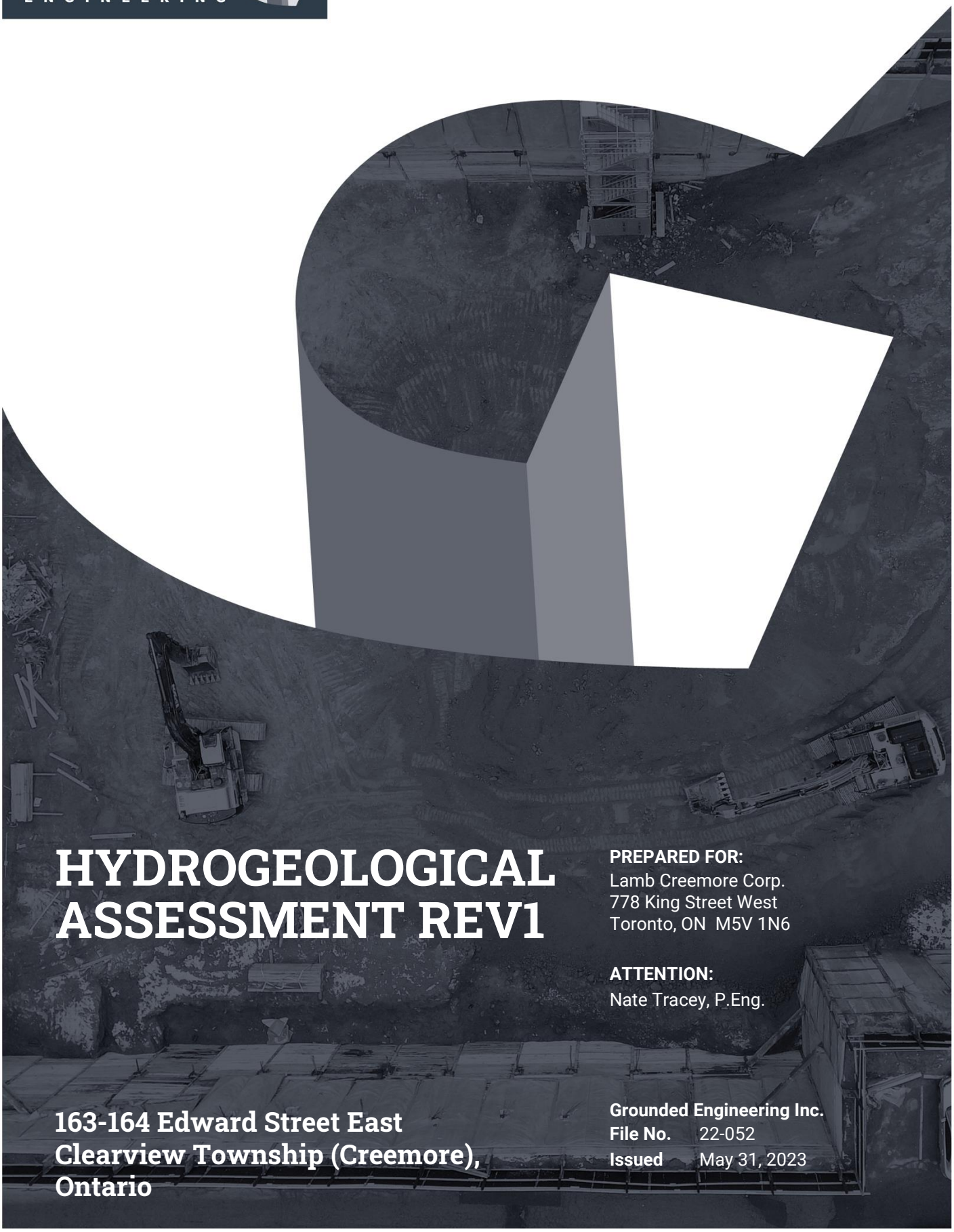


HYDROGEOLOGICAL ASSESSMENT REV1

PREPARED FOR:
Lamb Creemore Corp.
778 King Street West
Toronto, ON M5V 1N6

ATTENTION:
Nate Tracey, P.Eng.

163-164 Edward Street East Clearview Township (Creemore), Ontario

Grounded Engineering Inc.
File No. 22-052
Issued May 31, 2023

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1 Introduction

1.1 Background

Lamb Creemore Corporation retained Grounded Engineering Inc. (Grounded), to complete a Hydrogeological Assessment for the property located at the municipal address of 163-164 Edward Street East, in Clearview Township (Creemore), Ontario (the Property). The site location is presented in Figure 1.

Based on the Conceptual Site Plan dated May 5, 2022, prepared by Weston Consulting, it is understood that the Property will be developed as a subdivision consisting of a mix of single detached, and semi-detached homes, townhomes, and a hotel. The hydrogeological assessment has been prepared for review by the Nottawasaga Valley Conservation Authority (NVCA). A topographic site survey sketch prepared by Tatham Engineering during October 2019 is provided in Appendix A.

The hydrogeological assessment was undertaken to evaluate hydrogeological conditions of the proposed development on the Property and to develop a plan to manage risk of potential impacts associated with activities related to the proposed land use.

1.2 Scope of Work

A summary of the scope of work is provided below:

- Background Information Review: Review of available background geologic and hydrogeological information for the Property and surrounding areas. This included a review of the Ministry of the Environment, Conservation and Parks (MECP) well records, watershed information by the Nottawasaga Valley Conservation Authority (NVCA).
- Groundwater Level Monitoring: Groundwater level monitoring was conducted to assess the groundwater flow conditions.
- Hydraulic Conductivity Test: In-situ hydraulic conductivity tests were conducted in select monitoring wells to assess hydraulic conductivity of the strata. The underlying soils were assessed to determine potential dewatering requirements.
- Water Balance: A water balance and assessment of infiltration rates for existing (pre-development) and post development conditions was completed to determine the feasibility of the proposed development.

2 Site Information

2.1 Site Location and Description

The Property is generally rectangular in shape, with an approximate area of 37.2 ha. The site is used as agricultural land with the remnants of a demolished single-family dwelling and barn, and an associated dirt driveway located in the central portion of the Property. It is understood that the Property will be developed as a subdivision consisting of a mix of single detached, and semi-detached homes, townhomes, and a hotel. The general site features are presented in Figure 2.

The surrounding properties are primarily in agricultural use but also include a mixture of residential, commercial, and industrial uses

The Property information is provided below:

Municipal Address	163-164 Edward Street East, Clearview Township (Creemore), ON L0M 1G0
Area	37.2 ha
Legal Description	Part of Lot 8, Concession 3, Nottawasaga TWP, Township of Clearview, County of Simcoe
UTM Coordinates	17T 572710 m E, 4908515 m N
Current Property Use	Agricultural
Property Owner Information	Lamb Creemore Corp.
Person who has engaged the Qualified Person to conduct the assessment	Nate Tracey, P.Eng., MBA Lamb Creemore Corp.

2.2 Topography & Drainage

The Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF) databases were searched to obtain topographic and geological maps of Ontario for review. The maps are provided in Appendix B, and the information obtained is summarized below:

Records	Information
Topographic Maps	The elevation of the Property ranges from approximately 248 to 253 metres above sea level (mASL) from the northwest to the southeast, with a slight slope towards the southeast.

Records	Information
Hydrology	The Site is in the Mad River Sub-watershed, part of the larger Nottawasaga River Watershed. Watershed maps are provided in Appendix C. The nearest significant water body to the site is the Mad River, located approximately 520 metres southwest of the Property. Surface water is expected to flow towards the drainage ditches located both on the Property and along the north and south sides of Edward Street East, and towards the neighbouring sites. Groundwater is expected to flow southeast towards the Mad River tributary, based on ground elevation. NVCA maps the drainage swales as part of a tributary to the Mad River, which transects 164 Edward Street East and cuts across the northeast corner of 163 Edward Street East; however, in these areas the mapped tributary is apparent only as a swale through the agricultural fields and flow in the swale appears intermittent and there is no aquatic habitat identified.
Runoff	Storm water at the Property is expected to flow towards the drainage ditches located both on the Property and along the north and south sides of Edward Street East, and towards the neighbouring sites.

2.3 Regional Physiography

Creemore is on the eastern boundary of the Niagara Escarpment, the Site is on the eastern side of Creemore. The site is within the Horseshoe Moraines Physiographic region. The overburden consists of glaciofluvial outwash deposits comprised of sand and gravel, which includes proglacial river and deltaic deposits of the Port Huron Moraine system.

The Port Huron Moraine system forms the core of a horseshoe-shaped region flanking the upland that lies to the west of the highest part of the Niagara cuesta. The associated meltwater stream deposits are also included giving the region two chief landform components: (a) the irregular, stony knobs and ridges which are composed mostly of till and with some sand and gravel deposits (kames); and (b) the more or less pitted sand and gravel terraces and swampy valley floors. Creemore is situated in a broad area (from Singhampton to Caledon) where there are three moraines with trains of outwash between them; the sand and gravel terraces feature deeply-cut valleys.

The bedrock consists of shale, limestone, dolostone, and siltstone.

The Property is located within the Nottawasaga Valley Source Protection Area, the Nottawasaga Valley Watershed, and the Mad River sub-watershed. The source water protection area map and watershed map are presented in Appendix C.

2.4 Regional Geology and Soils

Based on the published information, the regional geology is described as below.

Records	Information
Geological Maps	Overburden: Glaciofluvial outwash deposits comprised of gravel and sand, which includes proglacial river and deltaic deposits. Bedrock: Bedrock consists of shale, limestone, dolostone, and siltstone from the Georgian Bay Formation. Depth to Bedrock: Based on the MECP well records, the depth to bedrock in the vicinity of the Property is approximately 21 mBGS (Well ID. 5712291).

It should be noted that the subsurface soil and rock conditions described above represent generalized conditions only and should not be considered site specific. The information is presented in Appendix E.

2.5 Regional Climate

The following climate data for the Property was obtained from the Nottawasaga Valley Source Protection Area Approved Assessment Report (Appendix J). Climate data for the Mad River sub watershed from 1950 to 2005 was used to produce the mean values below.

Mean annual precipitation (mm/yr.)	944 mm
Mean annual evapotranspiration	556 mm
Mean annual water surplus	388 mm

The climate is typical for the Mad River sub watershed, with precipitation exceeding evapotranspiration. It is noted that the above are average values, which are representative in a regional context. There will be seasonal and annual variations in these values. However, the average values will govern long-term groundwater recharge and discharge rates. Therefore, average values are appropriate for assessment of hydrogeologic conditions at the site.

2.6 Groundwater Resources

The MECP well record database was reviewed for wells located within 500 m radius of the Property. Nineteen (19) well records were retrieved from the well record database. The MECP well record is presented in Appendix D. A summary of data obtained is presented in the following table.

Table 2-1 Summary of Groundwater Use

Total Number of Existing Wells	**[19]**
Wells completed in Overburden	17 (90%)
Bedrock	1 (5%)
Unknown	1 (5%)
Depth Ranges	
50 ft. or less	11 (58%)
51 ft. to 100 ft.	2 (11%)
101 ft. to 200 ft.	5 (26%)
Unknown	1 (5%)
Water Use	
Monitoring/Test Holes	7 (37%)
Water Supply (domestic/livestock)	5 (26%)
Unknown/Not Used/Abandoned/Other	7 (37%)

The above summary indicates that most local wells registered in the area obtain their water supply from the overburden aquifer. The wells generally are used as water supply or for groundwater monitoring. Well records indicate that the majority of wells were 50ft or less deep.

2.7 Private Well Survey

A house-to-house water well survey within the 500 metres of the Property will need to be completed prior to construction of the proposed development to identify local private wells. Monitoring of the private wells identified within the survey area will be required prior, during, and after the construction of the proposed development.

2.8 Subsurface Investigation

A subsurface investigation was conducted by Grounded at the Property from April 18 to 27, 2022. The field investigation is summarized below. Borehole logs are presented in Appendix F. The location of the boreholes is shown on Figure 2. A cross-section is shown in Figure 3.

Consultant	Grounded Engineering Inc.
Boreholes	BH101 to BH116
Monitoring Wells	BH101 to BH116
Well Depth (mBGS)	4.3 to 9.1

The stratigraphy beneath the investigated areas of the Property generally consists of the following:

Geological Units	Description
Surficial Soil/Topsoil	16 boreholes encountered topsoil at ground surface ranging between 100 to 200 mm in thickness.
Earth Fill	Underlying the topsoil, a layer of reworked earth fill (reworked native soil) that extends to depths of 0.8 to 0.9 metres below grade (Elev. 248.2 to 251.6 metres) was observed. The reworked earth fill varies in composition but generally consists of sandy silt, silty sand, with some clay. This material contains trace amounts of rootlets, wood fragments, and rock fragments occasionally inferred cobbles. It frequently has an earthy organic odour. The earth fill is typically dark brown and moist.
Sand and Gravel	Underlying the fill materials, all boreholes encountered an undisturbed native sand and gravel deposit at 0.8 to 0.9 metres below grade (Elev. 248.2 to 251.6 metres) that extends down to a depth of 3.0 to 6.4 metres below grade (Elev. 244.5 to 247.8 metres). The composition of this unit ranges from cohesionless sands and gravels to gravelly sand with some to trace rock fragments with inferred cobbles. The sand and gravel unit ranges from 2 to 6 m thick. The brown sand and gravel unit is generally moist, becoming wet at Elev. 246± m.
Sand	Underlying the sands and gravels, all boreholes encounter an undisturbed native sands deposit at 3.0 to 6.4 metres below grade (Elev. 244.5 to 247.8 metres) and all boreholes terminated within the sand at depths of 8.2 to 9.8 m below grade (Elev. 239.9 to 244.2 m). The composition of this unit ranges from cohesionless sands with some silt to silty sands. The sand is generally wet and brown to greyish brown. Interbeds of silt and clay were encountered in the sand unit in Boreholes 104 at Elev. 246.2± m and in Borehole 115 and Elev. 245.0± m. This interbed unit was inferred to be approximately 1.5 m thick.

2.9 Groundwater Level Monitoring

Sixteen (16) monitoring wells were installed on the Property. Groundwater level measurements were taken from April 2022 to May 2023 as part of the hydrogeological assessment. Groundwater elevation contours are shown on Figure 2.

Observations pertaining to the depth of the water level and caving were made in the open boreholes immediately after completion of drilling and are reported on the borehole logs. The measured water levels are presented in Table 1.1 and 1.2. Groundwater levels are summarized in the following table:

Well ID	Ground Surface Elevation (masl)	Screen Interval (masl)	Soil Strata	Minimum Level (Lowest)		Maximum Level (Highest)		Seasonal Fluctuation
				Elevation (mASL)	Date	Elevation (mASL)	Date	(±m)
BH101	250.80	246.23-243.18	Sand	247.21	2022-11-29	249.85	2023-04-20	1.32
BH102	251.60	247.03-243.98	Silty Sand to Sand	247.99	2022-11-29	250.78	2022-06-15	1.40
BH103	251.78	247.21-244.16	Sand and Gravel to Sand	248.38	2022-11-29	251.13	2022-05-05	1.38
BH104	252.38	247.83-244.78	Sand	249.44	2022-11-29	252.17	2022-06-15	1.36
BH105	252.24	247.67-244.62	Sand and Gravel to Silty Sand	249.07	2022-11-29	251.58	2023-04-20	1.26
BH106	251.31	246.74-243.69	Sand and Gravel to Sand	248.19	2022-11-29	250.66	2023-04-20	1.24
BH107	250.76	246.19-243.14	Sand and Gravel to Sand	247.69	2022-11-29	250.00	2023-04-20	1.16
BH108	250.65	246.08-243.03	Sand and Gravel to Sand	247.23	2022-11-29	249.62	2023-04-20	1.19
BH109	251.71	247.44-244.39	Sand and Gravel to Sand	248.21	2022-11-29	250.87	2022-05-05	1.33
BH110	250.98	246.41-243.36	Sandy Silt to Sand	247.44	2022-11-29	250.05	2023-04-20	1.30
BH111	249.98	245.41-242.36	Sand	246.66	2022-11-29	248.99	2023-04-20	1.16
BH112	249.53	244.96-241.91	Sand	246.57	2022-11-29	248.60	2023-04-20	1.02
BH113	249.37	244.8-241.75	Sand	246.25	2022-11-29	248.39	2023-04-20	1.07
BH114	249.05	244.48-241.43	Sand	245.94	2022-11-29	248.21	2023-04-20	1.14
BH115	249.66	243.56-240.52	Sand	246.63	2022-11-29	249.22	2023-04-20	1.30
BH116	250.07	245.5-242.45	Sand	245.85	2022-11-29	249.47	2022-06-16	1.81

mBGS: metre below ground surface
mASL: metres above sea level

The groundwater table fluctuates across the site with groundwater measurements ranging from a seasonal low of 245.85 mASL in November 2022 at BH 116 to a high of 252.17 mASL in BH104. The groundwater table generally follows the ground surface topography of the site and slopes

towards the southeast toward the Mad River. The hydraulic gradient across the site generally is low, with average horizontal hydraulic gradient of 0.007. Groundwater levels may be influenced by climate, seasonal fluctuations, and presence of underground services/structures.

Water sampling was undertaken at BH108 to determine baseline groundwater quality and provide information for potential dewatering of excavations. The groundwater sample was analysed for metals, volatile organic compounds (VOCs), trihalomethanes, major ions, nutrients, cyanide, oil & grease, phenols, TSS, biochemical oxygen demand (BOD), and PCBs. The laboratory certificate of analysis is included as Appendix H. The results of analysis indicated that:

- The concentration of the parameters analysed met the Clearview sewer-use by-law for discharge to sanitary/combined sewers and the standards for discharge to storm sewers.
- The analyte concentrations generally met the respective provincial water quality objectives (PWQO), with the exceptions of:
    - Aluminium – the concentration of aluminium was 2080 µg/L exceeding the interim PWQO of 75 µg/L; however, the standard for aluminium is for a clay-free sample.
    - Cobalt – the concentration of cobalt was 1.6 µg/L, exceeding the interim PWQO of 0.9 µg/L.
    - Copper – the concentration of copper was 9.2 µg/L, exceeding the interim PWQO of 5 µg/L and the revised interim of 1 µg/L.
    - Iron – the concentration of iron was 3070 µg/L, exceeding the interim PWQO of 300 µg/L.
    - Lead – the concentration of lead 2.1 µg/L, exceeding the interim PWQO of 1 µg/L.
    - Total phosphorus - the concentration of total phosphorus was less than the method detection limit of 500 µg/L; however, the MDL exceeded the interim PWQO of 30 µg/L for rivers and streams.
    - VOCs – the concentrations of VOCs were below the respective MDLs; however, several MDLs exceeded the respective objectives.

Should discharge to surface be considered, analysis using a different method will be necessary to meet the detection limits necessary for comparison to PWQO.

2.10 Hydraulic Conductivity

2.10.1 In Situ Conductivity Testing (Single Well Response Tests)

In situ single well response tests (SWRT) were conducted in eight monitoring wells (BH101, BH103, BH105, BH107, BH109, BH111, BH113, and BH115) on May 5, 2022, to assess the hydraulic conductivity of the underlying soil. The monitoring wells were installed in sands and sands and gravels. The tests were conducted by drawing down or raising the water levels (slug and rising and falling head tests).

Data from the SWRT were analyzed using the Bouwer and Rice method (1976). The table below summarized the results of the hydraulic conductivity testing. The analysis graphs of the tests are presented in Appendix I.

Monitoring Well ID	Stratum Screened	Hydraulic Conductivity (m/sec)		
		Test 1	Test 2	Test 3
BH101	Sand	4.18×10^{-6}	1.79×10^{-5}	2.15×10^{-5}
BH103	Sand and Gravel to Sand	1.19×10^{-5}	-	-
BH105	Sand and Gravel to Silty Sand	2.14×10^{-5}	2.02×10^{-5}	2.18×10^{-5}
BH107	Sand and Gravel to Sand	5.41×10^{-6}	-	-
BH109	Sand and Gravel to Sand	2.58×10^{-4}	3.55×10^{-4}	-
BH111	Sand	9.82×10^{-5}	6.96×10^{-5}	-
BH113	Sand	5.09×10^{-4}	2.52×10^{-4}	-
BH115	Sand	1.08×10^{-5}	-	-

Based on the SWRT analysis, the hydraulic conductivity of the overburden ranges from 4.2×10^{-6} m/sec to 5.1×10^{-5} m/sec.

