importance of Drinking Water Source Protection

Drinking water source protection is intended to ensure that activities do not pollute sources of drinking water (Clean Water Act, 2006). Some chemicals such as liquid fuels and other chemicals are not removed from water, even with a water treatment system. In some cases when the pollution cannot be removed, the resulting contamination can ruin a water source forever. It is much easier to keep water clean than it is to try and clean it after it has been polluted. Thus, as per subsection 22(1) of Ontario Regulation 287/07 (General), the objectives of the Source Protection Plan are:

- To protect existing and future drinking water sources in the source protection area.
- Ensure that, for every area where an activity is or would be a significant drinking water threat (i) the activity never becomes a significant drinking water threat, or (ii) if the activity is occurring when the source protection plan takes effect, the activity ceases to be a significant drinking water threat.
- Continuous monitoring programs, including equipment fitted to detect contaminants that exceed the acceptable concentration limits
- A plan designed to response for various impacts and water emergencies when water quality is deteriorating, and the existing processes fail to detect or treat.

The basis of producing a science-based Source Protection Plan for municipal drinking water and assessing their vulnerability to contaminants, relies on identifying practices, policies and tools that would help inventory the activities in and around the water sources/water wells that may pose a threat to the quality of the drinking water sources. Threats here are prescribed by Ontario Regulation 287/07 (General). The Source Protection Plan is intended to be continually reviewed and improved over the long-term. Source protection is essential and complementary to water treatment in maintaining short and long-term clean drinking water sources.

The main purposes of Source Protection Plans are to identify vulnerable areas around municipal drinking water wells and intakes and identify threats that pose risks to the quality or quantity of drinking water within these vulnerable areas (MECP, 2021).

1.2.1. Local Source Protection Initiatives

Source protection initiatives have successfully been in place in Beachburg and Haley Townsite for almost 20 years. Wellhead protection areas and a groundwater vulnerability and threats assessment were completed in 2003 (INTERA, 2003). A WHPA delineation, groundwater vulnerability and a water quality threats assessment were updated in 2022 (Geocentric, 2022, WHPA report), using new and available data collected since 2003, such as water level data, updated municipal pumping rates, and available groundwater chemistry data. Additional demands for growth and development are anticipated in the coming years as Highway 17 is widened to four lanes toward the Township, so it was important to continue to conduct the technical studies and establish plans that will safeguard the current and long-term quality and quantity of the municipal water sources.

Development of a Beachburg and Haley Townsite Source Protection Plan was made possible using the results of the WHPA report (Geocentric, 2022). Our Team used a consultative approach to propose policies

that are appropriate, effective, and economical for local communities, along with analyses that used available science and data to assess drinking water threats and issues. Where there was uncertainty in the data, precautionary approaches were applied. The intent is that the proposed policies and approach is taken into good faith by individuals responsible for the implementation of said policies, and the municipality/township staff.

1.3. Source Water Protection Process

The Clean Water Act requires local communities identify existing and potential threats to the quality and quantity of their drinking water supplies and implement action plans to mitigate or address those threats. The Source Protection Plan falls under the Clear Water Act. A Source Protection plan is a strategy including list of policies designed to protect municipal sources of drinking water from contamination and overuse to protect human health, to ensure availability of potable clean water and to protect current and future water sources (CTCSWP, 2018). The required technical studies include the delineation of wellhead protection areas for municipal wells (#1, Figure 2), the identification of potential water quality threats, such as road salt, agricultural practices, or existing contaminant plumes (#2, Figure 2), and evaluation of the vulnerability of those drinking water sources to surficial sources of contamination (#3, Figure 2). The results of these studies identify the water quality threats that are of greatest concern, so risk management measures can be implemented to mitigate or remove the threats placed on the quality of the drinking water sources (#5, 6, Figure 2). This process includes public engagement (#4, Figure 2) and needs to be updated and evaluated periodically (#7, Figure 2) to ensure it continues to be relevant to the community.



Figure 2: Source Protection Program components

The Source Protection Plan, once approved, may set out policies to address significant drinking water threats, which planning decisions must conform. These policies will affect future activities and land use planning around municipal wellheads and surface water intakes.

There are a variety of policy tools under the Clean Water Act that can be used to meet the objectives of the Source Protection Plan, depending on the type of drinking water threat being addressed. Figure 3 illustrates some of these tools. Many of these tools already exist within the Township and are currently being used to regulate development and land uses. Other tools were created by the Clean Water Act to help fill regulatory gaps. These policy tools include Prohibition of current activities or future activities that would become threats on the water sources if/when established. Another policy tool is the implementation of Risk Management Plans, which are site-specific plans prepared under section 58 of the Clean Water Act to address activities that are significant threats to drinking water if not managed adequately. There are some tools that are in place, such as land use planning, which would be modified under Clear Water Act, to manage proposed activities that are threats to drinking water (e.g., industries close to wellhead protection areas). Some provincial approvals could be put in place to restrict exiting or proposed activities for the purposes of protecting drinking water from contaminations, even if those activities run by the municipality or the township, they require to review and modify their procedure to avoid drinking water threatening activities (e.g., preparing emergency response plan). Educational and outreach programs can help landowners about the impacts of their activities on the drinking water, and incentive programs could help them change the types of those activities on their properties and replace them with practices with lesser impact (Figure 3).



Figure 3: Source Protection Policy Tools

The Source Water Protection Process is based on the current delineation of vulnerable areas; however, any changes in transport pathways such as improperly abandoned wells, or changes in landowners and land-uses, may impact the delineation of the vulnerable area and the vulnerability score. If the Township finds that an activity may result in changes to the delineation and/or vulnerability score of the vulnerable area, then new recommendations may be proposed to amend the Source Protection Plan in place. Therefore, this Source Water Protection Plan and report are based on the current WHPA delineations, vulnerability scores and water quality threats identified for the Beachburg and Haley Townsite water supply wells.

2. Plan Development and Technical Input

2.1. Drinking Water Sources

Drinking water sources could be any water coming from the untreated water in lakes and rivers, and in underground aquifers, that people use for drinking water. For this study, groundwater resources or aquifers are the focus, which are considered highly vulnerable as they may not have enough natural protection above the aquifer.

2.2. Well Head Protection Areas

A thorough groundwater study was completed in 2003 (INTERA, 2003) to evaluate the source area for the two production wells in Beachburg (Dug Well and Drilled Well), and two wells in Haley Townsite that are completed in Precambrian Bedrock Aquifer. For this study (Geocentric, WHPA, 2022), two calibrated FEFLOW models were applied to delineate WHPAs for the municipal wells, and the process applied followed the Ontario Ministry of Environment, Conservation and Parks (MECP) Technical Rules (MECP, 2021) and the Clean Water Act legislation.

Capture zones are areas around a municipal groundwater supply well that are established based on the horizontal time of travel of groundwater through the subsurface to the well. WHPAs are the planning term used to describe the scientifically based capture zones that are delineated around drinking water supply wells and represent the source area for the wells (Figure 4). These zones also represent areas where protection or risk management measures can be implemented to reduce water quality threats within those zones.

The Ontario MECP Technical Rules (MECP, 2021) require that the following WHPAs be delineated for each active municipal drinking water supply well (Figure 4):

- **WHPA-A:** the surface and subsurface area centred on the well with an outer boundary identified by a radius of 100 m.
- **WHPA-B:** the surface and subsurface areas within which the time-of-travel to the well is less than or equal to 2 years but excluding WHPA-A.
- **WHPA-C:** the surface and subsurface areas within which the time-of-travel to the well is greater than 2 years, but less than or equal to 5 years.
- **WHPA-D:** the surface and subsurface areas within which the time-of-travel to the well is greater than 5 years, but less than or equal to 25 years.
- **WHPA-E:** for any groundwater wells that are classified as Groundwater Under Direct Influence of surface water (GUDI), WHPA-E is delineated as the area of land that drains into the surface water body measured from the high-water mark and the area must not exceed 120 metres.