2.10.2 Grain Size Analysis

Grain size analysis was conducted on representative soil samples through sieve and hydrometer analysis. The analysis is summarized below and presented in Appendix G.

The hydraulic conductivities of various soil types can also be estimated from grain size analyses. An assessment of the grain sizes was conducted using the excel-based tool, HydrogeoSieve XL© (*HydrogeoSieve XL ver.2.2, J.F. Devlin, University of Kansas, 2015*). HydrogeoSieve XL compares the results of the grain size analyses against fifteen (15) different analytical methods.

Given our experience in the area as well as published literature, some of the geometric means provided for the soil were biased low by one or more methods. In these instances, the values determined by these methods were excluded from the mean. The table below illustrates the hydraulic conductivity values estimated from the mean of the analytical methods where the soil met the applicable analysis criteria. The result of the analysis is also presented in Appendix G.

Borehole & Sample ID	Sample Depth (mBGS)	Grain Size Percentage (by weight)				Hydraulic Conductivity (m/s)	Soil Description (MIT System)
		Gravel	Sand	Silt	Clay		
BH105 SS1B	0.1	49	37	10	4	1.00E-05	Gravel and Sand, some silt, trace clay, trace rock fragments
BH104 SS1	0.3	7	32	43	18	1.30E-08	Sandy Silt, some clay, trace gravel
BH112 SS1	0.3	17	40	31	12	1.40E-07	Silty Sand, some clay, some gravel, trace rock fragments
BH116 SS1	0.3	2	39	40	19	1.20E-08	Silt and Sand, some clay, trace gravel, trace rock fragments
BH103 SS5	3.4	57	31	9	3	1.60E-05	Sand and Gravel, trace silt, trace clay, some rock fragments
BH109 SS5	3.4	42	48	7	3	1.50E-05	Sand and Gravel, trace silt, trace clay, trace rock fragments
BH101 SS6	4.9	1	94	3	2	7.50E-05	Sand, some silt, trace gravel, trace clay
BH102 SS6	4.9	1	57	35	7	4.30E-07	Silty Sand, trace clay, trace gravel
BH106 SS6	4.9	25	68	4	3	1.80E-05	Sand and Gravel, trace silt, trace clay
BH108 SS6	4.9	49	43	6	2	4.20E-05	Sand and Gravel, some silt, trace clay, some rock fragments
BH110 SS7	4.9	0	32	57	11	2.20E-08	Sandy Silt, some clay
BH111 SS6	4.9	0	63	34	3	7.50E-07	Silty Sand, trace clay
BH114 SS6	4.9	0	79	19	2	5.70E-06	Sand, some silt, trace clay
BH115 SS6B	5	1	16	67	16	1.30E-08	Silt, some clay, some sand, trace gravel
BH104 SS7B	6.5	2	8	53	37	6.90E-10	Clayey Silt, trace sand, trac gravel
BH113 SS8	7.9	3	92	3	2	9.50E-05	Sand, some silt, trace clay, some gravel, trace rock fragments

The unit of gravel and gravelly sand generally was not screened in the on-site wells. Based on the grain size analysis, the surficial aquifer, composed of gravels and gravelly sand with only trace fines, likely have hydraulic conductivities between 1×10^{-4} and 1×10^{-5} m/s (based on published literature) and provides significant local groundwater recharge.

2.11 Infiltration Testing

At the time of the subsurface investigation, infiltration testing was not completed on the Property.

2.12 Surface Water Features

A site inspection was conducted to assess the presence of surface water features on/or bounding the Property. The inspection includes the following:

- Inspection of surface and groundwater interactions and associated features
- Inspection of areas of actual and potential groundwater discharge

- Inspection of swales and drainage courses
- Evidence of phreatophytic vegetation, which may indicate seasonally high groundwater levels and/or groundwater discharge and seepage

The site inspection was conducted on March 23, 2022, to assess the presence of any natural environmental features. Notable features are summarized as follows:

- Topography across the site was generally flat with a slight slope towards the southeast.
- Ground surface was primarily covered by tilled farmland.
- A dug-out pond that appeared to have been manmade for agricultural purposes (irrigation, livestock, etc.) with an area of approximately 250 m2 was located in the east-central portion of the Property.
- Drainage ditches were observed along the north and south sides of Edward Street East (east to west alignment), and in the north portion of the Property (northeast to southeast alignment).
- A small culvert underneath Edward Street East was observed in the northeast portion of the Property.
- Standing water was observed in the following areas:
    - Adjacent to both sides of the driveway in the central portion of the Property at 163 Edward Street East.
    - South of Edward Street East and north of the demolished house and barn in the central portion of the Property at 163 Edward Street East.
    - South and north of Edward Street East in the west half of the Property.

Given the general flat topography of the site with a slight slope towards the southeast, the direction of surface water flow is towards agricultural areas within the Property; to the neighbouring sites to the east, south, and west; and to the drainage ditches located along Edward Street East and in the north portion of the Property.

2.13 Review of Current Regulatory Requirements

Current regulatory requirements associated with water supply and hydrogeology in connection with the proposed development was reviewed. This includes the review of the Nottawasaga Valley Conservation Authority Protection Plan. Relevant information is provided below and presented in Appendices C and J.

2.13.1 Nottawasaga Valley Conservation Authority (NVCA)

A review of the Nottawasaga Valley Conservation Authority (NVCA) website and mapping indicates that much of the Property **is** located within an NVCA-regulated area.

2.13.2 Wellhead Protection Areas and Aquifer Vulnerability

The following information is based on the Source Water Protection Report of the Property produced from the MECP source protection information atlas interactive map.

Table 2-2 Summary of Vulnerable Areas

Source Water Protection Regulated Area	Site Summary
Wellhead Protection Area (WHPA)	**Not** within a Wellhead Protection Area.
Source Protection Zone	**Not** within a Source Protection Zone.
Intake Protection Zone	**Not** within an Intake Protection Zone.
Significant Groundwater Recharge Area	**Is** within a Significant Groundwater Recharge Area. (Score 4)
Highly Vulnerable Aquifers (HVA)	**Not** within a Highly Vulnerable Aquifer

Table 2-3 MECP Source Water Protection Site Information

163 Edward Street East	164 Edward Street East
Latitude: **44.32588** Longitude: **-80.08862** UTM Zone: **17** Easting: **572667.78** Northing: **4908472.81** Upper Tier Municipality: **COUNTY OF SIMCOE** Lower Tier Municipality: **TOWNSHIP OF CLEARVIEW** Township Concession and Lot: **NOTTAWASAGA CON 3 LOT 8** Assessment Parcel Address: **163 EDWARD ST E** Assessment Roll #: **432901000111700000000** MECP District: **Barrie** MECP Region: **Central Region**	Latitude: **44.32822** Longitude: **-80.08888** UTM Zone: **17** Easting: **572644.37** Northing: **4908731.74** Upper Tier Municipality: **COUNTY OF SIMCOE** Lower Tier Municipality: **TOWNSHIP OF CLEARVIEW** Township Concession and Lot: **NOTTAWASAGA CON 3 LOT 8** Assessment Parcel Address: **164 EDWARD ST E** Assessment Roll #: **432901000111701000000** MECP District: **Barrie** MECP Region: **Central Region**
Source Protection Details for Location	**Source Protection Details for Location**
Source Protection Area: **Nottawasaga Valley** View Source Protection Plan Wellhead Protection Area: **No** Wellhead Protection Area E (GUDI): **No** Intake Protection Zone: **No** Issue Contributing Area: **No** Significant Groundwater Recharge Area: **Yes** ; score is **4** Highly Vulnerable Aquifer: **No** Event Based Area: **No** Wellhead Protection Area Q1: **No** Wellhead Protection Area Q2: **No** Intake Protection Zone Q: **No** Information is current as of: **May 12, 2022**	Source Protection Area: **Nottawasaga Valley** View Source Protection Plan Wellhead Protection Area: **No** Wellhead Protection Area E (GUDI): **No** Intake Protection Zone: **No** Issue Contributing Area: **No** Significant Groundwater Recharge Area: **Yes** ; score is **4** Highly Vulnerable Aquifer: **No** Event Based Area: **No** Wellhead Protection Area Q1: **No** Wellhead Protection Area Q2: **No** Intake Protection Zone Q: **No** Information is current as of: **May 12, 2022**

2.13.3 Other Regulatory Authorities

The Property is **not** located within the Niagara Escarpment Plan (NEP) area, Greenbelt Protection Act Area, Oak Ridges Moraine Plan Area, a Natural Heritage Area, an area of natural and scientific interest (ANSI), an unevaluated wetland, or a provincially significant wetland.

3 Discussion and Analysis

3.1 Proposed Development Plan

It is understood that the Property will be developed as a subdivision consisting of a mix of single detached, and semi-detached homes, townhomes, and a hotel. The proposed conceptual development plan is presented in Appendix A.

The following summarizes the proposed land coverage areas for the development:

Land Coverage Type	Areas	Percent
Building Envelopes	19.2 ha	52
Hard Surface Paving	13.3 ha	36
Landscape areas for infiltration	1.9 ha	5
Stormwater Management Pond	2.8 ha	8
Total Area	**37.2 ha**	**100**

3.2 Summary of Hydrogeologic Conditions

Based on the review of the available site information, the hydrogeologic conditions of the Property is summarized as follows:

- Site is characterized by surficial deposits of farm tilled (disturbed) topsoil underlain by reworked earth fill material that consisted of sandy silt, silty sand, with some clay, trace rootles, and rock and wood fragments. The reworked earth fill is of low permeability and provide for low recharge capability and groundwater movement.
- Undisturbed native sand and gravel was encountered beneath the topsoil and fill extending to depths of 3.0 to 6.4 metres below grade (Elev. 244.5 to 247.8 metres). The composition of this unit ranges from cohesionless sands and gravels to gravelly sand with some to trace rock fragments with inferred cobbles. The unit is generally moist and brown,

becoming wet at roughly Elev. 246 m. The sand and gravel unit is fairly permeability and provides for significant recharge capability and groundwater movement.

- Underlying the sands and gravels, the boreholes terminated within a native sand deposit at depths between 8.2 to 9.8 m below grade (Elev. 239.9 to 244.2 m). The unit consists of sands some silts to silty sands. The sand is generally wet and brown to greyish brown. The silt and silty sand unit is of generally low permeability and provide low capability and groundwater movement.
- Bedrock was not encountered during Grounded's subsurface investigation.
- Groundwater table elevation across the site with groundwater measurements ranging from Elev. 247.4 mASL in BH 113 to Elev. 252.4 m in BH104. The groundwater table generally follows the physical topography of the site and slopes towards the southeast, connecting with the Mad River. Additional groundwater monitoring at the Property will be required to determine seasonal groundwater conditions and confirm groundwater flow direction.
- Based on the higher permeability of the sand and gravel unit, moderate to significant groundwater transmission is expected. No area of groundwater discharge such as seepages and springs were noted at the Property during the site inspection.
- The Property lies within an NVCA-regulated area.
- The Property is not within a Wellhead Protection Area, a Source Protection Zone, or an Intake Protection Zone.
- The Property is located in a Significant Groundwater recharge area.
- The site is not within an area of Highly Vulnerable Aquifer.
- MECP well records for wells completed in the vicinity of the Property show that the primary aquifer used for potable water is within the overburden aquifer. Approximately 60% of wells were installed within 50 ft (15 mb) below grade or less. The wells are generally used as water supply or unknown/abandoned.

The above hydrogeologic features and functions were considered in assessing the potential impact of the proposed development. This information was used to provide mitigating measures to ensure that hydrogeologic function is not adversely affected during the proposed development.

3.3 Water Balance Analysis

A water balance model was prepared for the Property to assess the distribution of rainfall run-off and infiltration for existing (pre- and post-development) conditions (Appendix K). The model is based on Nottawasaga Valley's climate data presented in Section 2.5. The Thornthwaite method was used to evaluate the relative balance between rainfall, evaporation, and evapotranspiration in the shallow soil zones. An active SWM pond 28,000 m^2 in area was used for the post-

development run-off calculations. It was assumed that the SWM pond would be installed with a permeable base that permits infiltration. The water balance for pre- and post-development conditions is summarized below:

Table 3-1 Pre-Development Water Balance

	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-Off (m^3)
Buildings	630	627	-	-	627
Hard Surface Paving	0	0	-	-	0
Landscape Area	371,370	369,885	206,482	100,864	43,227
TOTAL	**372,000**	**370,512**	**206,482**	**100,864**	**43,885**

The post-development water balance accounts for hard surfaced areas created by buildings and pavements and uses the proposed land use statistic information provided by Weston Consulting (May 5, 2022).

Table 3-2 Post-Development Water Balance

	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-Off (m^3)	Captured Run-Off (m^3)
Buildings	192,000	191,232	-	-	191,232	-
Hard Surface Paving	133,000	132,468	-	-	132,468	-
Landscape Area	19,000	18,924	10,564	5,160	2,212	-
Stormwater Management Pond	28,000	27,888	15,568	7,605	3,259	19,914
TOTALS	**372,000**	**370,512**	**26,132**	**12,765**	**329,171**	**19,914**

The volume of surface water run-off available from residential roof tops was calculated to be 158,875 m^3, assuming 90% run-off can be captured. This volume of water will be available as a resource, to maintain groundwater recharge and function. The volume of roof run-off available is compared to the difference in infiltration volume between pre-development and post-development, as noted below:

Table 3-3 Pre- to Post-Development Water Balance Summary

Potential Post-Development Infiltration Deficit (m^3)	Volume of Roof Run-off Available (m^3)
88,099	172,109

3.4 Groundwater Control Requirements

Dewatering calculations were not completed for this preliminary design stage of the proposed development. No long-term water takings from the proposed development will be allowed to be discharged into the Town of Creemore's sewer systems, as per the requirement of the Town of Creemore. Given the general high hydraulic conductivity of the water table aquifer, dewatering of large excavations likely is not feasible; limited dewatering of shallow surficial soils may be possible.

3.5 Assessment of Potential Impact

The Property will be developed as a subdivision consisting of a mix of single detached, and semi-detached homes, townhomes, and a hotel. Two stormwater management ponds with a combined area of 2.8 ha located in the eastern portion of the Property are also proposed. The Property will be serviced with municipal piped water, storm, and sanitary sewers.

The usage of road salt during winter months on the asphaltic areas of the Property may impact groundwater quality in the area.

3.6 Mitigation Measures to Maintain Hydrogeologic Functions

3.6.1 Maintenance of Groundwater Recharge

The existing groundwater recharge rates at the Property are approximately 232 mm/a. This recharge occurs in a broad diffuse manner over the entire site. Mitigation measures are available to maintain recharge rates. There are no wetlands in the immediate vicinity of the Property. The nearest water body is the Mad River, located approximately 520 m southwest of the Property. There will be no direct surface runoff from the Property to the water bodies.

Appropriate low-impact development (LID) techniques which can be applied include maintenance of overall groundwater recharge across the site area. To maintain groundwater recharge for the Property, LID methods should be implemented. There is a surplus of water available following development to maintain groundwater recharge and function. As appropriate, green infrastructure may be considered and may include downspouts connected to rainwater cisterns, rain gardens, green roofs, vegetated filter strips, dry and bio swales, perforated pipe, infiltration trenches, and permeable pavement.

It is understood that two stormwater management ponds with a combined area of 2.8 ha will be constructed on the eastern portion of the Property as part of the proposed development.

3.6.2 Maintenance of Groundwater Transmission Pathways

As previously indicated, the soils present on the Property have moderate to high permeabilities. The overall continuity of the groundwater flow at the Property should be maintained to support local groundwater recharge. Generally, the groundwater transmission pathways can be maintained through the following means:

- Bedding materials beneath underground services may serve as a subdrain to collect and convey groundwater. To prevent drainage of groundwater along bedding materials, clay trench plugs should be provided at all manhole locations in order to cut off the granular bedding.
- The excavation of any underground services or utilities across permeable layers may interrupt the groundwater flow. It is recommended that trench backfilling be carried out with materials that are similar to the materials that have been excavated.

Groundwater flow may occur into the open shallow excavations if more permeable deposits (such as sand or gravel) are encountered. While dewatering of shallow surficial excavations may be possible, dewatering of larger excavations that extend below the water table likely is not feasible. Groundwater flow into smaller, shallow excavations can be controlled by utilizing localized sumps and pumps at the base of the excavations. In addition to this, it is recommended that any excavations should be staged or constructed in such a manner to avoid the collection of overland drainage.

4 Source Water Impact Assessment and Mitigation Plan (SWIAMP)

4.1 Risk Assessment

4.1.1 Identification of Vulnerable Areas

The Property is not located within any Wellhead Protection Areas (WHPAs) and is not located within the Niagara Escarpment Plan Area or the Oak Ridge Moraine Conservation Plan Area. It is not within a Highly Vulnerable Aquifer. It is within an area of significant groundwater recharge, which makes it a vulnerable aquifer.

4.1.2 Identification of Anthropogenic Transport Pathways

Local wells and subsurface structures may provide pathways to the aquifer; however, this pathway is unlikely to be significant considering the direct infiltration to the aquifer (significant groundwater recharge area).

4.1.3 Identification of Water Quality Impacts and Threats

The Clean Water Act, 2006, prescribes a number of land uses that are considered drinking water threats. The applicable circumstances for activities and conditions to the Property are listed, along with a qualitative evaluation of the threat level, in table below.

The proposed development includes the following land uses, which have potential to adversely affect groundwater quality:

- Commercial land uses may have high risk site activities such as outdoor storage of products, salt storage areas, and snow storage areas. Certain types of commercial lands such as gas stations, car washes and dry-cleaning facilities may also pose a significant threat.
- Institutional and multi-residential (low, medium, and high rise residential) land uses generally pose less of a risk than industrial and commercial sites with risks generally confined to chloride loading from the large parking facilities.
- Typical subdivision-style development with single family detached and townhomes present a smaller risk of contamination to groundwater resources but can contribute to pollutant loading via non-point source pollution such as oils and greases that accumulate on driveways and bacteria from pet waste.

For the proposed development Property, one activity from the list is considered a relevant potential drinking water quality threat: application of winter de-icing salt. This is listed as Prescribed Drinking Water Threat number 12 in section 1.1(1) of O. Reg. 287/07 under the *Clean Water Act, 2006*, (as amended, 1 June 2021). In the recent updates, Significant Groundwater Recharge Areas are removed, they are now being considered as Highly Vulnerable Aquifer.

Chemical Quantity Circumstance	Summary of the Description of the Threat	Vulnerable Zones that the Circumstances Apply	Chemicals Associated with the Circumstances	Risk Associated with the Circumstances and Vulnerable Zones
The road salt is applied in an area where the percentage of total impervious surface area, as set out on a total	Road salt is applied to roads, highways, or parking lots and may result in a release to groundwater or surface water	HVA with a score of 6	Chloride, Sodium	Low

impervious surface area
map, is 80 percent or more.

4.1.4 Identification of Drinking Water Quantity Impacts and Threats

Currently the area for the proposed development is agricultural land. The Property likely provides significant recharge into the shallow groundwater system.

Based on the subsurface investigation completed at the Property, topsoil and reworked native earth fill was underlain by approximately three (3) to six (6) metres of sand and gravel. Below the sand and gravel aquifer is silty sand that extended to the full depth of investigation of 9.8 m below grade. The sand and gravel aquifer is considered an enhanced zone of groundwater flow at the Property, providing groundwater recharge to the deep aquifer at the site.

While not known presently, we anticipate that the proposed development at the Property will be constructed as a slab-on-grade buildings. As such, there will not be a requirement to dewater and control groundwater during the construction and post-construction period.

There may be requirement for temporary groundwater control for the installation of footings and any subsurface utilities. While dewatering of shallow surficial excavations may be possible, dewatering of larger excavations that extend below the water table likely is not feasible. Groundwater flow into smaller, shallow excavations can be controlled by utilizing localized sumps and pumps at the base of the excavations. The groundwater seepage into the excavation would likely be controlled by implementation of gravity drainage and pumping from strategically placed filtered sumps.

As there will not be any short-term groundwater control requirements, there will be no water quantity threats to the underlying aquifer in which the water supply wells are installed.

4.2 Risk Management Plan

4.2.1 Water Quality Threat Management - Application of Road Salt

The preventive, mitigation and/or management measures [is] provided below.

Preventive, Mitigation, Management Measures
• Storage of salt at the Property shall be placed in water-impermeable containers and in roofed areas of the Property that either are asphalt-paved or have a poured concrete floor to minimize entry into the subsurface.

Preventive, Mitigation, Management Measures
• Run-offs from parking area/driveways will be directed into storm water catch basins located on the Property. This will prevent downward migration into the aquifer. The detailed design of the storm water management system will be provided to Clearview Township as part of the approval process. • The Transportation Association of Canada (TAC) has produced a document titled Syntheses of Best Practices – Road Salt Management (2013). These should be generally followed at the Property unless prohibited. In addition, best management practices for contractors, residents, and the community are provided by the not-for-profit organization Smart About Salt Council and their recommendations may be of benefit in reducing salt loads.

The monitoring, communication, and implementation plan, and/or emergency response plan [is] provided below.

	Description
Emergency Response Plan	The response plan should include: • Emergency contacts for the site, municipality, and region. • Any spills or leaks related to de-icing compounds will be reported to the Spills Action Centre by phone (+1-800-268-6060) or online (https://www.ontario.ca/page/report-pollution-and-spills#section-0). • Any spills or leaks related to sewage works located on the Property will be reported to the Spill Action Centre by phone (+1-800-268-6060) or online (https://www.ontario.ca/page/report-pollution-and-spills#section-0). • Potential actions to take to clean up spill. • Always report urgent pollution incidents by phone at 1-866-MOE-TIPS (663-8477), 24 hours a day, 7 days a week.

4.2.2 Water Quantity Threats Management

4.2.2.1 Dewatering and Depressurization

As there will not be any short-term groundwater control requirements, there will be no water quantity threats to the underlying aquifer in which the municipal production and public supply wells are installed in.

4.2.2.2 Reduction in Aquifer Recharge

The development will include the use of roof-top precipitation to maintain groundwater recharge. Thus, there is no anticipated adverse impact from the proposed development on the aquifer in which the water supply wells are screened. Reduction in aquifer recharge is not anticipated.

5 Conclusions and Recommendations

- The Site is characterized by surficial deposits of farm tilled (disturbed) topsoil mixed with and underlain by reworked native earth fill material that consisted of sandy silt, silty sand

with some clay, trace rootles, and wood and rock fragments. The reworked fill is of low permeability and provide for low to medium recharge capability and groundwater movement.

- Undisturbed native sand and gravel deposits was encountered beneath the topsoil and fill down to depths of 3.0 to 6.4 m below the existing grade (Elev. 244.5 to 247.8 m). The sand and gravel is moist (becoming wet at approximate Elev. 246 m), brown, and contains trace rock fragments. The sand and gravel aquifer unit is of higher permeability and provides significant recharge capability and groundwater movement.
- Underlying the sand and gravel, the boreholes encountered an undisturbed native silty sand deposit. The composition of this unit ranges from cohesionless sands with silt to silty sands. The silty sand is generally wet and brown to greyish brown. The boreholes terminated within this unit at depths of 8.2 to 9.8 m below grade. The silty sand is of low permeability and provide for low recharge capability and groundwater movement.
- The groundwater table fluctuates across the site with groundwater measurements ranging from a seasonal low of 245.85 mASL in November 2022 at BH 116 to a high of 252.17 mASL in BH104. The groundwater table generally follows the physical topography of the site and slopes towards the southeast, connecting with the Mad River. Average horizontal hydraulic gradient is 0.007. Additional groundwater monitoring at the Property will be required to determine seasonal groundwater conditions and confirm groundwater flow direction.
- Based on to the moderate to significant permeability of the water table aquifer at the Property, significant groundwater transmission is expected. No area of groundwater discharge such as seepages and springs were noted at the Property during the site inspection, consistent with water table depths.
- Groundwater quality met the Clearview sewer use bylaw for discharge to sanitary/combined sewers or to storm sewers.
- The Property lies within an NVCA regulated area.
- The Property is not within a Wellhead Protection Area, a Source Protection Zone, an Intake Protection Zone, or a Highly Vulnerable Aquifer.
- The Property is in a Significant Groundwater recharge area and, as such, is considered vulnerable.
- MECP well records for wells completed in the vicinity of the Property show that the primary aquifer used for potable water is within the overburden aquifer. Approximately 60% of wells were installed within 50 ft (15 mb) below grade or less. The wells are generally used as water supply or unknown/abandoned.
- There will be a post-development infiltration deficit of approximately 88 099 m3 per year for the Property. It is recommended that Low Impact Development (LID) measures be

implemented at the Property to maintain groundwater recharge and function across the site area. The LID measures will be designed by others.

- Stormwater management measures for the site must specifically address the maintenance of groundwater recharge of the proposed development to preserve any groundwater contributions to the downgradient features.

5.1 Signatures

The Hydrogeological Assessment was conducted by Bailey Walters, MSc PGeo QP$_{ESA|RA}$ under the supervision of Matthew Bielaski, PEng., QP $_{RA-ESA}$.

We trust that this report meets your requirements at present.

For and on behalf of our team,

GROUNDED ENGINEERING





Bailey Walters, MSc PGeo QP$_{ESA|RA}$
Senior Geoscientist

Mathew Bielaski, PEng., QP $_{RA-ESA}$
Principal

6 References

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7 Limitations and Restrictions

The assessment should not be considered a comprehensive investigation that eliminates all risks of encountering environmental problems. The information presented in this report is based on information collected during the completion of the Hydrogeological Assessment by Grounded Engineering Inc. It was based on the conditions on the Hydrogeological Assessment at the time of the site inspection supplemented by a review of historical information to assess the environmental conditions regarding the Property.

There is no warranty expressed or implied by this report regarding the hydrogeologic conditions of the Property. Professional judgement was exercised in gathering and analysing information collected by our staff, as well as that submitted by others. The conclusions presented are the product of professional care and competence and cannot be construed as an absolute guarantee.

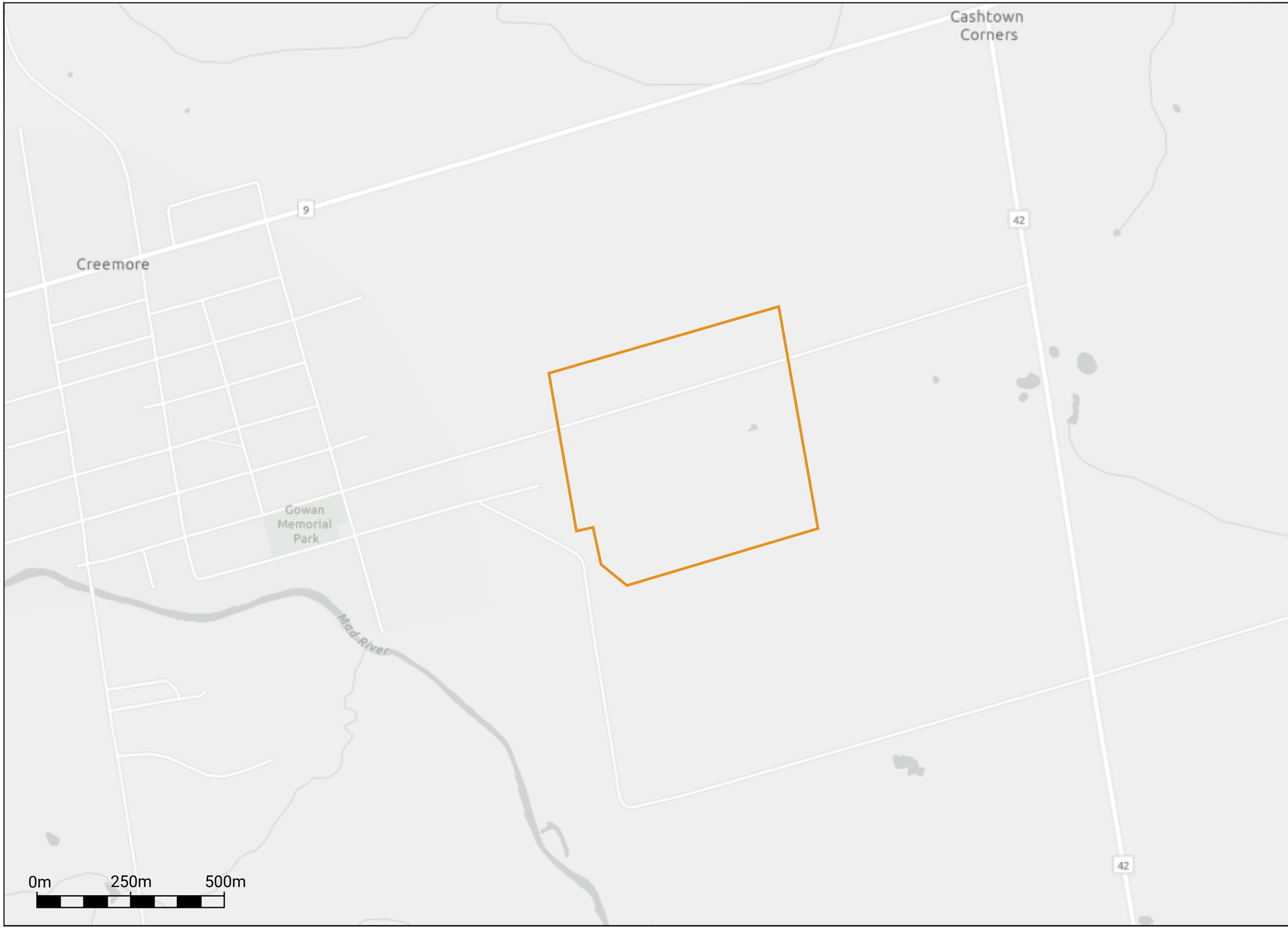
If new information regarding the hydrogeological condition of the Property is identified during future work, or outstanding responses from regulatory agencies indicate outstanding issues on file with respect to the Property, Grounded Engineering Inc. should be notified so that we may re-evaluate the findings of this assessment and provide amendments.

7.1 Report Use

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FIGURES





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LEGEND

APPROXIMATE PROPERTY BOUNDARY

Note

Reference

ArcGIS - My Map

Project

163-164 EDWARD STREET EAST, CREEMORE, ONTARIO

Figure Title

SITE LOCATION PLAN

North



Date

APRIL 2023

Scale

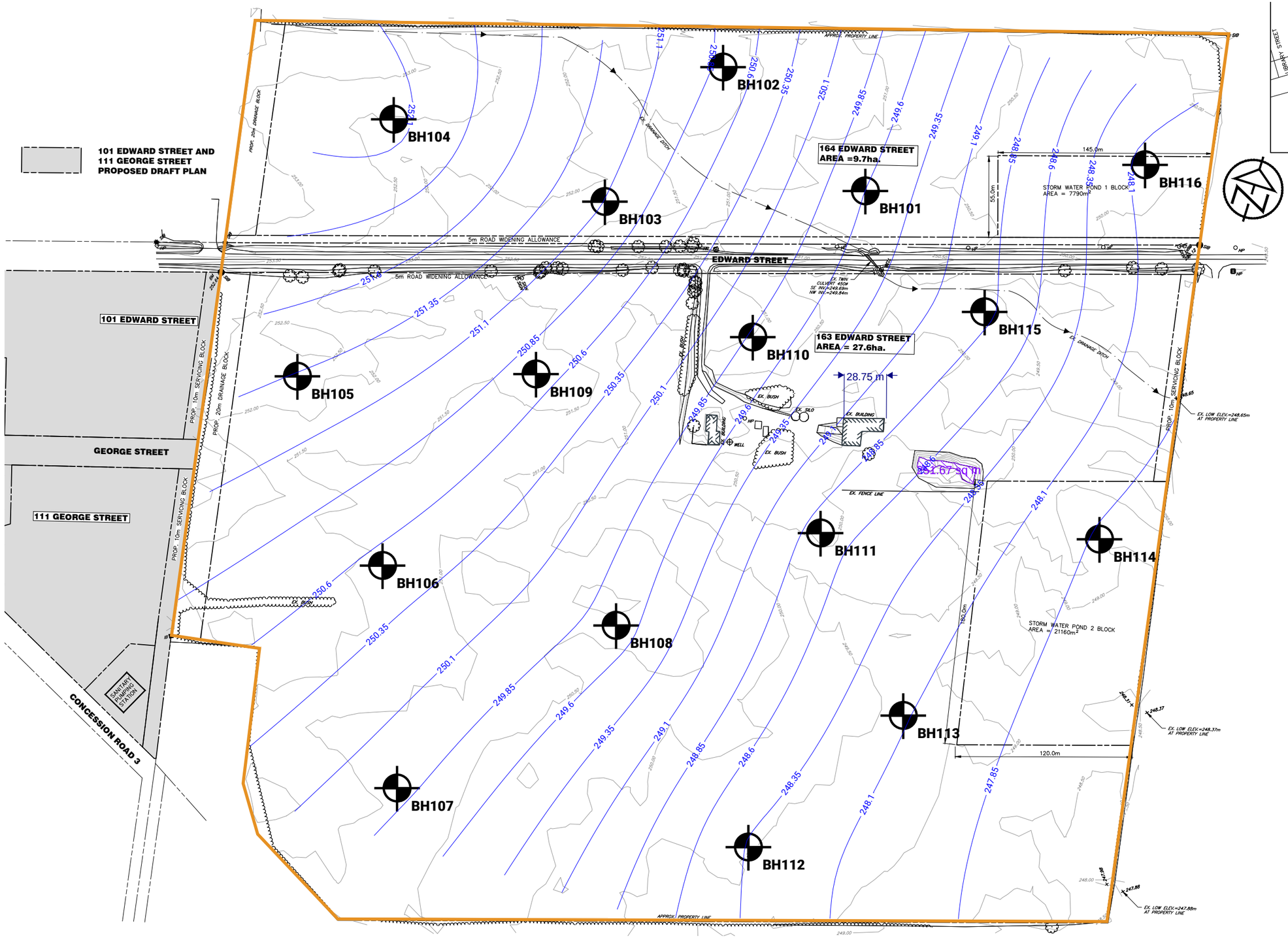
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22-052

Figure No

FIGURE 1



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LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- EXISTING BUILDING STRUCTURE
- MONITORING WELL BY GROUNDED

Note

Reference

ArcGIS - My Map

Project

163-164 EDWARD STREET EAST, CREEMORE, ONTARIO

Figure Title

BOREHOLE LOCATION PLAN - GROUNDWATER ELEVATION CONTOURS

North

TRUE

PROJECT

Date

APRIL 2023

Scale

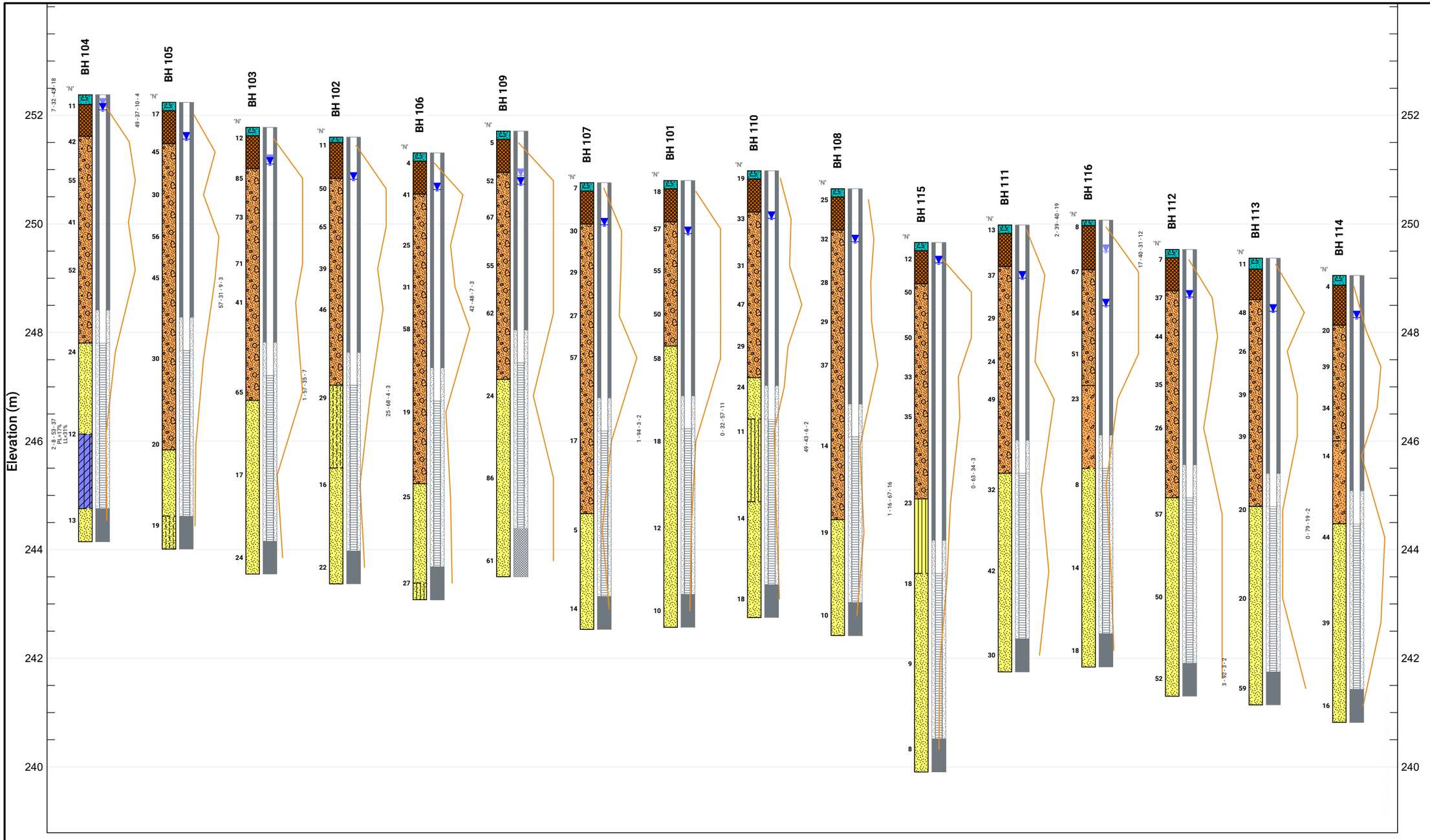
0m 50m 100m

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22-052

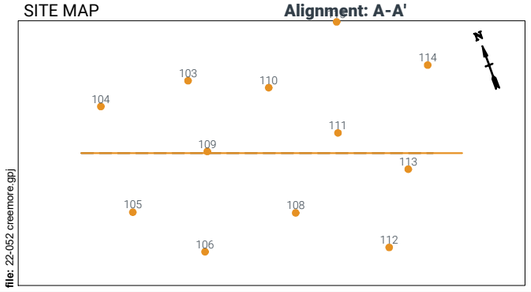
Figure No

FIGURE 2



SITE MAP

Alignment: A-A'



file: 22-052 creemore.gpj

Boreholes Equally Spaced

BOREHOLE STRATIGRAPHY LEGEND

- Topsoil
- Fill
- Sand and Gravel
- Sand
- Silty Sand
- Silt and Clay
- Sandy Silt
- Gravelly Sand
- Silt

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LEGEND

- FILL
- GRAVELS (gravel to gravelly sand)
- SILT TO SAND (not till)
- COHESIONLESS TILLS
- COHESIVE SOILS (clayey silt to clay, incl. tills)
- DISTURBED/REWORKED/ORGANIC

- water level, unstabilized
- water level, stabilized (latest)
- water level, stabilized (highest)

Project

163-164 EDWARD ST CREEMORE, ON

Figure Title

HYDROGEOLOGIC FENCE DIAGRAM A-A'

A-A'