WHPA-A to -D zones and capture zones are projections to ground surface and do not indicate that a contaminant released or spilled on the ground surface will travel to the municipal supply well within the specified period (e.g., two years). The time for a drop of water released at surface to reach a municipal well screened at depth, or beneath a confining layer, may be much longer than the capture zone time-of-travel suggests, because the vertical time-of-travel from surface to the top of the aquifer is not incorporated into the time-of-travel capture zones. Despite the level of conservatism, the time-of-travel methodology is appropriate as improperly abandoned boreholes or surface excavations have the potential to allow surficial contaminants to quickly migrate from surface to the municipal water supply aquifer.

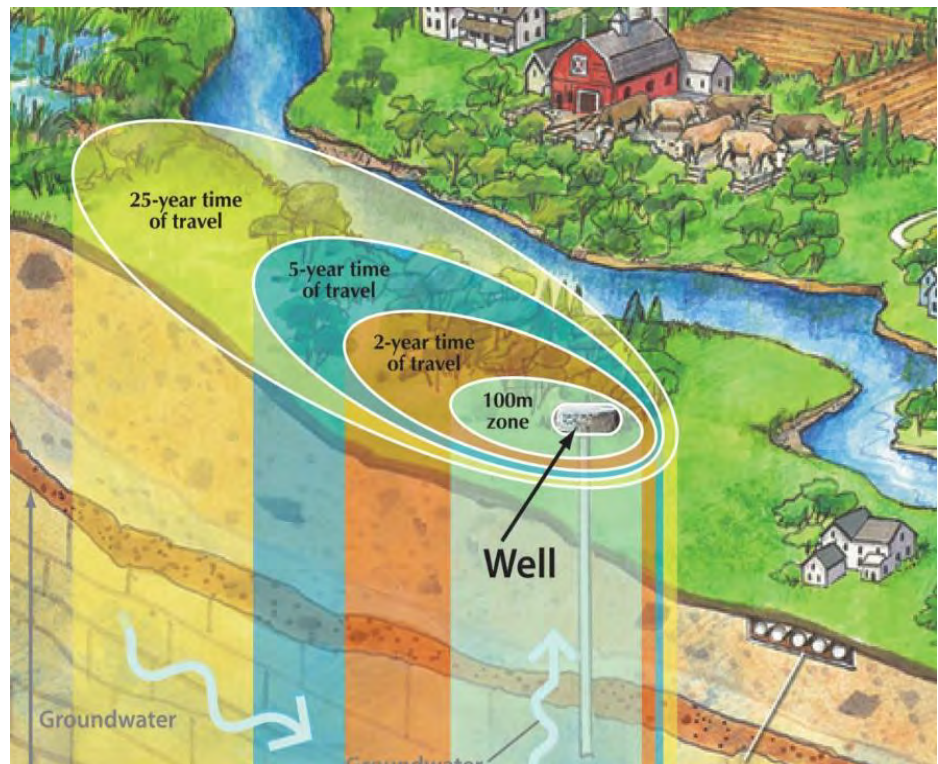


Figure 4: Delineation of capture zones around a well

The Beachburg and Haley Townsite WHPA study (Geocentric, WHPA, 2022) included the delineation of WHPA-A through -E zones for the groundwater supply wells. In Beachburg, WHPA-A is the 100 m radius around the well and extends beneath Jackson Lake that lies just south of the wells. The WHPA-D extends south of the wells to Little Lakes (Figure 5).



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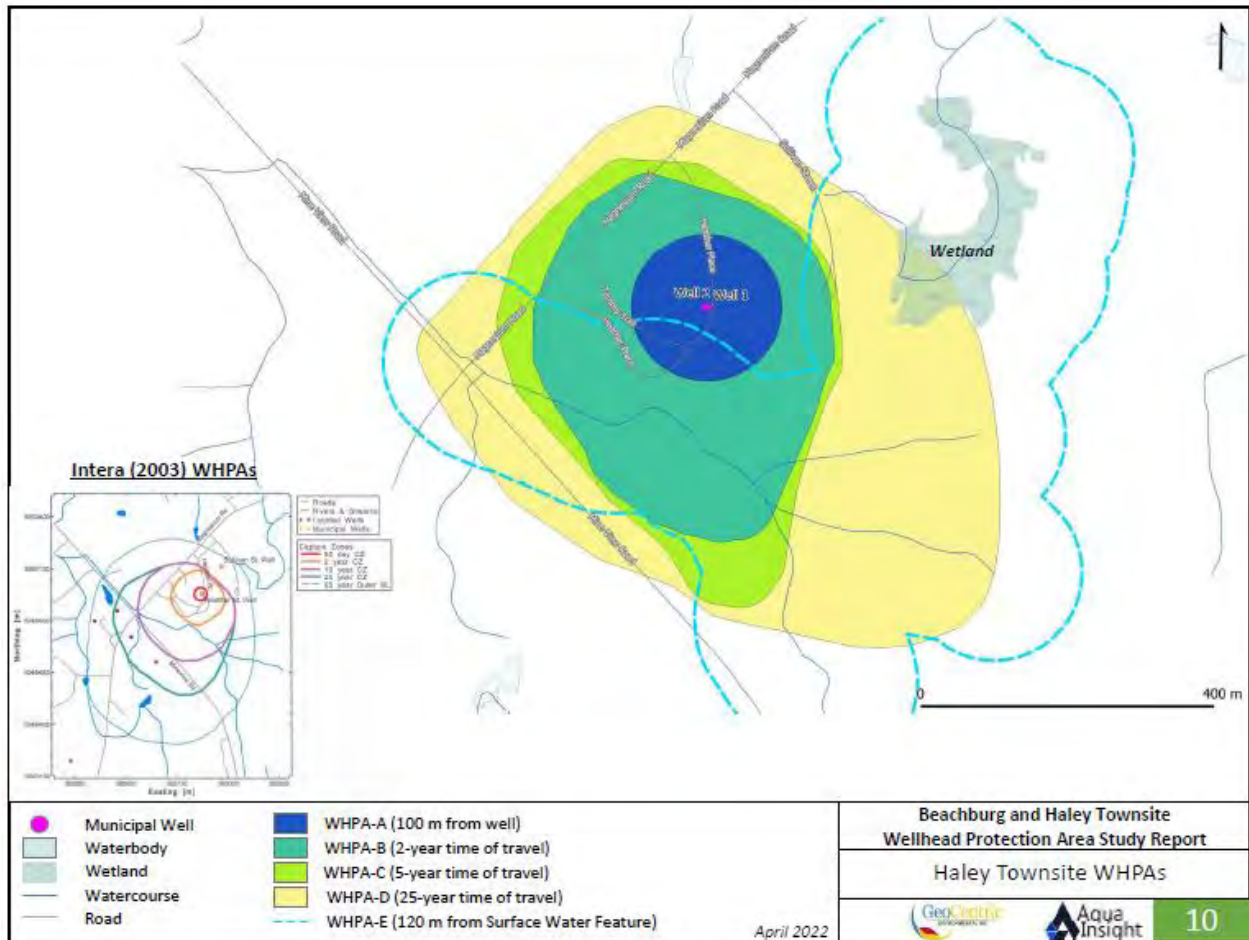


Figure 6: Haley Townsite Wellhead Protection Area (WHPA A to E) (from Geocentric and Aqua Insight, 2022)

Using data contained within all available borehole, water well or monitoring well records in the area, the project team assigned vulnerability scores using methodologies prescribed in the Technical Rules (MECP, 2021). The groundwater vulnerability for the Dug and Drilled Wells in Beachburg were classified as high as these wells are screened in an unconfined sand and gravel aquifer and as such, are susceptible to surficial sources of contamination. Meanwhile, Haley Townsite wells are also unconfined to semi-unconfined, so the vulnerability of Haley Townsite wells is also considered high. The wells are screened at depth but as the groundwater is extracted from fractured bedrock aquifer, there is potential for quick movement of contaminants from surface sources to migrate to the well.

The main objective of this report is to document the establishment of the wellhead protection areas, identification of water quality threats and development of robust and site-specific best management practices that include identifying, evaluating, and mitigating water quality threats using detailed monitoring programs and community awareness (Figure 7).



Figure 7: The planning of this report

2.3. Drinking Water Threats

There are two types of drinking water threats, ones that impact the quantity of the municipal drinking water supply well(s), and ones that impact the quality of the municipal drinking water supply. A drinking water quantity threat is defined as: a) a competing water demand near a municipal well(s) or intake that removes water from the groundwater aquifer or surface water body or b) a land use activity that reduces groundwater recharge to the underlying municipal aquifer via increased percentage of impervious surface. In the Beachburg and Haley Townsite area, the current and future municipal water demands are far lower than the permitted rates so long-term water quantity from the existing municipal aquifers are not a concern. As such, the focus of this project was on characterizing and identifying water quality threats and not water quantity threats.

Drinking water quality threats are defined as activities that may pose a risk to the municipal drinking water quality. The Province of Ontario (MECP, 2021) lists the following twenty drinking water quality threat activities:

- Sewage systems – their establishment, operation, or maintenance (including Septic Systems)
- Snow and Road salt: application, handling and storage
- Fuel: handling and storage
- Chemicals or organic solvent: handling and storage, and if/when used for de-icing: managing the runoff
- Waste disposal sites: establishing, operating and maintaining. Those sites are defined as both receivers and generators of waste
- Agricultural Practices: agricultural source material or commercial fertilizers (application to land, storage, management)
- Non-agricultural source material: application, handling and storage
- Land Associated with livestock: use of grazing, pasturing, confinement
- Fertilizer and pesticides: application, handling and storage
- Other Permitted practices

Threats are then categorized as significant, moderate, and low drinking water quality threats depending on the type of threat, and the vulnerability score, which is a combination of the vulnerability of the aquifer and the WHPA zone.

2.3.1. Sewage/Septic Systems

Sewage systems are essential for residential and commercial development but can also pose a serious risk to sources of drinking water, as when a septic system fails or is not functioning in an optimal manner, it can release waste and bacteria into the groundwater flow system and contaminate the drinking water source ground or surface water with pathogens, phosphorus, chloride, lead, acetone, or other contaminants. Septic systems may include leaching bed systems, earth pits, greywater systems and cesspools.

In the case of Beachburg and Haley Townsite, the operation, and maintenance of the local residential septic system, is one of the most important water quality threats, identified in the delineated WHPA areas. Septic systems are assumed to be used at all rural residential lots in both Beachburg and Haley Townsite. Septic systems that are not properly maintained and/or older can contribute to pathogen and chemical contamination in groundwater aquifers. Septic effluent disposal systems may contribute nitrate and bacteria such as E. Coli to the groundwater system.

A total of 33 and 25 Significant Drinking Water Threats (i.e., septic systems) were identified in Beachburg and Haley Townsite WHPAs, respectively. In the Beachburg area, fifteen septic systems lie within the WHPA-A (100 m from the municipal well) and an additional eighteen septic systems are located in the WHPA-B, and all of these are classified as Significant Water Quality Threats. Septic systems located in the WHPA-C and -D are classified as Moderate Water Quality Threats (Figure 5). In Haley Townsite, nine septic systems lie within the WHPA-A and sixteen in the WHPA-B, and all of these are classified as Significant Water Quality Threats, while septic systems in the WHPA-C or -D areas are considered Moderate Water Quality Threats (Figure 6). There are elevated levels of E. coli and total coliforms present in the raw water quality samples collected at both Beachburg and Haley Townsite water supply wells, and the source of the E. Coli and total coliforms are interpreted to be derived from septic systems located within the WHPA-A and -B.

2.3.2. Salt and Snow Storage and Management

As more roads are built and more development occurs across the landscape, road salt application rate will continue to increase. Road salt can contaminate drinking water with sodium and/or chloride which is difficult to treat. In a 2001 report published by Environment and Climate Change Canada (ECCC), concluded that high releases of road salts were having an adverse effect on freshwater ecosystems, soil, vegetation, and wildlife (Conservation Ontario, 2018, Government of Canada, 2022). Accordingly, the ECCC Code recommends that areas where the groundwater is classified as having a high vulnerability require additional salt management measures. ECCC includes protection of areas that drain into groundwater recharge areas for municipal wells as high vulnerability areas, as road salts could raise chloride and sodium concentration levels.

Salt application is considered a significant drinking water threat based on the percentage of total impervious surface area where road salt may be applied. Impervious surfaces include asphalt roads, or any land surfaces used for vehicular traffic, parking and/or pedestrian paths. Salt application is considered a Significant Drinking Water Threat when greater than 30% of the WHPA area may have road salt applied, and where the vulnerability score of that area is greater than 8.

Meanwhile, road salt storage facilities may also be classified as Significant water quality threats if not cited in the proper location. Road salt becomes a significant drinking water threat-based on the mass of the salt and the type of storage facility where its kept. In other words, if the salt is stored where it can be exposed to precipitation or runoff and is located in an area near a municipal well and where the vulnerability score is high, the facility may become a Significant Water Quality threat.

Similarly, storage of snow is considered a potential drinking water threat under the Clean Water Act. This includes snow that is pushed into larger piles on a property parking lot or snow disposal sites, the Act excludes snow accumulated on the roadsides. Stored snow becomes significant threat when melting snow piles release chemicals from paved surfaces including oil/grease, heavy metals, and cyanide as runoff into the drinking water resources. There are multiple factors to consider when categorizing accumulated snow as threat, such as the types of chemical contaminants, and the size of the snow pile and storage site, and the vulnerability score where the snow accumulates.

In Beachburg and Haley Townsite, application of road salt was identified as Moderate drinking water threat. In Haley Townsite specifically, the application of road salt in the WHPA-A and -B zones is considered a Moderate Drinking water threat, while it is considered a low drinking water threat in the WHPA-C and -D zones. Sodium concentrations at the Haley Townsite wells have been noted to be higher than the Ontario Drinking Water Standards, so the management of salt within the streets and roads near the wells within the WHPAs should be monitored to reduce the impacts on the municipal water sources.

2.3.3. Fuel

Fuel and types of fuels could spill or infiltrate into groundwater aquifers contaminating groundwater resources, becoming a significant water quality threat. Fuel oil, which is common as home heating oil, contains benzene, toluene, ethylbenzene, and xylene. These chemicals are known to impact human health, and some are known carcinogens and can cause birth defects.

When these compounds enter drinking water, they can negatively affect reproductive, respiratory, immune, and nervous system health. Potential sources of fuel contamination could be associated with automotive garages, where fuel and/or engine oil or battery acid could spill and infiltrate into the pervious surrounding areas. Fuel spills could also come from fuel storage tanks associated with commercial or residential properties such as heating oil tanks. Those stored barrels can act as drinking water threats for underlying groundwater aquifers. The biggest threat from fuels is associated from the storage of the liquid fuel in a tank. The category of significance as drinking water threat would be determined based on the volume of the fuel, how and where it is stored and potential chemicals it may release in case of spills. Depending on the volume of the fuel, the type of the chemical and the location of the storage the threat level is determined.