Date

APRIL 2023

Scale

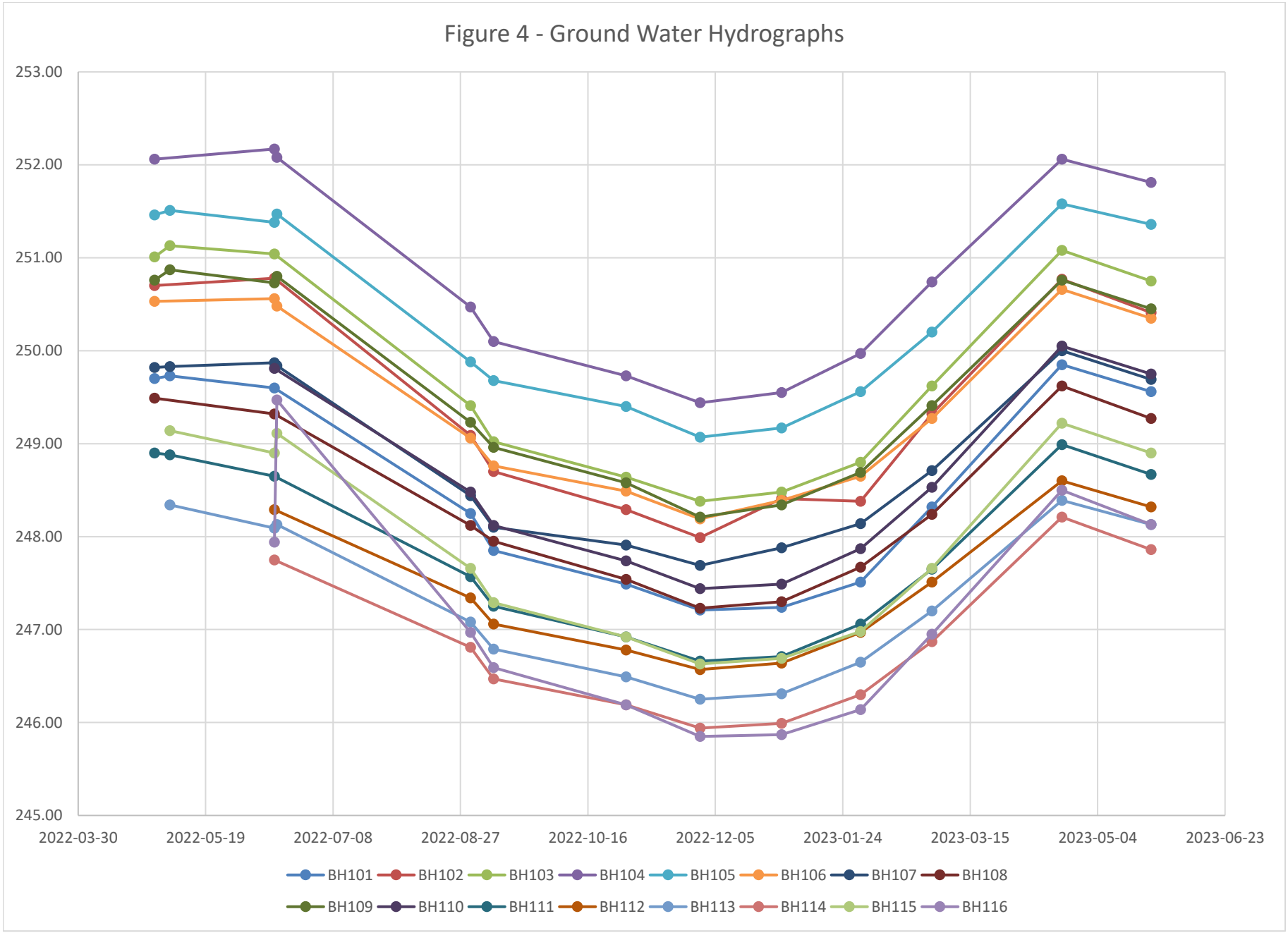
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22-052

Figure No

FIGURE 3


Figure 4 - Ground Water Hydrographs
253.00
252.00
251.00
250.00
249.00
248.00
247.00
246.00
245.00
2022-03-30
2022-05-19
2022-07-08
2022-08-27
2022-10-16
2022-12-05
2023-01-24
2023-03-15
2023-05-04
2023-06-23
BH101
BH102
BH103
BH104
BH105
BH106
BH107
BH108
BH109
BH110
BH111
BH112
BH113
BH114
BH115
BH116

TABLES



TABLE 1.1
GROUNDWATER LEVEL MONITORING SUMMARY
163-164 EDWARD ST E
CREEMORE, ON
PROJECT # 22-052

Well ID	Ground Surface Elevation (masl)	Screen Interval (mbgs)	Screen Interval (masl)	Soil Strata	Grounded Engineering														Minimum Level (Lowest)			Maximum Level (Highest)			Seasonal Fluctuation
					2022-04-22	2022-04-29	2022-05-05	2022-06-15	2022-06-16	2022-08-31	2022-09-09	2022-10-31	2022-11-29	2022-12-31	2023-01-31	2023-02-28	2023-04-20	2023-05-25							
					(mbgs)	(mbgs)	(mbgs)	(mbgs)	(mbgs)	(mbgs)	(mbgs)	(mbgs)	(mbgs)	(mbgs)	(mbgs)	(mbgs)	(mbgs)	(mbgs)	(mbgs)	Instances	Date	(mbgs)	Instances	Date	(±m)
BH101	250.8	4.57-7.62	246.23-243.18	Sand		1.10	1.07	1.20		2.55	2.95	3.31	3.59	3.56	3.29	2.48	0.95	1.24	3.59	1	2022-11-29	0.95	1	2023-04-20	1.32
BH102	251.6	4.57-7.62	247.03-243.98	Silty Sand to Sand		0.90		0.82		2.51	2.90	3.31	3.61	3.19	3.22	2.28	0.83	1.19	3.61	1	2022-11-29	0.82	1	2022-06-15	1.40
BH103	251.8	4.57-7.62	247.21-244.16	Sand and Gravel to Sand		0.77	0.65	0.74		2.37	2.76	3.14	3.40	3.30	2.98	2.16	0.70	1.03	3.40	1	2022-11-29	0.65	1	2022-05-05	1.38
BH104	252.4	4.57-7.62	247.83-244.78	Sand		0.32		0.21	0.30	1.91	2.28	2.65	2.94	2.83	2.41	1.64	0.32	0.57	2.94	1	2022-11-29	0.21	1	2022-06-15	1.37
BH105	252.2	4.57-7.62	247.67-244.62	Sand and Gravel to Silty Sand		0.78	0.73	0.86	0.77	2.36	2.56	2.84	3.17	3.07	2.68	2.04	0.66	0.88	3.17	1	2022-11-29	0.66	1	2023-04-20	1.26
BH106	251.3	4.57-7.62	246.74-243.69	Sand and Gravel to Sand		0.78		0.75	0.83	2.25	2.55	2.82	3.12	2.92	2.66	2.04	0.65	0.96	3.12	1	2022-11-29	0.65	1	2023-04-20	1.24
BH107	250.8	4.57-7.62	246.19-243.14	Sand and Gravel to Sand		0.94	0.93	0.89	0.92	2.32	2.66	2.85	3.07	2.88	2.62	2.05	0.76	1.07	3.07	1	2022-11-29	0.76	1	2023-04-20	1.16
BH108	250.7	4.57-7.62	246.08-243.03	Sand and Gravel to Sand		1.16		1.33		2.53	2.70	3.11	3.42	3.35	2.98	2.41	1.03	1.38	3.42	1	2022-11-29	1.03	1	2023-04-20	1.20
BH109	251.7	4.57-7.32	247.44-244.39	Sand and Gravel to Sand		0.95	0.84	0.98	0.91	2.48	2.75	3.13	3.50	3.37	3.02	2.30	0.95	1.26	3.50	1	2022-11-29	0.84	1	2022-05-05	1.33
BH110	251.0	4.57-7.62	246.41-243.36	Sandy Silt to Sand	0.8*			1.17		2.50	2.86	3.24	3.54	3.49	3.11	2.45	0.93	1.23	3.54	1	2022-11-29	0.93	1	2023-04-20	1.31
BH111	250.0	4.57-7.62	245.41-242.36	Sand		1.08	1.10	1.33		2.41	2.73	3.06	3.32	3.27	2.92	2.33	0.99	1.31	3.32	1	2022-11-29	0.99	1	2023-04-20	1.17
BH112	249.5	4.57-7.62	244.96-241.91	Sand	1.0*			1.24		2.19	2.47	2.75	2.96	2.89	2.56	2.02	0.93	1.21	2.96	1	2022-11-29	0.93	1	2023-04-20	1.02
BH113	249.4	4.57-7.62	244.8-241.75	Sand	0.9*		1.03	1.28	1.24	2.29	2.58	2.88	3.12	3.06	2.72	2.17	0.98	1.24	3.12	1	2022-11-29	0.98	1	2023-04-20	1.07
BH114	249.1	4.57-7.62	244.48-241.43	Sand	0.8*			1.30		2.24	2.58	2.86	3.11	3.06	2.75	2.18	0.84	1.19	3.11	1	2022-11-29	0.84	1	2023-04-20	1.14
BH115	249.7	4.57-9.14	243.56-240.52	Sand	0.3*		0.52	0.76	0.55	2.00	2.37	2.74	3.03	2.97	2.68	2.00	0.44	0.76	3.03	1	2022-11-29	0.44	1	2023-04-20	1.30
BH116	250.1	4.57-7.62	245.5-242.45	Sand		1.8*		2.13	0.60	3.10	3.48	3.88	4.22	4.20	3.93	3.12	1.57	1.94	4.22	1	2022-11-29	0.60	1	2022-06-16	1.81

mbgs = metres below existing ground surface
masl = metres above sea level
* = unstabilized groundwater level
NA = not available: unable to access monitoring well
-' = no value: monitoring well not accessed

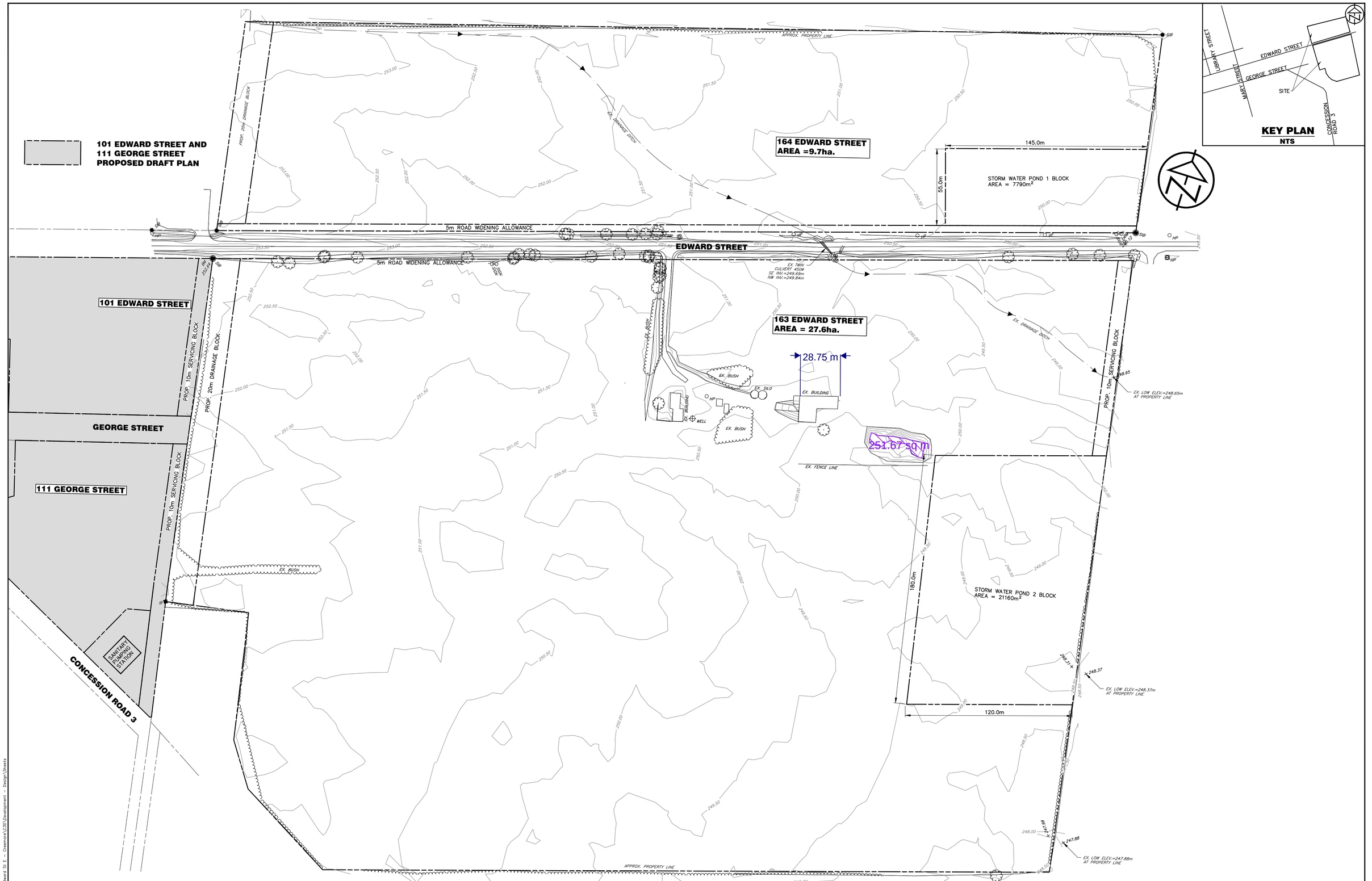
TABLE 1.2
GROUNDWATER ELEVATION MONITORING SUMMARY
163-164 EDWARD ST E
CREEMORE, ON
PROJECT # 22-052

Well ID	Grounded Engineering														Minimum Level (Lowest)		Maximum Level (Highest)		Seasonal Fluctuation
	2022-04-22	2022-04-29	2022-05-05	2022-06-15	2022-06-16	2022-08-31	2022-09-09	2022-10-31	2022-11-29	2022-12-31	2023-01-31	2023-02-28	2023-04-20	2023-05-25	(mASL)	Date	(mASL)	Date	(±m)
BH101		249.70	249.73	249.60		248.25	247.85	247.49	247.21	247.24	247.51	248.32	249.85	249.56	247.21	2022-11-29	249.85	2023-04-20	1.32
BH102		250.70		250.78		249.09	248.70	248.29	247.99	248.41	248.38	249.32	250.77	250.41	247.99	2022-11-29	250.78	2022-06-15	1.40
BH103		251.01	251.13	251.04		249.41	249.02	248.64	248.38	248.48	248.80	249.62	251.08	250.75	248.38	2022-11-29	251.13	2022-05-05	1.38
BH104		252.06		252.17	252.08	250.47	250.10	249.73	249.44	249.55	249.97	250.74	252.06	251.81	249.44	2022-11-29	252.17	2022-06-15	1.36
BH105		251.46	251.51	251.38	251.47	249.88	249.68	249.40	249.07	249.17	249.56	250.20	251.58	251.36	249.07	2022-11-29	251.58	2023-04-20	1.26
BH106		250.53		250.56	250.48	249.06	248.76	248.49	248.19	248.39	248.65	249.27	250.66	250.35	248.19	2022-11-29	250.66	2023-04-20	1.24
BH107		249.82	249.83	249.87	249.84	248.44	248.10	247.91	247.69	247.88	248.14	248.71	250.00	249.69	247.69	2022-11-29	250.00	2023-04-20	1.16
BH108		249.49		249.32		248.12	247.95	247.54	247.23	247.30	247.67	248.24	249.62	249.27	247.23	2022-11-29	249.62	2023-04-20	1.19
BH109		250.76	250.87	250.73	250.80	249.23	248.96	248.58	248.21	248.34	248.69	249.41	250.76	250.45	248.21	2022-11-29	250.87	2022-05-05	1.33
BH110	*			249.81		248.48	248.12	247.74	247.44	247.49	247.87	248.53	250.05	249.75	247.44	2022-11-29	250.05	2023-04-20	1.30
BH111		248.90	248.88	248.65		247.57	247.25	246.92	246.66	246.71	247.06	247.65	248.99	248.67	246.66	2022-11-29	248.99	2023-04-20	1.16
BH112	*			248.29		247.34	247.06	246.78	246.57	246.64	246.97	247.51	248.60	248.32	246.57	2022-11-29	248.60	2023-04-20	1.02
BH113	*		248.34	248.09	248.13	247.08	246.79	246.49	246.25	246.31	246.65	247.20	248.39	248.13	246.25	2022-11-29	248.39	2023-04-20	1.07
BH114	*			247.75		246.81	246.47	246.19	245.94	245.99	246.30	246.87	248.21	247.86	245.94	2022-11-29	248.21	2023-04-20	1.14
BH115	*		249.14	248.90	249.11	247.66	247.29	246.92	246.63	246.69	246.98	247.66	249.22	248.90	246.63	2022-11-29	249.22	2023-04-20	1.30
BH116		*		247.94	249.47	246.97	246.59	246.19	245.85	245.87	246.14	246.95	248.50	248.13	245.85	2022-11-29	249.47	2022-06-16	1.81

mbgs = metres below existing ground surface
masl = metres above sea level
* = unstabilized groundwater level
NA = not available: unable to access monitoring well
-' = no value: monitoring well not accessed

APPENDIX A





DISCLAIMER AND COPYRIGHT

CONTRACTOR MUST VERIFY ALL DIMENSIONS AND BE RESPONSIBLE FOR SAME. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER BEFORE COMMENCING WORK. DRAWINGS ARE NOT TO BE SCALED.

TATHAM ENGINEERING LIMITED CLAIMS COPYRIGHT TO THIS DRAWING WHICH MAY NOT BE USED FOR ANY PURPOSE OTHER THAN THAT PROVIDED IN THE CONTRACT BETWEEN THE OWNER/CLIENT AND THE ENGINEER WITHOUT THE EXPRESS CONSENT OF TATHAM ENGINEERING LIMITED.

BENCHMARKS

TBM1 – ELEVATION 252.643m
TBM1 SET ON A SIB AT THE WEST END OF LOT 163 ON THE SOUTH SIDE OF ROAD.

TBM2 – ELEVATION 250.118m
TBM2 IS SET ON THE SIB AT EAST END OF LOT 164 ON NORTH SIDE OF ROAD.