During the site visit to both Beachburg and Haley Townsite, there did not appear to be large fuel storage facilities; nevertheless, they may exist on homeowner lots, so they are drinking water quality threats that are flagged as part of the Plan.

2.3.4. Chemicals

Chemicals or dense non-aqueous phase liquids (DNAPLs) include organic solvents, adhesives, varnishes, and resins used in manufacturing, commercial autobody shops, metal treatment workshops, or chemicals used at dry-cleaning operations. Chemicals at those commercial and industrial sites can pose a significant threat to sources of drinking water. DNALPs do not dissolve in water, but sink to the bottom of the aquifer, making its filtration and treatment not only difficult, but sometimes impossible. Wells contaminated by DNAPLs are often best to be decommissioned as any chemical spill will make the water undrinkable. It is easier to prevent contamination than to clean chemical spills. Therefore, prevention is the only effective way to deal with DNAPLs and chemicals and prevent them from getting into the water sources in the first place.

Chemicals and DNAPLs need to be stored, used, and disposed of properly, and handling chemicals and DNAPLs should be within the drinking water threat planning. The level of significance of chemical contamination is determined based on the location of the handling or storage of the chemical and the type of chemical. For example, close to a wellhead (WHPA-A), any chemical related activity is classified as a Significant drinking water threat. The chemical category, and along with the DNAPLs, there are also the organic solvents, which are substances that dissolve or disperse in water. The significance of threat from organic solvents are similar to that of DNALPs, thus organic solvents require certain measures of handling, storing, and using.

In Beachburg and Haley Townsite, there no industrial sites in the WHPA A zones, and a during the site visit there did not appear to be any facilities that store DNAPLs or other chemicals, besides possible small residential workshops. As part of the evaluation, this report will still consider the potential presence of these chemicals as part of the Source Protection Plan framework.

2.3.5. Waste Disposal Sites

Waste sites undergo thorough reviews to ensure they are located in the most appropriate, and least vulnerable areas. Future waste sites will not be permitted where they would pose a significant threat to drinking water. Some types of waste are hazardous and can harm our health such as industrial wastes, recycling depots in retails stores or disposal of used oil (Drinking Water Source Protection, 2015). Waste stores or disposed, even within the waste sites, could leach into the ground and into the aquifers contaminating municipal or private wells or surface water bodies (Drinking Water Source Protection, 2015).

The type of waste at the waste site, and the vulnerability score(s) at the waste site together determines the threat level or significance of the drinking water threat. For example, untreated seepages from the waste site could cause potential pathogen or nutrient contamination, and if the waste site is used to store or discharge tailings from mine sites, then the type of chemicals found in the tailings will also play a role

in determining the significance of the threat. Landfills that contain municipal waste or industrial waste factor into the significance of the drinking water threat depending on the size of those sites and the type of chemicals contained within them that could migrate into the underlying groundwater flow system or nearby surface water bodies.

There are no identified landfills or waste disposal sites found within the WHPAs (Geocentric, WHPA, 2022). There are large extents of lands that are vacant within the WHPA areas at Beachburg and Haley Townsite, which should not be used at any point in the future as a potential waste disposal site, unless clear mandates and monitoring programs are set in place.

2.3.6. Agricultural Practices- Management, Storage, Land Applications

Agricultural activities such as the storage and land-application of agricultural source material (ASM) is material produced on a farm that is applied to land, usually as a fertilizer. Agricultural Source Material is applied to improve the growth of crops and for soil conditioning and it has the potential to result in elevated concentrations of contaminants like nitrogen, phosphorus, and pathogens being introduced into drinking water sources. Agricultural source material (ASM) could be in any of the following forms: (1) manure produced by farm animals (most common type) (2) runoff from storages (3) wash water (4) biproducts of anaerobic digestion, etc. (Drinking Water Source Protection, 2022). Pathogens, such as *E. coli*, are microscopic organisms capable of causing serious infections or infectious disease in humans, thus if any of those contaminants are found in the drinking water sources, they can cause human health issues.

When identifying the significance of drinking water threats associated with the storage and handling of ASM, the amount of material applied, the extent of the lands managed and the vulnerability score of the vulnerable area are all factors. Similar to application, storage of ASM can also pose a significant threat to drinking water sources, and the circumstances depend on the type of the storage facility (temporary, permanent), the location and the size of the facility or the amount stored and the location (as well as the vulnerability score where the facility is located).

In Beachburg town, and based on the delineated WHPAs, including the WHPA-E area, there are no areas that are currently used for agricultural purposes, and the total managed lands are less than 40% of the vulnerable area, which means the management, storage and application of agricultural source materials is classified as a low drinking water threat. There is potential for fertilizers to be applied in the residential lots; however, the percentage of the WHPA areas is still below the 40% threshold specified in the Technical Rules (MECP, 20217), so the potential for threats due to agricultural source material application on managed land is considered low.

In Haley Townsite, there is a small area of the WHPAs located north of the residential subdivision that is used for agricultural purposes, and the management, storage, and application of agricultural source material on these lands is considered to be a Low drinking water threat.

2.3.7. Non-Agricultural Source Material

Non-agricultural source materials (NASM) are materials produced off-farm, such as biosolids, that are used as a fertilizer and/or applied to land to improve the growth of crops and for soil conditioning. NASM

includes pulp and paper biosolids, anaerobic digestion output, and any other material that is not from an agricultural source that can be applied to land as nutrients (Drinking Water Source Protection, 2022). The improper storage or application of NASM can contaminate surface water or groundwater with nutrients (such as nitrogen and phosphorus) or pathogens. Pathogens, such as E. coli, can cause serious infections or infectious disease in humans, and as such, NASM has potential to contaminate drinking water. The Clean Water Act and Nutrient Management Act (Ontario Regulation 267/03) works to classify the management, storage, and handling of NASM as potential drinking water threats (Drinking Water Source Protection, 2022). NASM becomes a Significant drinking water threat when there is a spill of the material or runoff from the storage area which results in the presence pathogens or nutrients seep into the drinking water source. The significance of the threat increase depending on the type of storage site, the location, the quantity, and type of stored material, in conjunction with the vulnerability score in the vulnerable area.

NASM does not appear to be a major threat to the drinking water quality in the municipal wells in Beachburg or Haley Townsite, as there are no areas that are currently used for agricultural purposes within the delineated WHPAs, including WHPA-E zones. Thus, NASM is not considered a significant drinking water threat in the Townsite, unless there were land use changes made in the future to the vacant lands located within the WHPAs.

2.3.8. Land Associated With Livestock- Grazing, Pasturing, Confinement

The use of land for livestock grazing and pasturing, which refers to forage crop production where animals do the harvesting is a prescribed drinking water threat under the Clean Water Act. Confinements are also drinking water threats and are defined as areas with no roof that include high animal concentration areas where animals are fed and watered, and grazing provides less than 50 percent of their feed, or areas where farm animals are concentrated, and where food and water are not provided. The circumstances within which those activities take place determine the significance of the threat, for example, the livestock density, the number of animals, and the type of activity (as well as the vulnerability score where the livestock are present). Grazing, pasturing, and confinement are types of activities that result in presence of nutrients such as Nitrogen, total phosphorus, and/or pathogens such as E. Coli, being infiltrate into the groundwater or surface water body. Pathogens can be excreted from a range of livestock and are capable of producing infections or infectious disease in humans (Drinking Water Source Protection, 2022). Due to the impacts of those contaminants on water resources, the Clean Water Act designated activities related to livestock grazing as drinking water threats.

Surface water is especially vulnerable to contamination from pathogens, and in Beachburg, there is a large water body (Jackson Lake) that overlies the WHPA zones. No barns or livestock were mapped to be present within 200 m of Jackson Lake, and no agricultural land uses were identified in any of the Beachburg WHPAs. Therefore, there is a Low potential for nutrient application associated with Livestock Density to exceed crop requirements, and there are no Moderate or Significant drinking water threats associated with Livestock Density in the Beachburg area.

In Haley Townsite, there was one livestock barn noted during the site visit, that is outside the WHPA zones, but associate with the land use mapped as agricultural on the northwestern side of intersection between Magnesium Road and Mine View Road (Figure 6). It is believed that the barn is no longer operational; however, it is important to consider the possibility that the barn would still contain livestock and a very conservative assessment was conducted with the assumption that swine may be contained within the barn, which could produce nutrients (0.69 Nutrient Units per acre) that are greater than 0.5 NU/acre threshold defined in the Technical Rules (MECP, 2021) but less than 1.0 NU/acre. Even under this very conservative assumption, the drinking water threat associated with livestock grazing and pasturing and the potential for nutrient application to exceed crop requirements was classified as Moderate in the WHPA-B, and Low Drinking Water Threat in remainder of the WHPAs.

2.3.9. Fertilizer and Pesticide – Storage and Application

Commercial fertilizers are synthetic substances containing nitrogen, phosphorus, potassium, or other chemicals, which aim to improve the condition of soils or to aid in plant growth or crop yields (Trent Conservation Coalition, 2014).

When considering fertilizers, both handling and storage are prescribed as drinking water threats. While applying fertilizers, it could become a significant drinking water threat depending on the percent managed land in which the fertilizers are being applied and the local livestock density. Meanwhile, storage of fertilizers and pesticides can become significant threat to drinking water depending on the mass of all materials stored the type of storage and the potential for a spill of the fertilizer.

Pesticides include herbicides, insecticides, and fungicides. These types of compounds can contain several harmful chemicals which can enter sources of drinking water. Pesticides as per the Clean Water Act, 2006 are defined as an organism, substance or thing that is manufactured, represented, sold, or used in controlling, any pest that harm the growth, development of the plant life. Pesticides include a variety of substances that may be a source of chemicals to a drinking water source. Like fertilizers, handling and storage of pesticides are prescribed as a drinking water threat. When applying pesticides, the significance of the threat is based on the type of the chemical, the land area where it is applied (size and location).

In Beachburg, there were no greenhouses or agricultural lands within the WHPA zones, nor did it appear to be any storage or handling issue relating to pesticides or fertilizer.

In Haley Townsite, there is a small area used for agricultural purposes in the WHPA-B to -E zones; thus, there was a possibility of drinking water threats due to fertilizer and pesticide storage and application. As the areas used for agriculture are less than 40% of the total WHPA area; fertilizers and pesticides were considered Low drinking water threats in Haley Townsite.

2.3.10. Other Permitted Practices

Transportation such as roads, railways or shipping lanes could be transporting dangerous and hazardous goods. Those transportation corridors increase the vulnerability of drinking water protection zones, because when any of the hazardous transported goods is spilled it could contaminate surface and groundwater. Given the potential for drinking water sources to become contaminated along

transportation corridors, the Clean Water Act allows policies to be developed that address this concern, by recommending policies for spill preventions and emergency response plans in case of an accident spill (Drinking Water Source Protection, 2022).

2.4. Source Water Plan Objectives

The objective of the Source Protection plan is to ensure that each of the drinking water threats associated with the potential sources of contamination are identified and protective measures are in place to ensure a long-term viable drinking water source for the communities.

2.5. Land Use Policy and Official Plan

As part of the Regions Land use Policy and the Official Plan, there should be an emphasis on the identification and protection of lands within the WHPAs and potential restrictions on the future land uses are in the area. As some vacant lands lie within the wellhead protection areas, surficial sources of contamination have the potential to impact water quality at the drinking water wells. consequently, any changes in land development in those vacant land areas be given consideration for potential threats placed on the water quality. For example, an auto wrecker, dry cleaner, or similar commercial establishment may be permitted in the area as long as there are risk management plans in place to eliminate or mitigate potential chemical releases to the underlying municipal aquifer.

2.6. Future Considerations

Any future development or expansion of the towns, construction of roads, widening existing ones, additional residential homes, or industrial sites, have the potential to act as new drinking water threats to both the quantity and the quality. Continuous monitoring of current and existing activities of handling and storing road salt, fuel, chemicals fertilizers and pesticides is recommended.

3. Protection Plan Framework

3.1. Establishment of Source Protection Policy Areas

Based on the WHPA study report (Geocentric, 2022), source protection policies will be applied based on the presence of Significant drinking water threats delineated within the WHPA-A to -E zones.

3.2. Risk Management- Land Uses and Contaminant Source Protection

Focusing on the above-mentioned drinking water threats, risk management measures are recommended to be drafted and implemented for the Significant drinking water threats located within the WHPA zones, based on land use activity and contaminant source that may impact the groundwater sources.

3.2.1. Sewage/Septic Systems

Under the Technical Rules (MECP, 2021), septic systems fall under the establishment, operation or maintenance of a system that collects, stores, transmits or disposes of sewage. Septic systems are identified as Significant Water Quality Threats where they lie within WHPA zones with vulnerability scores

of 8 or 10. Leaks from sewage/septic systems could contaminate drinking water sources; therefore, to manage the risk, prevention of such spills is necessary. The existing septic systems in the WHPA-A and WHPA-B in both Beachburg and Haley Townsite, are significant drinking water threats; however, given they fall on private properties, the exact locations of those septic tanks are not known.

Sewage/ Septic Systems	Risk Management Plan Summary
	• Locate the septic system and leaching bed • Ensure septic systems are pumped periodically (3-5 years) • Regularly inspect the system to prevent problems and keep record of septic maintenance • Divert surface water away from the leaching bed • Replace inefficient toilets • If a private septic tank is located near a municipal well, inspectors from the municipality may ensure the integrity of the septic system • Set guidelines on best practices of using septic systems e.g., not to pour cooking oil, hazardous chemicals or pharmaceuticals down the drain • Avoid planting trees and shrubs near the tank and leaching bed

3.2.2. Salt and Snow Storage and Management

Road salt or snow pile accumulation are also sources of infiltrated contamination into the groundwater is not managed properly to prevent any leak/seepage into the aquifers (Government of Canada, 2022; Drinking Water Source Protection, 2022). A Road Salt Management Plan documents what a municipality currently does for winter maintenance and identifies affordable actions they can take to improve their management of road salt. The handling and storage of road salt is a significant threat if it is stored in a manner that may result in exposure to precipitation or runoff (Drinking Water Source Protection, 2022). Risk Management Plan of existing storage of road salt and storage of snow (at snow dumps where snow is hauled from another location) are designated for the purpose of Section 58 of the Clean Water Act, requiring a Risk Management Plan in areas where the threat is significant (Drinking Water Source Protection, 2022).

Salt	Risk Management Plan Summary
Salt Application	• delivering the right amount of road salts in the right place at the right time • training personnel and monitoring the effectiveness of salt application technique, and encourage smart salt practices for municipally owned parking lots, sidewalks and other public facilities • benchmarking spreader routes, calibrating existing equipment, establishing/reviewing level of service policies and tracking material usage • Implementation a Road Salt Management Plan for these areas in accordance with Environment Canada's Code of Practice for the Environmental Management of Road Salts

In summary, for all road salt management plans, it is necessary to update/establish salt management plants to account for the delineated vulnerable areas.