NOTES

No.	REVISION DESCRIPTION	DATE

ENGINEER STAMP

DRAFT

163,164 EDWARD STREET
CREEMORE

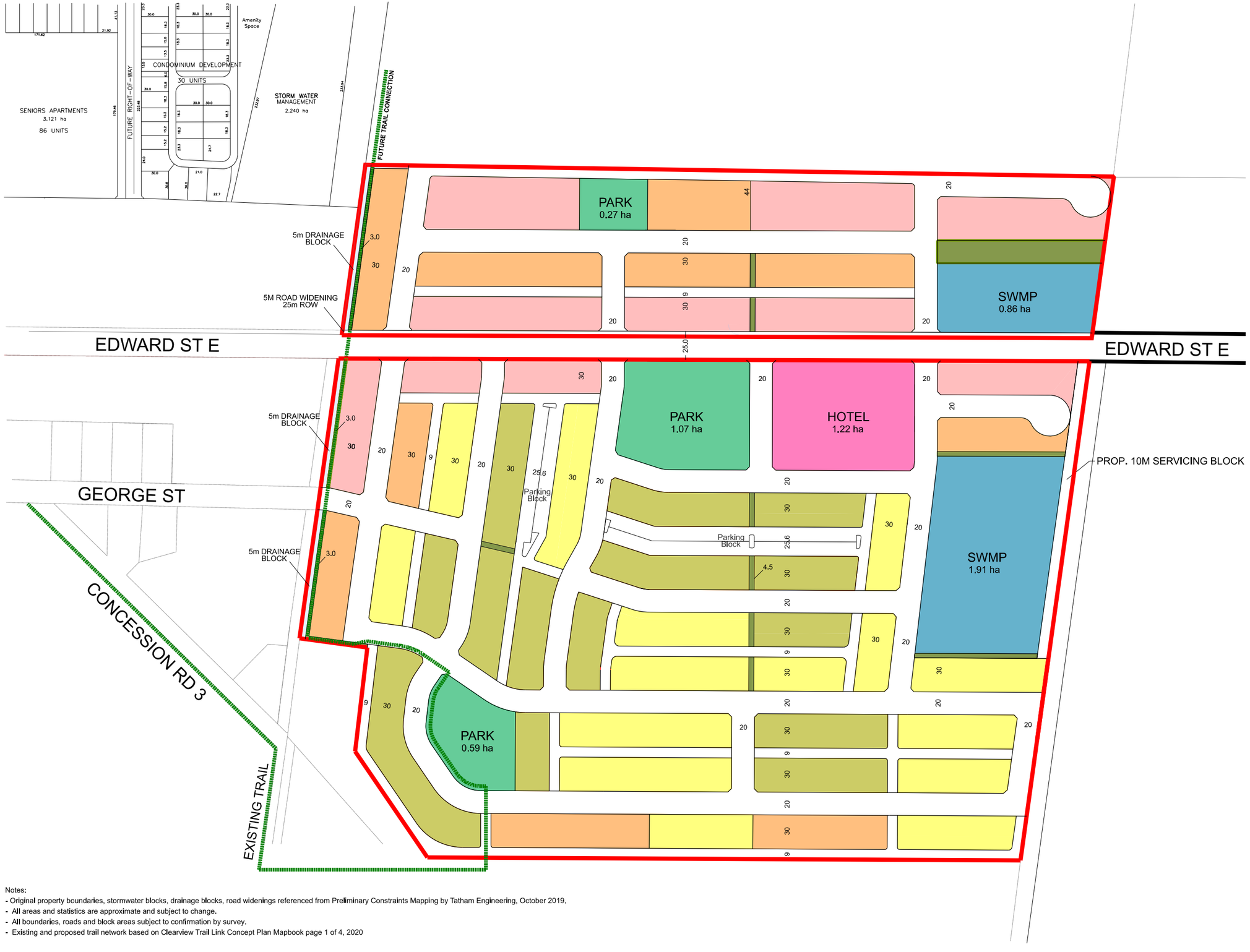
PRELIMINARY CONSTRAINTS MAPPING

TATHAM ENGINEERING

DESIGN: KPP	FILE: 419453	DWG: CM-1
DRAWN: KPP	DATE: OCT 2019	
CHECK: NM	SCALE: 1:1250	

T:\2019 PROJECTS\419453 - 163 & 164 Edward St E - Creemore\GIS\Development - Design\Sheets

Drawing Name: 419453-GS01.dwg, Plotted: Oct 09, 2019



DRAFT

FOR DISCUSSION PURPOSES ONLY

LEGEND

- Subject Lands
- Hotel
- Single Detached [40'/12.2m]
- Single Detached [30'/9.1m]
- Semi-detached [25'/7.6m]
- Townhouse [20'/6.1m]
- Parks
- Walkway Blocks
- Existing Trail
- Planned Trail
- SWM Blocks
- Drainage Blocks
- Laneways [9m ROW]
- Parking Block

DEVELOPMENT STATISTICS ±:

Gross Subject Lands: 37.2 ha [91.9 acres]

	Area	Area %	Frontage	Yield	Yield %
Hotel:	1.2 ha	3.2 %			
Single Detached 40':	4.2 ha	11.3 %	1166 m	95 units	14.5 %
Single Detached 30':	3.7 ha	10.0 %	1156 m	127 units	19.4 %
Semi-Detached 25':	4.9 ha	13.2 %	1571 m	206 units	31.4 %
Townhouses 20':	4.7 ha	12.6 %	1479 m	227 units	34.7 %
Parks:	1.9 ha	5.1 %			
SWM:	2.8 ha	7.5 %			
Drainage Blocks:	0.2 ha	0.5 %			
Servicing Block:	0.3 ha	0.8 %			
TOTAL:	23.9 ha	64.2 %	5372 m	655 units	100 %

DRAWN / REVISED

05 MAY 2022	Issued for client review
25 FEB 2022	Revised Draft
15 JULY 2021	First Draft

DEVELOPMENT CONCEPT

163-164 EDWARD ST E TOWNSHIP OF CLEARVIEW COUNTY OF SIMCOE

N

SCALE 0 20 40 60 80m

WESTON CONSULTING

File Number: 8216-1
Date: 2022-05-05
Drawn By: SM
Planner: AK
CAD: 8216-1concepts/C5_2022_05_05.dgn

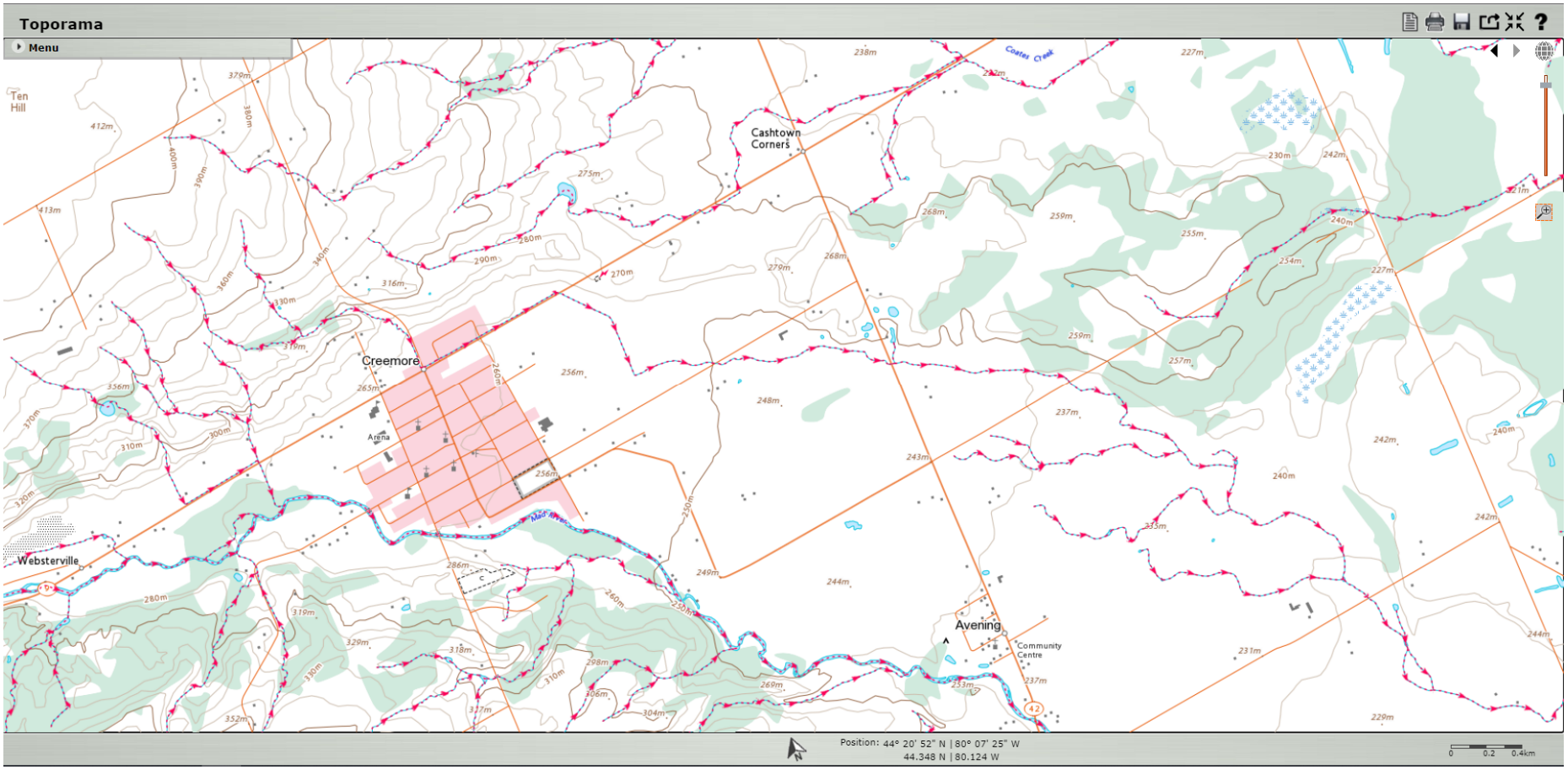
Drawing C5

Notes:
- Original property boundaries, stormwater blocks, drainage blocks, road widenings referenced from Preliminary Constraints Mapping by Tatham Engineering, October 2019.
- All areas and statistics are approximate and subject to change.
- All boundaries, roads and block areas subject to confirmation by survey.
- Existing and proposed trail network based on Clearview Trail Link Concept Plan Mapbook page 1 of 4, 2020

APPENDIX B



Topographic and Geological Maps



Ontario **Make A Topographic Map**
Ministry of Natural Resources and Forestry

Creemore

français

Legend

Refer to Help for Legend details

- Building as Symbol
- Building to Scale
- Airport
- Heliport \ Hospital Heliport
- Seaplane Base
- Ferry Route
- Trail Head \ Trail
- Railway \ Train Station
- Railway with Bridge
- Railway with Tunnel
- Road (Major → Minor)
- Winter Road
- Road with Bridge
- Road with Tunnel
- Primary, Kings or 400 Series Highway
- Secondary Highway
- Tertiary Highway
- District, County, Regional or Municipal Road
- Toll Highway
- One Way Road
- Road with Permanent Blocked Passage
- Road with Address Ranges
- Hydro Line, Communication L or Unknown Transmission Lin
- Natural Gas Pipeline, Water F or Unknown Pipeline
- Spot Height
- Index Contour
- Contour
- Wooded Area
- Wetland
- Waterbody
- Waterbody Elevation
- Watercourse
- Falls
- Rapids
- Rapids \ Falls
- Rapids
- Rocks
- Lock Gate
- Dam \ Hydro Wall
- Dam \ Hydro Wall

I want to...

Tools

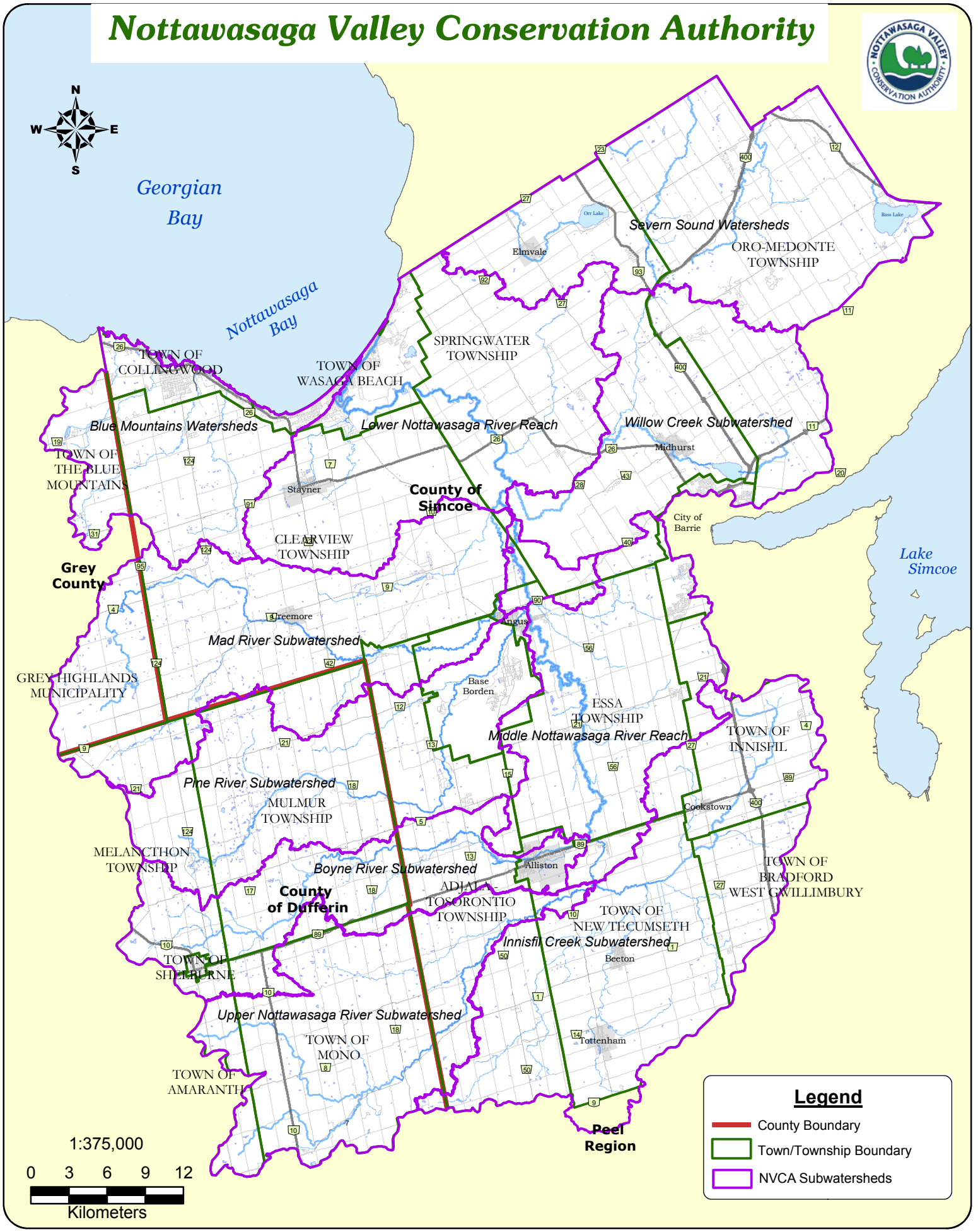
About Workflow (1) Legend

0 100 200m

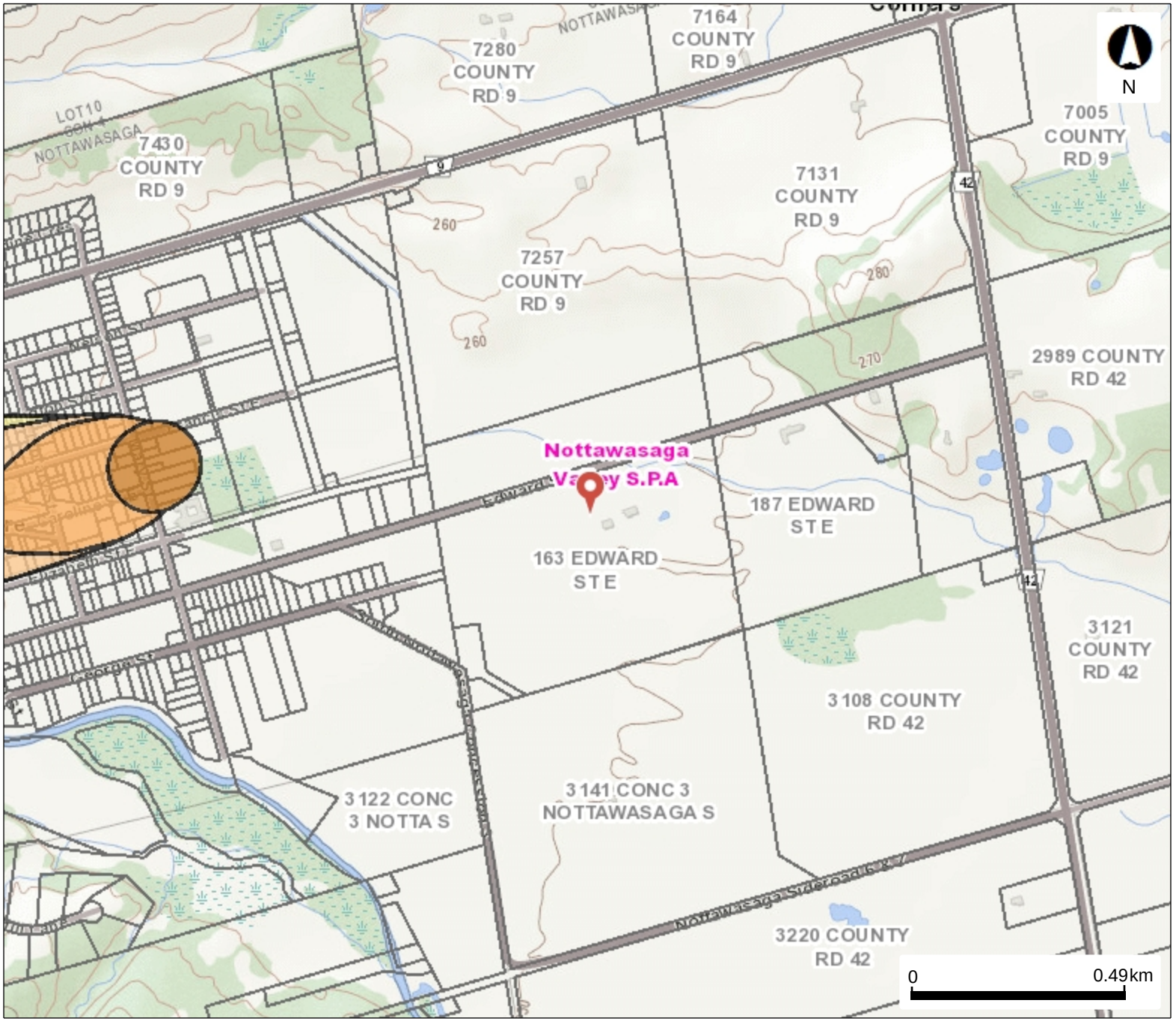
APPENDIX C



Nottawasaga Valley Conservation Authority



Source Protection Map



Legend

- Source Protection Areas
- Issue Contributing Areas
- WHPA Groundwater Under Direct Influence (WHPA-E)
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Intake Protection Zone 1
- Event Based Areas
- Intake Protection Zone 2
- Assessment Parcel with Addre

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

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Map Created: 6/24/2022
Map Center: 44.32674 N, -80.08831 W


660.24 m
611.16 m
418.00 m
111.90 m
520.04 m
Area: 38.64 ha
Perimeter: 2,485.39 m
164
163
187
196
215
257
County Road 42
Edward Street East
George Street
Concession 3 South Matawasaga
Mad River
7257
3065
3089
3108
3122
3141

APPENDIX D



Water Well Records

April 5, 2022

4:00:01 PM

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
CREEMORE VILLAGE	17 572031 4908563 W	2011-09 6809						7179469 (C15793) A043968 P	
CREEMORE VILLAGE	17 572030 4908562 W	2006-10 6809	2				0045 5	5741343 (Z51224) A043968	BRWN SAND GRVL 0015 BRWN SAND 0035 BRWN SILT 0039 BRWN SAND 0050
NOTTAWASAGA TOWNSHIP CON 03 008	17 573373 4908863 W	2015-11 3602	8.25 6.25	UT 0101	74/95/7/1:	DO	0095 6	7259245 (Z219950) A137567	BRWN SAND STNS 0009 GREY SAND GRVL 0027 GREY CLAY SOFT 0073 GREY CLAY HARD 0092 BRWN SAND 0101
NOTTAWASAGA TOWNSHIP CON 04 008	17 572237 4908479 W	2009-09 7190	2	0007			0003 12	7132875 (Z82600) A066585	BRWN SAND GRVL 0007 BRWN SAND 0015

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code

PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBDN	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPS	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDYOAPSTONE		