3.2.3. Fuel Handling and Storage

Risk Management Plan for the existing or future handling and storage of fuel at a facility as defined in Section 1 of Ontario Regulation 213/01 except for the handling and storage of fuel regulated under the Safe Drinking Water Act is designated for the purpose of Section 58 of the Clean Water Act, is focused on areas where the threat is or would be significant (Drinking Water Source Protection, 2022).

Source of fuel leaks from private properties or commercial units are often linked to existing fuel tanks. The risk management plan on prevention is the key to a successful fuel handling and storage plan.

Fuels	Risk Management Plan Summary
Develop risk management plan to reduce the risk to source water using the existing procedures and introducing new ones.	• Choosing double walled tank with secondary containment. If single walled, Fuel tanks must be replaced every 10 years • Replacement or new tanks must be more leak resistant than single-walled steel outfitted with a tank tray to capture fuel in the event of an overfill or small leak • Installation of fuel tank be done away from floor drains or openings on the floor to prevent spills, with an overfill protection or drip trays under the tank. • Annual inspections must be carried out by a certified Oil Burner Technician, and prompt repairs and upgrades when deficiencies are noted. • Monitoring the tank for evidence of rust, wet spots, excessive dents on the tank • Oil lines must be installed and maintained in a manner that protects them from physical damage • Establishing a procedure to follow in an event of a spill • Decommission unused fuel oil tanks in accordance with Section 6.16 of the Ontario Installation Code for Oil-burning Equipment. • Prohibition of future business (gas stations), especially, that require stored fuel of more than 250 liter stored below grade.

Handling and storing fuel (existing and/or future) may become a significant drinking water threat (as per definition in Appendix B of Clean Water Act). Field visits suggests, currently Beachburg and Haley Townsite have some areas of WHPA-A and -B that include residential or industrial land uses that may have fuel storage tanks.

3.2.4. Chemicals

Local Source Water Protection Plans may contain policies that safeguard the quality and quantity of municipal drinking water sources. Some of the policies manage the risk posed by storage and use of

chemicals and other toxic substances. Some policies provide conditions on how or where they are used, in what volumes, or what measures need to be in place in the event of an accidental spill. Some policies may prohibit their use in certain situations. The handling and storage of a dense non-aqueous phase liquid (DNAPL) and/or organic solvent of any quantity for commercial/industrial uses are Significant drinking water threats in areas where the vulnerability score is greater than or equal to 6. Risk management plans are required for these activities in these areas.

Risk management plan for the existing handling storage of DNAPL and organic solvent substances is designated for the purpose of Section 58 of the Clean Water Act, requiring a Risk Management Plan in areas where the threat is Significant.

Similar to risk management of fuel, managing chemicals need to focus on prevention rather than treatment, as there are types of chemicals which are impossible to treat once they are infiltration into the water source. If chemicals contaminate a source municipal drinking water, it is possible that a new municipal well or drinking water source should be established (Drinking Water Source Protection, 2022).

3.2.5. Waste Disposal Sites

Waste disposal sites pose the highest significant threat to drinking water sources within the WHPA-A or B (Drinking Water Source Protection, 2015). Waste disposal sites require Environmental Compliance Approval based on an established risk management plan that existing waste storage sites are managed and monitored properly. However, no new waste disposal sites are allowed to be established within the vulnerable areas after the delineation and establishment of source water protection sites/zones (Drinking Water Source Protection, 2015; Drinking Water Source Protection, 2022). No action or risk management plan summary is required at this time.

3.2.6. Agricultural Practices- Management, Storage, Land applications

The application or storage of any amount of ASM is considered a significant drinking water threat in areas where the vulnerability score is greater than or equal to 8, because of potential pathogen infiltration into the water resources. Pathogens can cause serious health problems, thus, any amount of ASM (without a minimum or maximum limit) is considered significant threat to drinking water within the delineated protected areas around the source well (Drinking Water Source Protection, 2022). Where ASM land application and storage current or future can become a significant drinking water threat, it is then governed by Prescribed Instrument (Nutrient Management Strategy or Plan developed under General Regulation 267/03 of the Nutrient Management Act), this activity shall continue to be managed through the existing regulatory requirements administered by the Ontario Ministry of Agriculture, Food and Rural Affairs. No action or risk management plan summary is required at this time.

3.2.7. Non-Agricultural Source Material

The application or storage of any amount of NASM that contains material from a meat plant or sewage works is considered a significant drinking water threat in WHPA A with vulnerability score is 8 to 10. Similar to ASM, NASM is also a pathogen threat, thus there is no minimum or maximum limit of volume or mass,

thus, NASM is considered a significant threat within a certain proximity to a municipal drinking water source. The existing and future land application, handling, or storage of NASM is designated for the purpose of Section 58 of the Clean Water Act, requiring a Risk Management Plan in areas where the threat is or would be significant. The storage of NASM that does not contain material from a meat plant or sewage works is considered a significant drinking water threat depending on the location of storage (above or below grade), the type of storage (permanent or temporary field storage) and the mass of nitrogen in tonnes when the storage is located in, i.e., WHPA A with vulnerability score 9 to 10 (Drinking Water Source Protection, 2022). No action or risk management plan summary is required at this time.

3.2.8. Land Associated with Livestock- Grazing, Pasturing, Confinement

The use of land as livestock grazing or pasturing, an outdoor confinement area or a farm-animal yard for one or more animals is considered a significant threat in WHPA areas with vulnerability score between 8 and 10, because the threat from livestock is a pathogen threat. Since any quantity of pathogens could cause serious health issues, no minimum limit is set for this drinking water threat (Drinking Water Source Protection, 2022). The use of land or plot as outdoor confinement for animals, current or in the future, is considered a Significant drinking water threat and is governed by a Prescribed Instrument (Nutrient Management Strategy developed under General Regulation 267/03 of the Nutrient Management Act).

Current and future land that will be used for livestock grazing, pasturing or confinement is designated by Section 58 of the Clean Water Act and require a Risk Management Plan. This plan is not applicable to small scale, non-intensive farms.

3.2.9. Fertilizer and Pesticide – Storage and Application

Any amount of commercial fertilizer applied to land is considered a significant drinking water threat in areas where the level of agricultural activity is already high. The application and the storage of commercial fertilizer (existing and/or future) would be a significant drinking water threat government Prescribed Instrument Nutrient Management Plan developed under General Regulation 267/03 of the Nutrient Management Act). Activities relating to commercial fertilizers are designated by Section 598 of Clean Water Act and require Risk Management plan in areas where it is significant drinking water threat. The Risk Management Plan should demonstrate and ensure compliance with Canadian Fertilizer Institute guidelines and codes of practice where appropriate. The future handling and storage of commercial fertilizer for retail sale is designated as prohibited under Section 57 of the Clean Water Act in areas where the threat would be significant. The existing handling and storage of pesticide at a manufacturing, processing, or wholesaling facility, retail outlet or custom applicator's storage yard is designated for the purpose of Section 58 of the Clean Water Act, requiring a Risk Management Plan in areas where the threat is significant (Drinking Water Source Protection, 2022).

Fertilizer and Pesticide	Risk Management Plan Summary
Developed risk management plan to reduce the risk to source water using the existing	The handling and storage of commercial fertilizer is considered a significant drinking water threat when more than 2,500 kilograms is stored for retail sale.

procedures and introducing new ones.	- The handling and storage of a pesticide is a significant threat depending on the amount stored and the purpose of the storage - Where the application of pesticide (existing and/or future) is or would be a significant drinking water threat Prescribed Instrument governs the activity
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3.2.10. Other Permitted Practices

One of the examples of other permitted practices are related to the construction and expansion of highways, or the transport of hazardous goods/material using these roads/highways, given the risk of an accident and spillage. Ontario Regulation 287/07 (under the Clean Water Act) contains the requirement regarding transport pathways, that a person requires and approval to engage in an activity in a WHPA, which may result in creation of a new a new transport pathway or the modification of an existing transport pathway (Drinking Water Source Protection, 2022).

The Township is strongly encouraged to ensure that local first responders have information about the Wellhead Protection Areas and Intake Protection Zones and should update Emergency Response Plans.

Transporting Hazardous Material	Risk Management Plan Summary
Ensure that municipalities are prepared for emergencies and spills within the vulnerable areas and have up-to-date procedures and information.	- First responders should update their Emergency Response plan to include maps to show the location of municipal drinking water systems and associated Wellhead Protection Areas - They should incorporate requirements to contain water and chemicals used to suppress fires that occur in these areas - Establish Spill contingency measures for spills of any potential contaminant (e.g., fuel, chemicals, septage), and update spill response procedures for the purpose of protecting drinking water sources with respect to spills that occur within a Wellhead Protection Area

3.3. Site Monitoring

Throughout the establish risk management plan and the Prescribed Instrument governing the application of the guidelines and policies regarding the drinking water threats, continued site monitoring is important following these policies.

Prohibited Land Use	Risk Management Plan Summary
Ensure that specific land uses never become established in areas where the associated activities would be significant drinking water threats.	The following land uses must be prohibited from becoming established in the future in part of WHPA-B: waste disposal sites involving activities that would be significant drinking water threats, wastewater treatment facilities that would be significant drinking water threats
Low Impact Development	Risk Management Plan Summary
Encourage municipalities to incorporate low impact development into new/expanding	Municipalities should consider how to incorporate low impact development techniques related to proposed

developments to reduce impervious surfaces, maintain natural recharge and maximize infiltration of clean water prior to collection in a stormwater management facility.	stormwater management plans for a new/expanding development in the WHPA (not including single lot residential development).
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In conclusion, the significant water quality threat in both Beachburg and Haley townsite found to be the septic systems, and their operations and maintenance. Elevated E-Coli levels are observed at the water supply wells that are interpreted to be attributed to improper maintenance and operation of septic systems in Beachburg, where nitrate and bacteria infiltrated into the groundwater flow system toward the municipal wells.

Overall, there is a level of uncertainty when assessing the drinking water threats, because of the lack of detailed data of water level, and water quality data around the water resources wells. However, with the available land use and water use data in the area, the significant drinking water, and risk management plans have been suggested. For both Beachburg and Haley Townsite, it is highly recommended to ensure the hydrogeologic information are always up to date over the time to remove any uncertainty around the WHPA delineation and the drinking water threats.

4. Plan Education and Outreach

4.1. Overview

The primary source of drinking water for the Beachburg and Haley Townsite for individuals and communities is groundwater. The overall goal of the Source Water Protection Plan Education is to provide local end users with the information necessary for them to consider how to proactively protect the sources of drinking water for these areas, to consider protecting these sources for the long term where a municipal drinking water supply may be required in the future, and to manage activities that would pose a threat to the quality of the public groundwater sources.

The Township of Whitewater Region can play an integral role in coordinating the implementation of the Source Protection Plan so that there is consistent messaging and a centralized location for source protection information across the area. The Region could also deliver, specific education and incentive programs to fill gaps.

The Township should consider coordinating its targeted efforts, as well as those of local Stakeholder and communicate via with those Stakeholders to updated drinking water source protection information in the wellhead protection areas where significant drinking water threats can or do exist.

The community education and outreach could benefit from different initiatives that may include but are not limited to:

1. Outreach with local Stakeholders
2. Groundwater Protection Information Announcements; and
3. Source Water Protection Road Signs

4.2. Local Outreach with Stakeholders

Education and outreach programs in the vulnerable areas are crucial to the success of source water protection plan implementation. The end goal is to build support through understanding and integration of practices to protect sources of drinking water from contamination and over-use.

Communication of key source protection messages from trusted professional sources in a manner that is practical and relevant to target audiences is considered an essential component of source protection plan implementation. The following policies (one for significant drinking water threat areas and one for those that are moderate and low) developed under section 22(7) and of the Clean Water Act recognizes that there are many local and provincial groups that manage education and outreach programs aimed at protecting the natural environment and water. The following groups could be approached by the Township with an information package, to help deliver sector-specific source water protection information:

- Local farm organizations and the Ministry of Agriculture, Food and Rural Affairs;
- Canadian Oil Heat Association, local fuel distributor
- Well Aware Program;
- Local Builders and Septic System installers/contractors and
- Ontario Groundwater Association, licensed well technicians and water treatment specialists

4.3. Groundwater Protection Information Announcements

The Township disseminates guidance to the community on a wide variety of matters. The Township is ideally positioned to disseminate information about groundwater protection to the local end users in the Well Head Protection Areas. The information announcements could be provided to the end users by way of:

- Open houses, either specific on Source Water Protection or during other municipal events;
- Use of Township website with important linkages to the Protection Plan;
- Use targeting mail outs with water bills as reminder to local users

4.4. Source Protection Road Signs

Spills along highways and arterial roads could have critical impacts on the Townships abilities to provide safe drinking water. The proximity of the road to the wells or intakes may leave them susceptible to spill contamination. Road signs are one tool that may be useful to help prevent and respond to spill events.

People may be less likely to illegally dump unwanted waste (e.g., old paint, waste oil) in the vulnerable areas if they are aware that a drinking water source could be impacted. Also, emergency responders would be reminded that drinking water treatment plant operators should be contacted in the event of a spill so that action to temporarily suspend drinking water distribution can be taken, if necessary.

5. Recommendations

Based on the work completed as part of the Source Water Protection evaluation (Geocentric, 2022) and the evaluation completed as part of this report, the following recommendations are provided:

- **Data Management:** It is recommended that Whitewater Region assemble the historic and current data to evaluate if there are any increasing trends in the water quality data, such as nitrate, sodium, and chloride that Whitewater Region may wish to address via risk management measures or best management practices before they become water quality issues.
- **Hydrogeological Investigations:** A total of 33 and 25 Significant Drinking Water Threats (i.e., septic systems) were identified in Beachburg and Haley Townsite, respectively. These septic systems should be prioritized as the water quality threats of greatest concern. A hydrogeological assessment should be completed to further prioritize the septic systems that may be having the greatest impact on the water quality at the drinking water wells.
- **Future Refinements:** Refinements to the understanding of hydrogeological settings may result in modifications to the predicted WHPAs including the drilling of new wells. Whitewater Region should update the WHPAs as they collect additional data, refine the understanding of the subsurface geology and hydrogeology, or change the operation of the wells or pumping rates in the future
- **The community education and outreach** could benefit from a number of different initiatives, including but not limited to:
 1. Outreach with local Stakeholders
 2. Groundwater Protection Information Announcements; and
 3. Source Water Protection Road Signs

6. Closure and Limitations

This report has been prepared for the exclusive use of the Township of Whitewater Region. Information, interpretations, and summary comments contained herein are provided for the purpose stated in the Study Objectives. Under no circumstance may this information be used for purposes other than those specified unless formal authorization is provided by Geocentric Environmental Inc.

Hydrogeologic investigations are inexact sciences because groundwater systems are naturally complex, and those conditions must be interpreted between observation and measurement points. Conceptual and numerical models are simplifications of reality, and the validity and accuracy of the model depends on the amount and quality of data available for characterization relative to the degree of complexity of the setting.