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Well Use

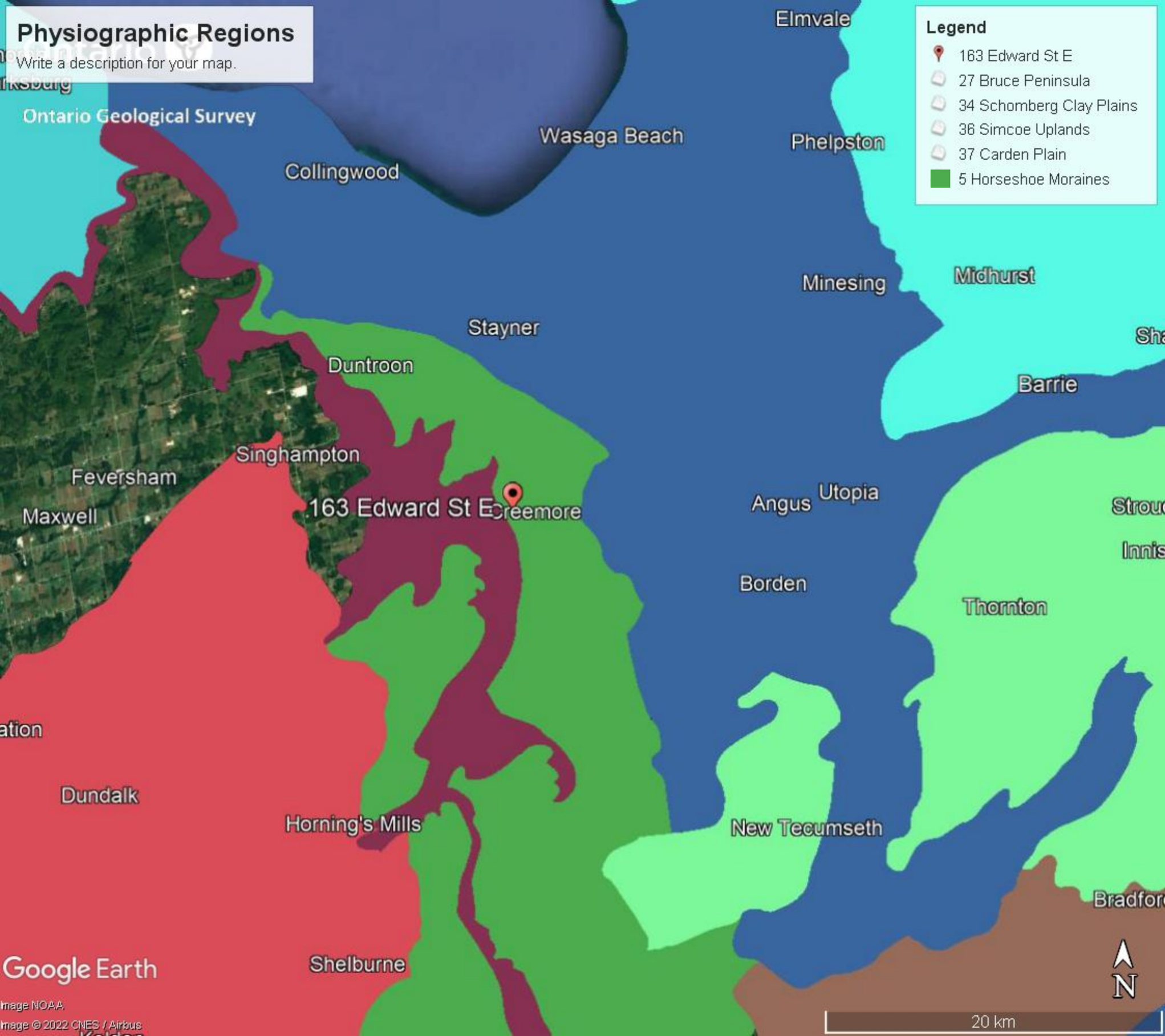
Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring TestHole
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

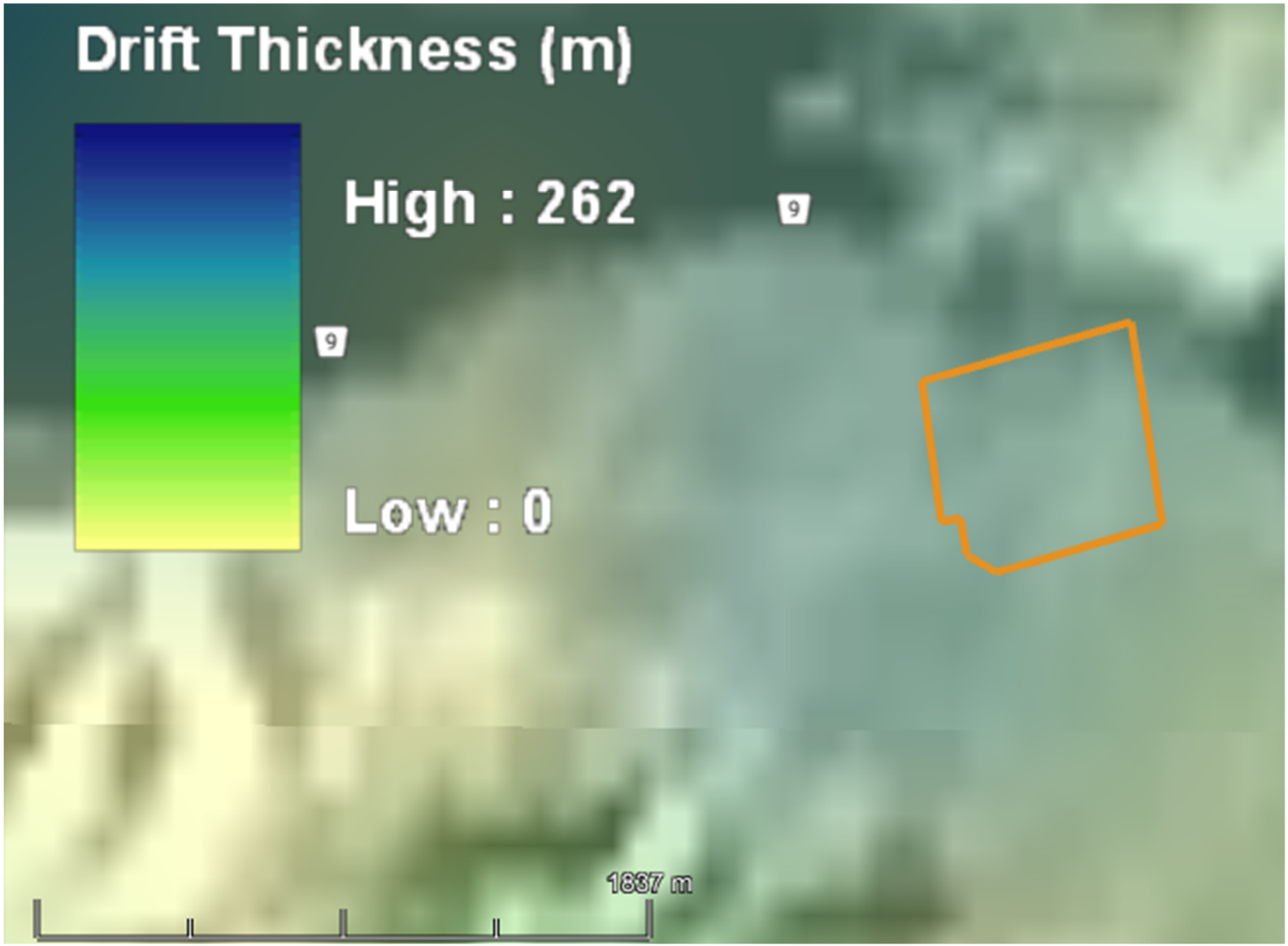
Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

APPENDIX G

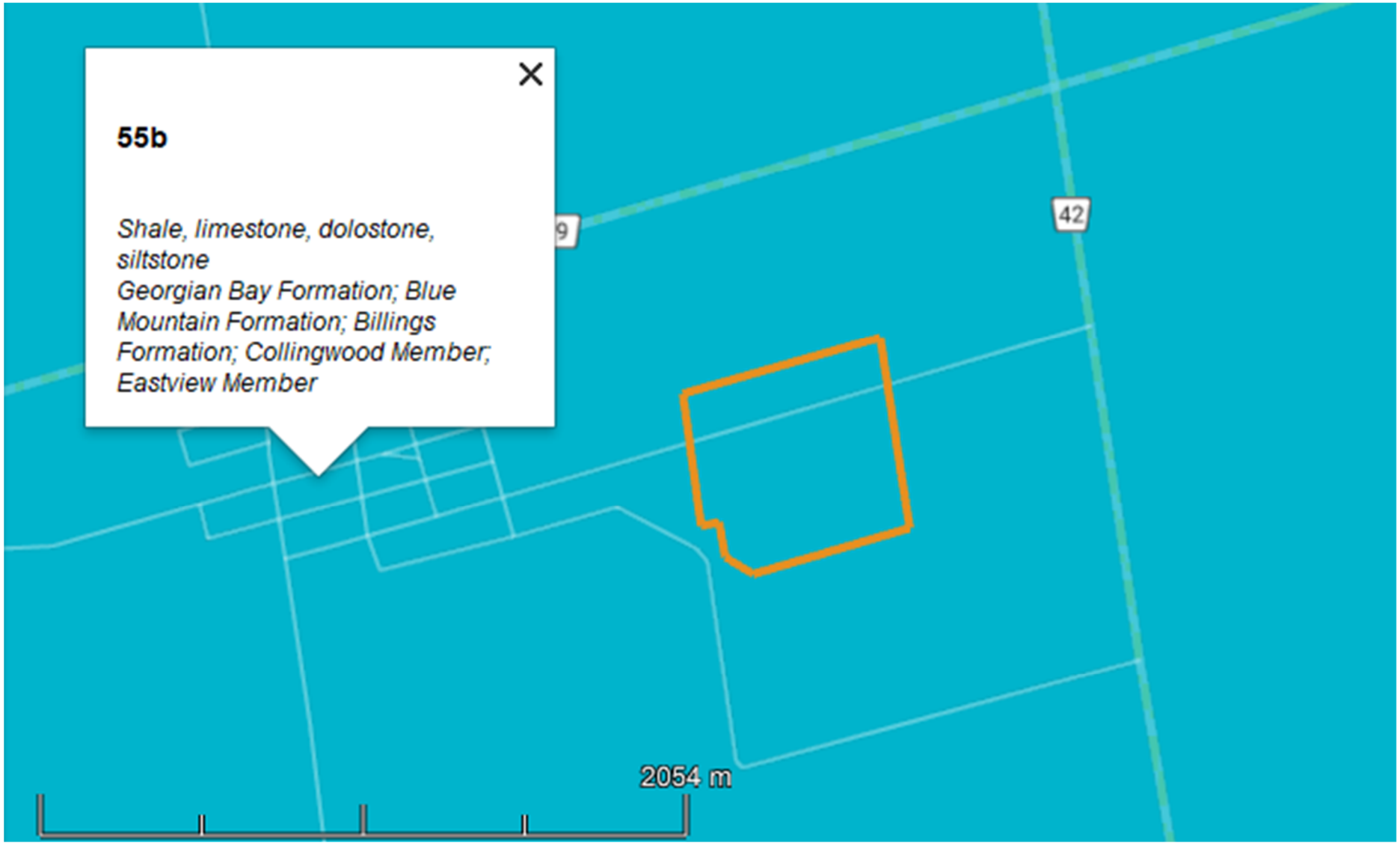



Physiographic Regions
Write a description for your map.
Ontario Geological Survey
Legend
163 Edward St E
27 Bruce Peninsula
34 Schomberg Clay Plains
36 Simcoe Uplands
37 Carden Plain
5 Horseshoe Moraines
Elmvale
Wasaga Beach
Phelpston
Collingwood
Minesing
Midhurst
Stayner
Duntroon
Barrie
Singhampton
Feversham
Maxwell
163 Edward St E
Creemore
Angus
Utopia
Borden
Thornton
Dundalk
Horning's Mills
New Tecumseth
Shelburne
Google Earth
Image NOAA
Image © 2022 CNES / Airbus
N
20 km

Topographic and Geological Maps



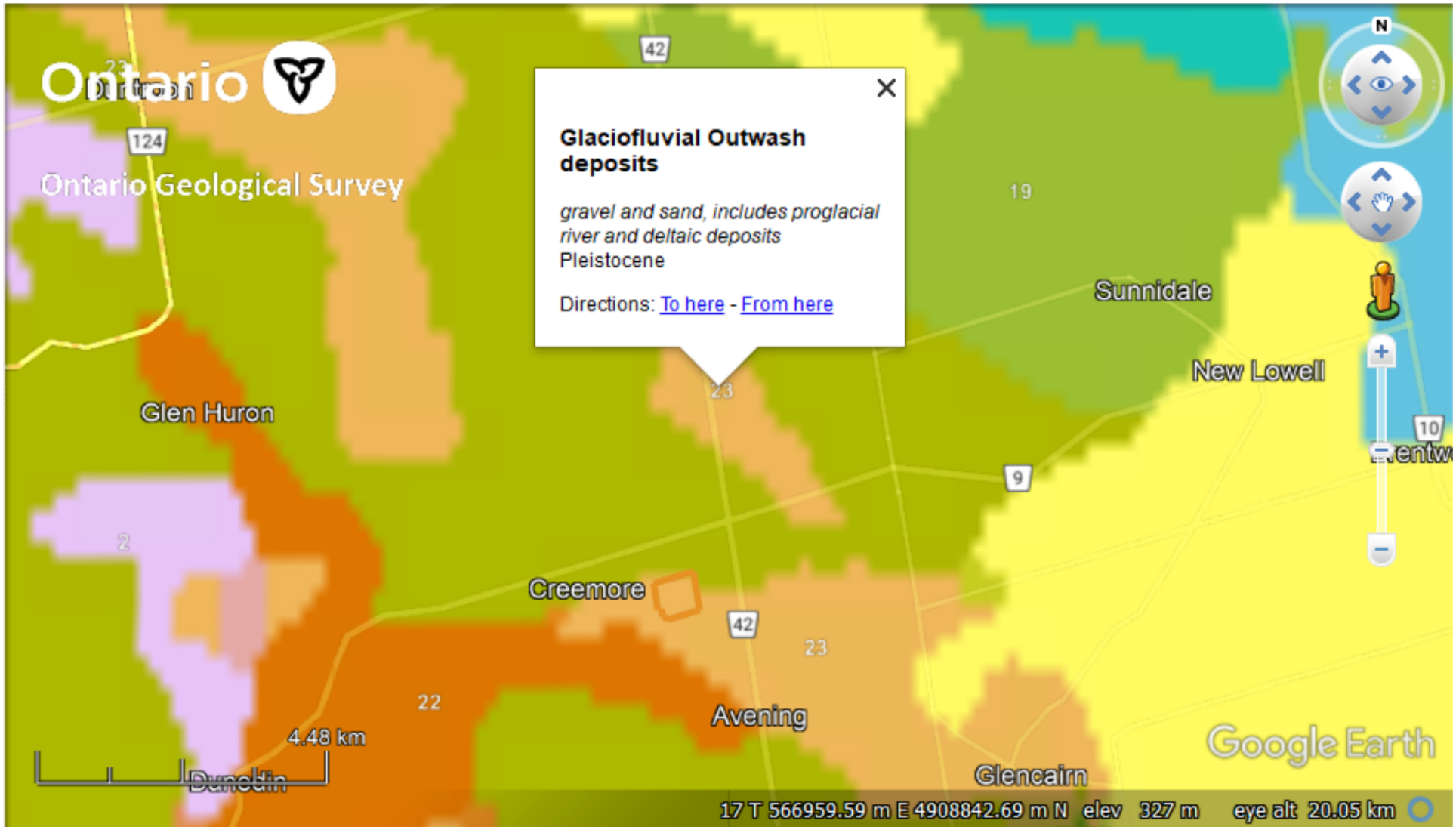
Topographic and Geological Maps



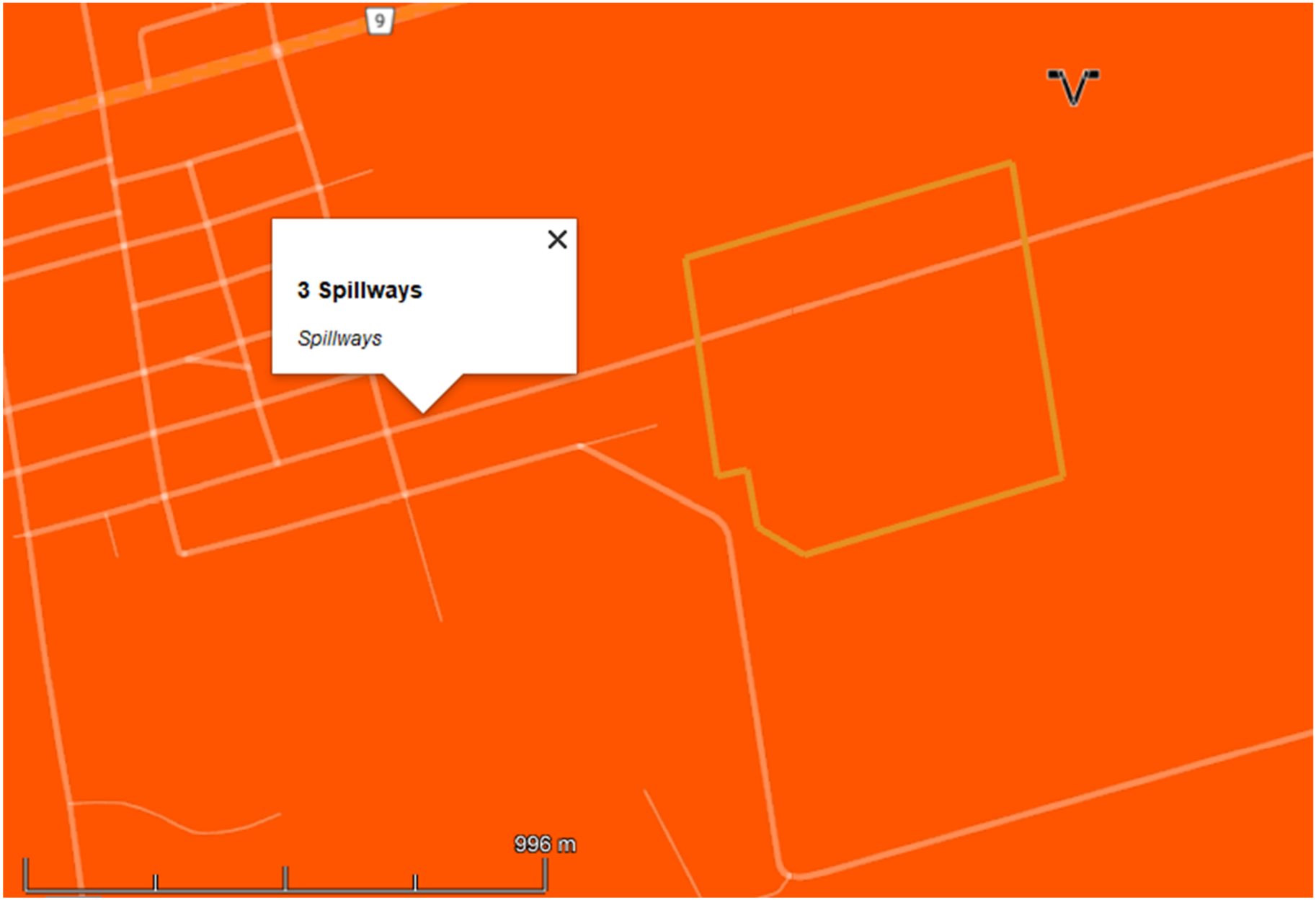
Topographic and Geological Maps



Topographic and Geological Maps



Topographic and Geological Maps



APPENDIX F



BOREHOLE LOG TERMINOLOGY

GROUNDED ENGINEERING

SAMPLING/TESTING METHODS

SS: split spoon sample

AS: auger sample

GS: grab sample

FV: shear vane

DP: direct push

PMT: pressuremeter test

ST: shelby tube

CORE: soil coring

RUN: rock coring

SYMBOLS & ABBREVIATIONS

MC: moisture content

LL: liquid limit

PL: plastic limit

PI: plasticity index

γ: soil unit weight (bulk)

G_s: specific gravity

S_u: undrained shear strength

▽ unstabilized water level

▼ 1st water level measurement

▼ 2nd water level measurement most recent

▼ water level measurement

ENVIRONMENTAL SAMPLES

M&I: metals and inorganic parameters

PAH: polycyclic aromatic hydrocarbon

PCB: polychlorinated biphenyl

VOC: volatile organic compound

PHC: petroleum hydrocarbon

BTEX: benzene, toluene, ethylbenzene and xylene

PPM: parts per million

FIELD MOISTURE (based on tactile inspection)

DRY: no observable pore water

MOIST: inferred pore water, not observable (i.e. grey, cool, etc.)