Despite the level of care employed, no warranty, express or implied, is made regarding the conditions presented in this report. The insights gained through the characterization process should be used to guide decisions but there may be local level variations in groundwater characteristics.

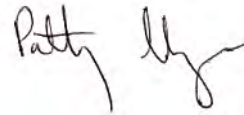
We trust that this information is satisfactory for your present requirements. Should you have any questions or require additional information, please do not hesitate to contact the undersigned. Thank-you for the opportunity to work on this project.

Geocentric Environmental Inc

A handwritten signature in black ink, appearing to read 'S. Livingstone'.

Stephen Livingstone, M.Sc., P.Geo
Principal Hydrogeologist

Aqua Insight Inc.

A handwritten signature in black ink, appearing to read 'Patty Meyer'.

Reviewed by
Patricia Meyer, P. Geo.
Senior Hydrogeologist

7. References

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Meeting Date:	June 16, 2021
Contact:	Ivan Burton, Planner/EDO iburton@whitewaterregion.ca 613-646-2282, Ext. 124

Title:

Provincially Licensed Hauled Sewage Spreading

Recommendation:

That Council of the Township of Whitewater Region receive this report for information purposes.

Background:

Dating back to November 2020, staff and Council have been receiving inquiries relating to hauled sewage spreading sites located in the Township and more particularly west of Beachburg in Westmeath. Since the first inquiry, a group has formed called *Whitewater Raw Sewage* to advocate against the spreading of hauled sewage. In the fall, an anonymous letter was distributed to landowners and more recently, a letter was provided to Council in February 2021, an article was published in the Eganville Leader (May 19), and an email was sent to the Honorable Jeff Yurek, Minister of Environment, Conservation and Park (MECP) on May 28.

Since the first inquiry, staff have had continued dialogue with the Greg Davis, Environmental Officer with the MECP, Ottawa District Office and have generally directed residents to this representative for any questions. Staff have also met with the former Property Standards Committee (Nov. 2020), including Melvin Langton and Andrew Coulas, to discuss the concerns that were raised directly to them.

There is a total of four (4) Provincially licensed hauled sewage spreading sites located at 1444/1446 Zion Line, 168 Davidson Road, 31 Watchorn Drive and 1108 Zion Line. Based on information obtained from MECP, each site has been issued an Environmental Compliance Approval (ECA) which permits them to spread hauled sewage in strict accordance with their approvals, incl. maximum application rates. It is the responsibility of the MECP to regulate, license/approve and inspect these sites to ensure continued compliance. Hauled sewage spreading is permitted to occur

between April 1 to November 30 subject to certain requirements (i.e., snow cover).

Analysis:

Provincial Regulations

Licensed hauled sewage spreading sites are approved by the issuance of Environmental Compliance Approval (ECA) pursuant to Section 27 of the Environmental Protection Act (EPA). ECA's are issued by the Ministry of the Environment, Conservation and Parks and the EPA, among others, established the authority and responsibility of the Ministry, the legal requirements for proponents of various proposals, obligations of the owners of existing facilities and equipment with respect to their impact on public health and the environment, and the rights of residents of Ontario with respect to those proposals, facilities and equipment.

These requirements and rights include the need to obtain approvals or permits prior to implementation of proposals with a potential for impact on public health and /or the environment, and the right of the residents of Ontario to be made aware of proposals, in order that the public has opportunity to comment on those proposals.

If the proposal is subject to the Environmental Bill of Rights (EBR) requirements, any comments that are received from the public as a result of the notification on the Environmental Registry (ER) will be considered in the review.

Provincial Policy Statement

The Provincial Policy Statement (PPS) outlines that appropriate development should be promoted while protecting resources of provincial interest, public health and safety, and the quality of the natural and built environment. Hauled sewage spreading sites are generally included within the definition of the term "infrastructure" which is summarized as physical structures (facilities and corridors) that form the foundation for development including septage treatment systems.

The PPS specifies that healthy, integrated and viable (rural) communities should be supported by ensuring that necessary infrastructure are or will be available to meet current and projected needs to avoid the need for the unjustified and/or uneconomical expansion of this infrastructure. Further, development and land use patterns which may cause environmental or public health and safety concerns should be avoided and the conservation of biodiversity and ecological benefits should be considered.

The Provincial Policy Statement further outlines that a coordinated, integrated and comprehensive approach should be used when dealing with planning matters within municipalities, across lower and upper-tier municipal boundaries, and with other orders of government, agencies and boards.

Official Plan of the County of Renfrew

The County of Renfrew Official Plan provides general development policies relating to Hauled Septage Disposal which is summarized as follows:

- Defines hauled septage as waste removed from a septic tank and permits the use in Rural or Agricultural designations.
- Requires a local zoning by-law amendment for new sites.
- Permits a local municipality to establish minimum separation distances in the zoning by-law for new hauled septage disposal sites and existing or proposed residential, commercial, institutional and recreational uses and associated wells as well as public roads and surface waters.
- Specifies that sites shall be located so that pollution of any watercourse or ground water does not occur.
- Requires that sites be adequately screened, fenced and posted including all open storage areas and disposal site operation.
- Specifies that the operation, maintenance and closing of a hauled septage disposal site shall be in accordance with the standards and regulations of the Ministry of the Environment and Climate Change.

There are also general development policies relating to Nutrient Management and the land application of septage which is regulated by the Province in accordance with the Nutrient Management Act and the Environmental Protection Act.

Whitewater Region Zoning By-laws

Westmeath Zoning By-law No. 98-13 and Ross Zoning By-law No. 23-92 both establish land-use policies to regulate the use of hauled sewage spreading sites. The use is generally defined as *untreated sanitary waste from a septic tank, privy or holding tank*. Both zoning by-laws establish the following similar separation distances:

- i. Two hundred (200) metres of any dwelling on another lot;
- ii. Seven hundred fifty (750) metres of any subdivision or land zoned for residential development;
- iii. One hundred fifty (150) metres of any uncased well;
- iv. Seventy-five (75) metres of any well with a casing depth of six (6.0) metres or less;

- v. One hundred eighty (180) metres of any surface water;
- vi. Thirty (30)/ Sixty (60)/ Ninety (90) metres of the right-of-way of any road;
- vii. Sixty (60) metres of any land used for livestock pasturing.

Strategic Plan Departmental Workplan:
N/A

Engagement Consultation:

The Township has had continued dialogue with a representative of the Ministry of the Environmental, Conservation and Parks. We have also communicated with staff from the County of Renfrew and neighboring municipalities.

Financial Implications:

There are no financial implications.

Next Steps:

Take the necessary steps as directed by Council.

Attachments:

None

Prepared by:	Ivan Burton, MCIP, RPP, Planner/EDO
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Approved by:	Robert Tremblay, Chief Administrative Officer
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Council Members

Mayor Michael Moore

Reeve Cathy Regier

Councillors:

Charlene Jackson

Dave Mackay

Daryl McLaughlin

Neil Nicholson

Chris Olmstead

Certified true copy

Wednesday, June 16, 2021

Re: Resolution - Provincially Licensed Hauled Sewage Spreading

Dear Ivan,

At its meeting of June 16, 2021, the Council of the Township of Whitewater Region adopted the following resolution:

Moved by Reeve Cathy Regier, seconded by Councillor Charlene Jackson

That Council of the Township of Whitewater Region ask that MOE to not allow septage trucks from outside of the township to dump in our region.

Carried - Resolution - #2021-4495

Sincerely,

(613) 646-2282



A handwritten signature in blue ink that reads "C Miller".

P.O. Box 40,
44 Main Street
Cobden, ON
K0J 1K0



Carmen Miller
Clerk/CEMC



whitewaterregion.ca