WET: visible pore water

COHESIONLESS

Relative Density	N-Value
Very Loose	<4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	>50

COHESIVE

Consistency	N-Value	Su (kPa)
Very Soft	<2	<12
Soft	2 - 4	12 - 25
Firm	4 - 8	25 - 50
Stiff	8 - 15	50 - 100
Very Stiff	15 - 30	100 - 200
Hard	>30	>200

COMPOSITION

Term	% by weight
trace silt	<10
some silt	10 - 20
silt***y***	20 - 35
sand ***and*** silt	>35

ASTM STANDARDS

ASTM D1586 Standard Penetration Test (SPT)
Driving a 51 mm O.D. split-barrel sampler ("split spoon") into soil with a 63.5 kg weight free falling 760 mm. The blows required to drive the split spoon 300 mm ("bpf") after an initial penetration of 150 mm is referred to as the N-Value.

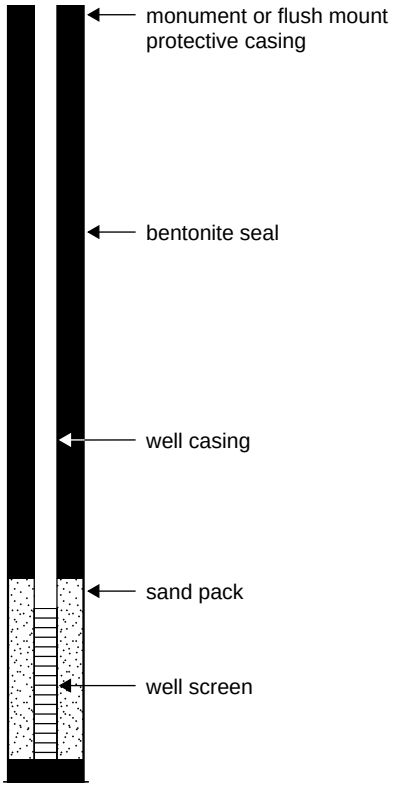
ASTM D3441 Cone Penetration Test (CPT)
Pushing an internal still rod with a outer hollow rod ("sleeve") tipped with a cone with an apex angle of 60° and a cross-sectional area of 1000 mm^2 into soil. The resistance is measured in the sleeve and at the tip to determine the skin friction and the tip resistance.

ASTM D2573 Field Vane Test (FVT)
Pushing a four blade vane into soil and rotating it from the surface to determine the torque required to shear a cylindrical surface with the vane. The torque is converted to the shear strength of the soil using a limit equilibrium analysis.

ASTM D1587 Shelby Tubes (ST)
Pushing a thin-walled metal tube into the in-situ soil at the bottom of a borehole, removing the tube and sealing the ends to prevent soil movement or changes in moisture content for the purposes of extracting a relatively undisturbed sample.

ASTM D4719 Pressuremeter Test (PMT)
Place an inflatable cylindrical probe into a pre-drilled hole and expanding it while measuring the change in volume and pressure in the probe. It is inflated under either equal pressure increments or equal volume increments. This provides the stress-strain response of the soil.

WELL LEGEND



BOREHOLE LOG 101

Date Started : Apr 27, 2022
Position : E: 572747, N: 4908726 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : B-57

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
250.8	**GROUND SURFACE**				
250.6 / 0.2	150mm **TOPSOIL**				
	SANDY SILT, trace clay, trace gravel, trace rootlets, trace rock fragments, organic odour, compact, dark brown, moist (REWORKED)		1	SS	18
250.0 / 0.8	**SAND AND GRAVEL**, trace silt, some rock fragments, trace clay, (inferred cobbles), very dense, brown, moist		2	SS	57
			3	SS	55
	...at 2.3 m, some silt, trace clay		4	SS	50
247.8 / 3.0	**SAND**, some silt, trace gravel, trace clay, very dense, brown, wet		5	SS	58
	...at 4.6 m, trace silt, compact		6	SS	18
	...at 6.1 m, some gravel		7	SS	12
			8	SS	10
242.6 / 8.2	**END OF BOREHOLE**				

depth scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8

well details

elevation (m): 250, 249, 248, 247, 246, 245, 244, 243

undrained shear strength (kPa)
○ unconfined + field vane
● pocket penetrometer ■ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
⊠ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS1: BTEX, PAHs, OCs, VOCs

SS2: H-Ms, Metals, ORPs

SS3: BTEX, PHCs

1 94 3 2

Unstabilized water level measured at 1.2 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jun 15, 2022	1.2	249.6
Aug 31, 2022	2.6	248.2
Sep 9, 2022	3.0	247.8
Oct 31, 2022	3.3	247.5
Nov 29, 2022	3.6	247.2
Dec 31, 2022	3.6	247.2
Jan 31, 2023	3.3	247.5
Feb 28, 2023	2.5	248.3
Apr 20, 2023	1.0	249.8

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

Date Started : Apr 26, 2022
Position : E: 572630, N: 4908778 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 102

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : B-57

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
251.6	**GROUND SURFACE**				
	100mm **TOPSOIL**		1	SS	11
250.8 / 0.8	**SANDY SILT**, some clay, trace gravel, trace rootlets, trace rock fragments (inferred cobbles), organic odour, compact, dark brown, moist (REWORKED)				
	SAND AND GRAVEL, trace silt, trace clay, some rock fragments (inferred cobbles), very dense to dense, brown, moist		2	SS	50
			3	SS	65
			4	SS	39
			5	SS	46
247.0 / 4.6	**SILTY SAND**, trace clay, trace gravel, compact, brown, wet		6	SS	29
245.5 / 6.1	**SAND**, some silt, trace gravel, trace clay, compact, brown, wet		7	SS	16
	...at 7.6 m, some gravel		8	SS	22
243.4 / 8.2	**END OF BOREHOLE**				

depth scale (m): 0 1 2 3 4 5 6 7 8

well details

elevation (m): 251 250 249 248 247 246 245 244

undrained shear strength (kPa)
○ unconfined + field vane
● pocket penetrometer ■ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
⊠ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS1: H-Ms, Metals, ORPs, PAHs
Insufficient soil recovery for a moisture content test

SS2: OCs

SS3: BTEX, PHCs

SS4: BTEX, VOCs

1 57 35 7

Unstabilized water level measured at 0.8 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Apr 29, 2022	0.9	250.7
Jun 15, 2022	0.8	250.8
Aug 31, 2022	2.5	249.1
Sep 9, 2022	2.9	248.7
Oct 31, 2022	3.3	248.3
Nov 29, 2022	3.6	248.0
Dec 31, 2022	3.2	248.4
Jan 31, 2023	3.2	248.4
Feb 28, 2023	2.3	249.3
Apr 20, 2023	0.8	250.8

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

BOREHOLE LOG 103

Date Started : Apr 26, 2022
Position : E: 572578, N: 4908664 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : B-57

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
251.8	**GROUND SURFACE**				
251.6 / 0.2	150mm **TOPSOIL**		1A	SS	12
	SANDY SILT, some clay, trace gravel, trace rootlets, trace rock fragments, organic odour, compact, dark brown, wet (REWORKED)		1B		
251.0 / 0.8	...at 0.5 m, some gravel, trace rock fragments (inferred cobbles), brown, moist		2	SS	85
	SAND AND GRAVEL, trace silt, trace clay, some rock fragments (inferred cobbles), very dense to dense, brown, moist		3	SS	73
			4	SS	71
	...at 3.0 m, sandy gravel		5	SS	41
			6A	SS	65
246.8 / 5.0	**SAND**, some silt, trace gravel, compact, grey, wet		6B		
			7	SS	17
			8	SS	24
243.6 / 8.2	**END OF BOREHOLE**				

depth scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8

elevation (m): 251, 250, 249, 248, 247, 246, 245, 244

well details

undrained shear strength (kPa): unconfined, field vane, pocket penetrometer, Lab Vane; 40, 80, 120, 160

SPT N-values (bpf): dynamic cone; 10, 20, 30, 40

headspace vapour (ppm): hexane, isobutylene, methane; 100, 200, 300

moisture / plasticity: PL, MC, LL; 10, 20, 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT): GR SA SI CL

1B: OCs

SS2: H-Ms, Metals, ORPs, PAHs

1.2m: auger grinding

SS3: BTEX, PHCs

57 31 9 3

SS7: BTEX, VOCs

Unstabilized water level measured at 0.8 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Apr 29, 2022	0.8	251.0
May 5, 2022	0.7	251.1
Jun 15, 2022	0.7	251.1
Aug 31, 2022	2.4	249.4
Sep 9, 2022	2.8	249.0
Oct 31, 2022	3.1	248.7
Nov 29, 2022	3.4	248.4
Dec 31, 2022	3.3	248.5
Jan 31, 2023	3.0	248.8
Feb 28, 2023	2.2	249.6
Apr 20, 2023	0.7	251.1

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Apr 21, 2022
Position : E: 572423, N: 4908674 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 104

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : B-57

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
252.4	**GROUND SURFACE**				
252.2 / 0.2	175mm **TOPSOIL**				
	SANDY SILT, some clay, trace gravel, trace rootlets, organic odour, compact, dark brown, wet (REWORKED)		1	SS	11
251.6 / 0.8	**SAND AND GRAVEL**, trace silt, trace clay, some rock fragments (inferred cobbles), dense to very dense, brown, moist		2	SS	42
			3	SS	55
			4	SS	41
			5	SS	52
247.8 / 4.6	**SAND**, some gravel, some silt, trace clay, compact, brown, moist		6	SS	24
246.2 / 6.2	**CLAYEY SILT**, trace sand, trace gravel, stiff, greyish brown, wet		7A / 7B	SS	12
244.8 / 7.6	**SAND**, some silt, trace gravel, compact, grey, wet		8	SS	13
244.2 / 8.2	**END OF BOREHOLE**				

depth scale (m) 0–8 | well details | elevation (m) 252–245

undrained shear strength (kPa): unconfined, field vane, pocket penetrometer, Lab Vane; 40 80 120 160
SPT N-values (bpf): dynamic cone; 10 20 30 40
headspace vapour (ppm): hexane, isobutylene, methane; 100 200 300
moisture / plasticity: PL MC LL; 10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)

GR SA SI CL
7 32 43 18

SS1: PAHs, OCs

Insufficient soil recovery for a moisture content test

SS2: H-Ms, Metals, ORPs

SS4: BTEX, PHCs
Insufficient soil recovery for a moisture content test

SS6: BTEX, VOCs

2 8 53 37

Unstabilized water level measured at 0.8 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Apr 29, 2022	0.3	252.1
Jun 15, 2022	0.2	252.2
Jun 16, 2022	0.3	252.1
Aug 31, 2022	1.9	250.5
Sep 9, 2022	2.3	250.1
Oct 31, 2022	2.7	249.7
Nov 29, 2022	2.9	249.5
Dec 31, 2022	2.8	249.6
Jan 31, 2023	2.4	250.0
Feb 28, 2023	1.6	250.8
Apr 20, 2023	0.3	252.1

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

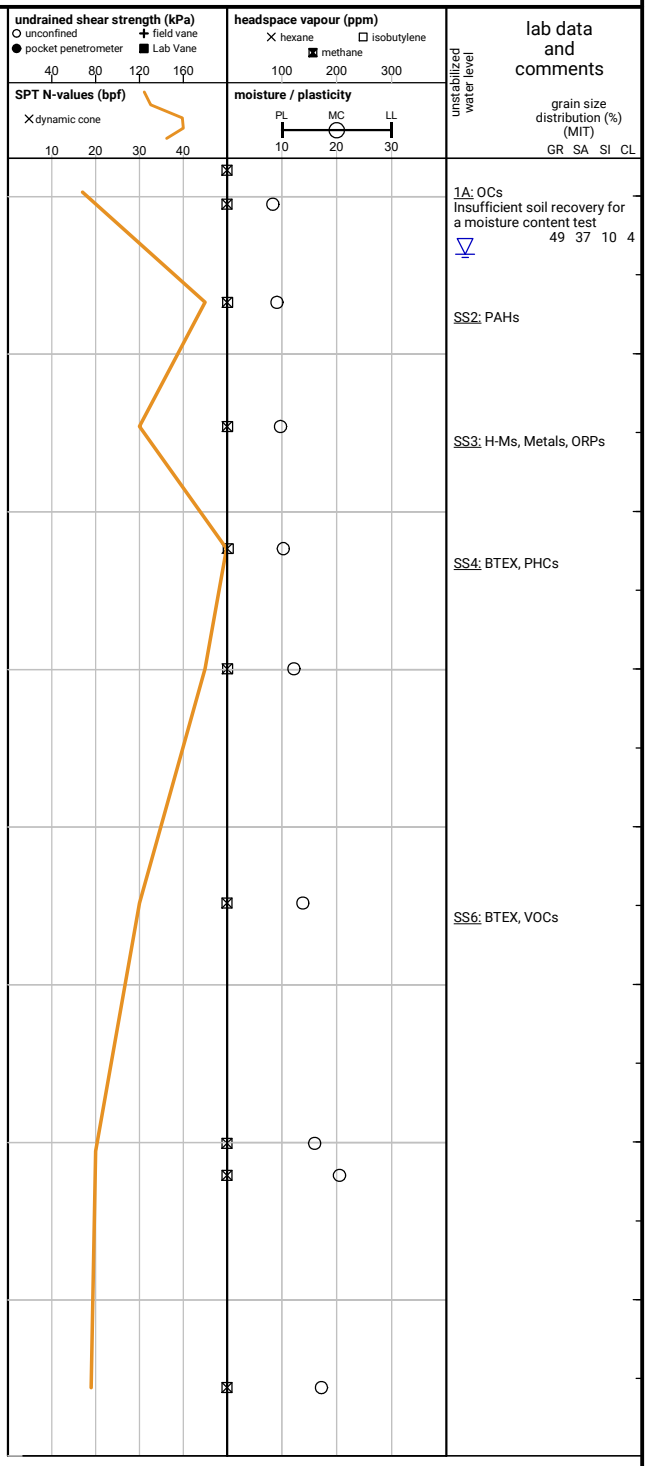
BOREHOLE LOG 105

Date Started : Apr 21, 2022
Position : E: 572414, N: 4908485 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
252.2	**GROUND SURFACE**				
252.0 / 0.2	150mm **TOPSOIL**		1A	SS	17
	GRAVEL AND SAND, some silt, trace clay, trace rootlets, trace rock fragments, organic odour, compact, dark brown, moist (REWORKED)		1B		
251.4 / 0.8	**SAND AND GRAVEL**, trace silt, trace rock fragments (inferred cobbles), dense to very dense, brown, moist		2	SS	45
			3	SS	30
	...at 2.3 m, some silt		4	SS	56
			5	SS	45
	...at 4.6 m, gravelly sand, trace silt, grey		6	SS	30
245.8 / 6.4	**SAND**, some silt, some clay, trace gravel, compact, grey, wet		7A / 7B	SS	20
244.6 / 7.6	**SILTY SAND**, some clay, trace gravel, compact, grey, wet		8	SS	19
244.0 / 8.2	**END OF BOREHOLE**				



Unstabilized water level measured at 0.6 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Apr 29, 2022	0.8	251.4
May 5, 2022	0.7	251.5
Jun 15, 2022	0.9	251.3
Jun 16, 2022	0.8	251.4
Aug 31, 2022	2.4	249.8
Sep 9, 2022	2.6	249.6
Oct 31, 2022	2.8	249.4
Nov 29, 2022	3.2	249.0
Dec 31, 2022	3.1	249.1
Jan 31, 2023	2.7	249.5
Feb 28, 2023	2.0	250.2
Apr 20, 2023	0.7	251.5

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

BOREHOLE LOG 106

Date Started : Apr 21, 2022
Position : E: 572507, N: 4908380 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : 050

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
251.3	**GROUND SURFACE**				
251.1 / 0.2	150mm **TOPSOIL**				
	SANDY SILT, some clay, trace gravel, trace rootlets, trace wood fragments, organic odour, loose, dark brown, wet (REWORKED)		1	SS	4
250.5 / 0.8	**SAND AND GRAVEL**, trace silt, trace clay, dense to compact, brown, moist		2	SS	41
	...at 1.5 m, some silt, trace rock fragments		3	SS	25
			4	SS	31
	...at 3.0 m, trace silt, very dense		5	SS	58
	...at 4.6 m, gravelly sand, compact		6	SS	19
245.2 / 6.1	**SAND**, some gravel, some silt, trace clay, compact, grey, wet		7	SS	25
243.4 / 7.9			8A	SS	27
243.1 / 8.2	**SANDY SILT**, trace clay, trace gravel, compact, grey, wet		8B		

depth scale (m): 0 1 2 3 4 5 6 7 8

elevation (m): 251 250 249 248 247 246 245 244

well details

undrained shear strength (kPa): unconfined, field vane, pocket penetrometer, Lab Vane; 40 80 120 160

SPT N-values (bpf): dynamic cone; 10 20 30 40

headspace vapour (ppm): hexane, isobutylene, methane; 100 200 300

moisture / plasticity: PL MC LL; 10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT) GR SA SI CL

SS1: H-Ms, Metals, ORPs, PAHs

Insufficient soil recovery for a moisture content test

SS3: OCs

SS4: BTEX, PHCs, VOCs

25 68 4 3

END OF BOREHOLE

Unstabilized water level measured at 0.8 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Apr 29, 2022	0.8	250.5
Jun 15, 2022	0.8	250.5
Jun 16, 2022	0.8	250.5
Aug 31, 2022	2.3	249.0
Sep 9, 2022	2.6	248.7
Oct 31, 2022	2.8	248.5
Nov 29, 2022	3.1	248.2
Dec 31, 2022	2.9	248.4
Jan 31, 2023	2.7	248.6
Feb 28, 2023	2.0	249.3
Apr 20, 2023	0.7	250.6

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

BOREHOLE LOG 107

Date Started : Apr 21, 2022
Position : E: 572566, N: 4908251 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : D50

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
250.8	**GROUND SURFACE**				
250.6 / 0.2	150mm **TOPSOIL**		1	SS	7
250.0 / 0.8	**SANDY SILT**, trace clay, trace gravel, trace rootlets, trace rock fragments (inferred cobbles), organic odour, loose, dark brown, moist (REWORKED)		2	SS	30
	SAND AND GRAVEL, trace silt, trace clay, some rock fragments (inferred cobbles), compact, brown, moist				
	...at 1.5 m, some silt, trace rock fragments, orangish-brown		3	SS	29
			4	SS	27
	...at 3.0 m, very dense		5	SS	57
	...at 4.6 m, gravelly sand, trace silt, compact, brown		6	SS	17
244.7 / 6.1	**SAND**, some silt, trace clay, trace gravel, loose, brown, wet		7	SS	5
	...at 7.6 m, some gravel, trace silt, compact		8	SS	14
242.6 / 8.2	**END OF BOREHOLE**				

depth scale (m): 0 1 2 3 4 5 6 7 8

well details

elevation (m): 250 249 248 247 246 245 244 243

undrained shear strength (kPa)
○ unconfined + field vane
● pocket penetrometer ■ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
▣ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS1: BTEX, VOCs
Insufficient soil recovery for a moisture content test

SS2: BTEX, OCs, PHCs

SS3: PAHs

SS4: H-Ms, Metals, ORPs

Unstabilized water level measured at 0.8 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Apr 29, 2022	0.9	249.9
May 5, 2022	0.9	249.9
Jun 15, 2022	0.9	249.9
Jun 16, 2022	0.9	249.9
Aug 31, 2022	2.3	248.5
Sep 9, 2022	2.7	248.1
Oct 31, 2022	2.9	247.9
Nov 29, 2022	3.1	247.7
Dec 31, 2022	2.9	247.9
Jan 31, 2023	2.6	248.2
Feb 28, 2023	2.1	248.7
Apr 20, 2023	0.8	250.0

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

GROUNDED ENGINEERING

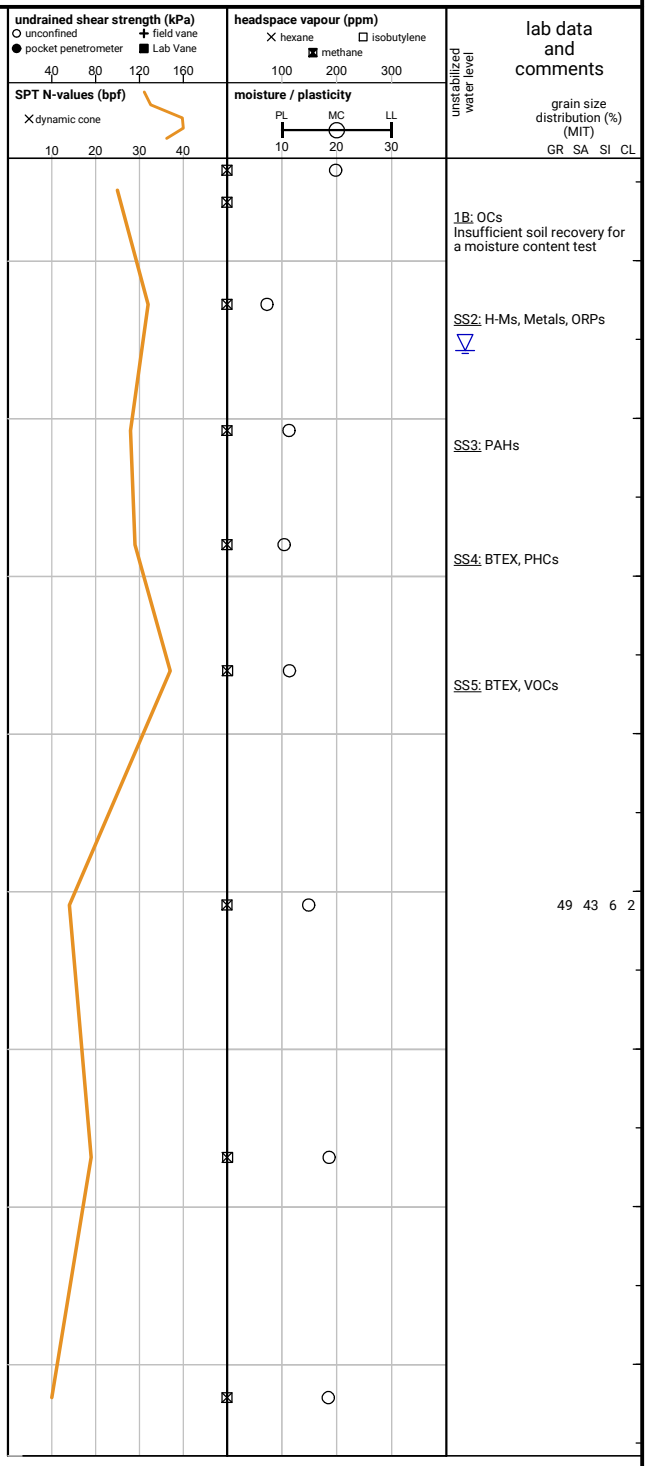
Date Started : Apr 21, 2022
Position : E: 572675, N: 4908390 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 108

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : hollow stem augers OD=215 mm, D50

elev depth (m)	description	graphic log	number	type	SPT N-value
250.7	**GROUND SURFACE**				
250.5	150mm **TOPSOIL**		1A		
0.2	**SANDY SILT**, some clay, trace gravel, trace rootlets, trace rock fragments, organic odour, compact, dark brown, moist (REWORKED)		1B	SS	25
249.9					
0.8	**SAND AND GRAVEL**, some silt, trace clay, some rock fragments (inferred cobbles), dense to compact, moist		2	SS	32
	...at 1.5 m, trace rock fragments		3	SS	28
			4	SS	29
			5	SS	37
	...at 4.6 m, trace silt, wet		6	SS	14
244.6					
6.1	**SAND**, some silt, some gravel, compact, brown, wet		7	SS	19
			8	SS	10
242.5					
8.2	**END OF BOREHOLE**				



Unstabilized water level measured at 1.2 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Apr 29, 2022	1.2	249.5
Jun 15, 2022	1.3	249.4
Aug 31, 2022	2.5	248.2
Sep 9, 2022	2.7	248.0
Oct 31, 2022	3.1	247.6
Nov 29, 2022	3.4	247.3
Dec 31, 2022	3.4	247.3
Jan 31, 2023	3.0	247.7
Feb 28, 2023	2.4	248.3
Apr 20, 2023	1.0	249.7

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

BOREHOLE LOG 109

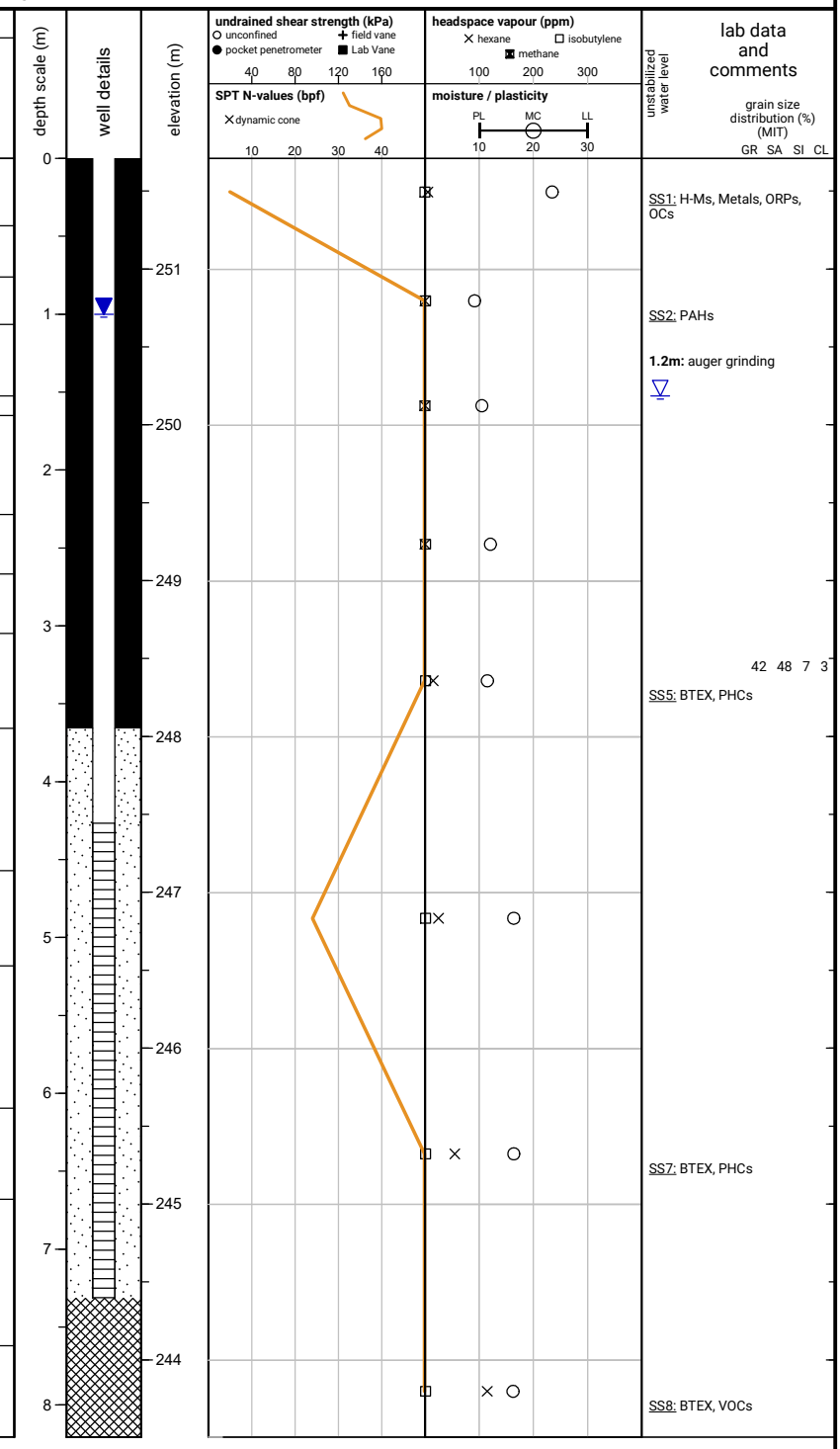
Date Started : Apr 25, 2022
Position : E: 572568, N: 4908540 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : B-57

hollow stem augers OD=215 mm

elev depth (m)	description	number	type	SPT N-value
251.7	**GROUND SURFACE**			
251.5 / 0.2	150mm **TOPSOIL**			
	SANDY SILT, some clay, trace gravel, trace rootlets, trace rock fragments, organic odour, loose, dark brown, wet (REWORKED)	1	SS	5
250.9 / 0.8	**SAND AND GRAVEL**, trace silt, trace clay, trace rock fragments (inferred cobbles), very dense, brown, moist	2	SS	52
		3	SS	67
		4	SS	55
		5	SS	62
247.1 / 4.6	**SAND**, some silt, trace clay, trace gravel, compact, brown, wet	6	SS	24
	...at 6.1 m, very dense	7	SS	86
		8	SS	61
243.5 / 8.2	**END OF BOREHOLE**			



Unstabilized water level measured at 1.5 m below ground surface; open upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Apr 29, 2022	1.0	250.7
May 5, 2022	0.8	250.9
Jun 15, 2022	1.0	250.7
Jun 16, 2022	0.9	250.8
Aug 31, 2022	2.5	249.2
Sep 9, 2022	2.8	248.9
Oct 31, 2022	3.1	248.6
Nov 29, 2022	3.5	248.2
Dec 31, 2022	3.4	248.3
Jan 31, 2023	3.0	248.7
Feb 28, 2023	2.3	249.4
Apr 20, 2023	1.0	250.7

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Apr 18, 2022
Position : E: 572704, N: 4908607 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 110

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : *D50*

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
251.0	**GROUND SURFACE**				
250.8 / 0.2	150mm **TOPSOIL**		1	SS	19
	SANDY SILT, trace clay, trace gravel, trace wood fragments, trace rootlets, trace rock fragments (inferred cobbles), organic odour, compact, dark brown, moist (REWORKED)				
250.2 / 0.8	**SAND AND GRAVEL**, trace silt, some rock fragments (inferred cobbles), dense, brown, moist		2	SS	33
			3	SS	31
			4	SS	47
	...at 3.0 m, gravelly sand, compact		5	SS	29
247.2 / 3.8	**SAND**, some silt, trace clay, trace gravel, compact, brown, wet		6	SS	24
246.4 / 4.6	**SANDY SILT**, some clay, compact, greyish brown, wet		7	SS	11
244.9 / 6.1	**SAND**, some silt, trace clay, trace gravel, compact, greyish brown, wet		8	SS	14
			9	SS	18
242.8 / 8.2	**END OF BOREHOLE**				

depth scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8

well details

elevation (m): 250, 249, 248, 247, 246, 245, 244, 243

undrained shear strength (kPa)
○ unconfined + field vane
● pocket penetrometer ■ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
▣ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS1: OCs

SS2: H-Ms, Metals, ORPs

SS3: PAHs

SS5: BTEX, PHCs

0 32 57 11

SS8: BTEX, VOCs

Unstabilized water level measured at 1.5 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jun 15, 2022	1.2	249.8
Aug 31, 2022	2.5	248.5
Sep 9, 2022	2.9	248.1
Oct 31, 2022	3.2	247.8
Nov 29, 2022	3.5	247.5
Dec 31, 2022	3.5	247.5
Jan 31, 2023	3.1	247.9
Feb 28, 2023	2.5	248.5
Apr 20, 2023	0.9	250.1

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

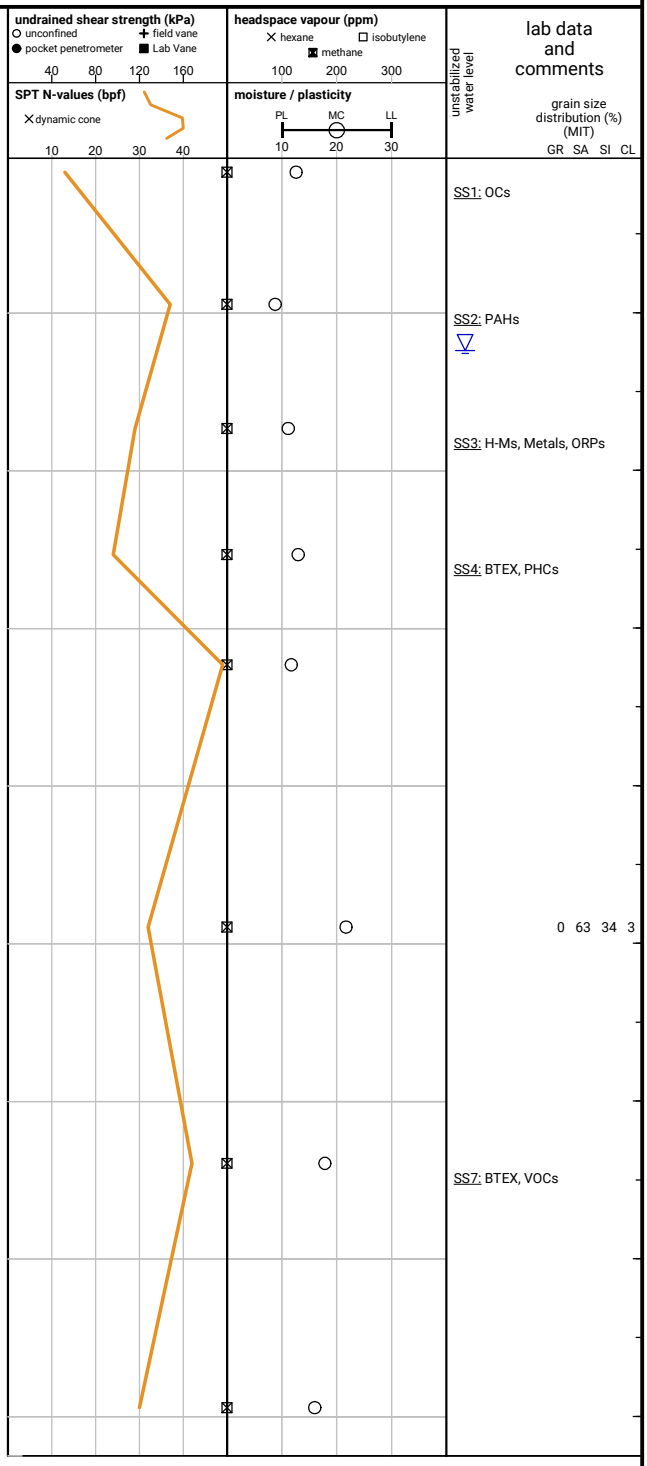
BOREHOLE LOG 111

Date Started : Apr 20, 2022
Position : E: 572789, N: 4908494 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : hollow stem augers OD=215 mm, D50

elev depth (m)	description	graphic log	number	type	SPT N-value
250.0	**GROUND SURFACE**				
249.8	150mm **TOPSOIL**		1	SS	13
0.2	**SANDY SILT**, trace clay, trace gravel, trace wood fragments, trace rootlets, trace rock fragments (inferred cobbles), organic odour, compact, dark brown, moist (REWORKED)				
249.2			2	SS	37
0.8	**SAND AND GRAVEL**, trace silt, some rock fragments (inferred cobbles), compact to dense, brown, moist				
			3	SS	29
	...at 2.3 m, gravelly sand, trace rock fragments		4	SS	24
			5	SS	49
245.4					
4.6	**SILTY SAND**, trace clay, dense, brown, wet		6	SS	32
			7	SS	42
			8	SS	30
241.8					
8.2	**END OF BOREHOLE**				



Unstabilized water level measured at 1.2 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Apr 29, 2022	1.1	248.9
May 5, 2022	1.1	248.9
Jun 15, 2022	1.3	248.7
Aug 31, 2022	2.4	247.6
Sep 9, 2022	2.7	247.3
Oct 31, 2022	3.1	246.9
Nov 29, 2022	3.3	246.7
Dec 31, 2022	3.3	246.7
Jan 31, 2023	2.9	247.1
Feb 28, 2023	2.3	247.7
Apr 20, 2023	1.0	249.0

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

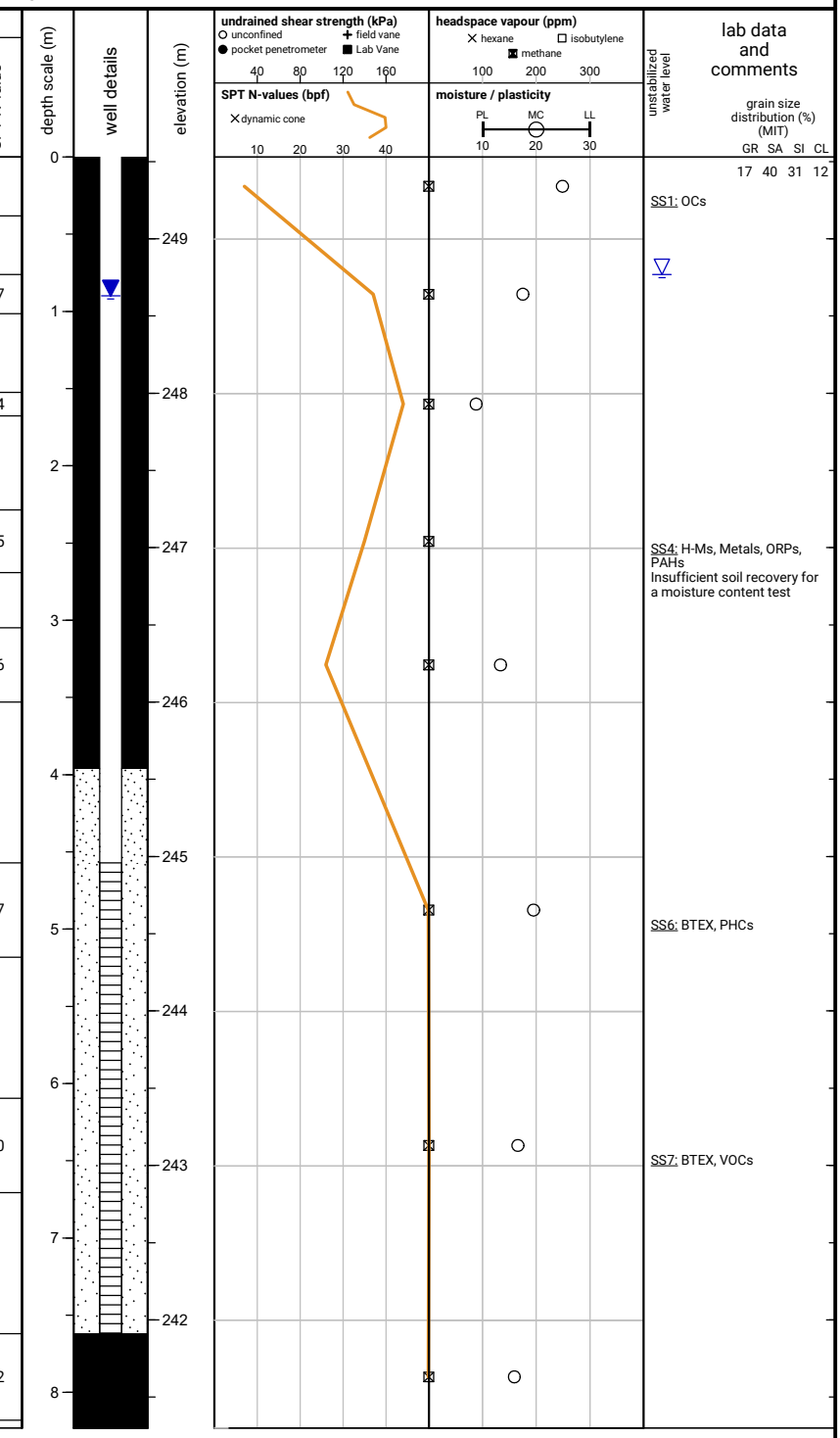
BOREHOLE LOG 112

Date Started : Apr 19, 2022
Position : E: 572805, N: 4908280 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : hollow stem augers OD=215 mm, D50

elev depth (m)	description	graphic log	number	type	SPT N-value
249.5	**GROUND SURFACE**				
249.3	150mm **TOPSOIL**				
0.2	**SILTY SAND**, some clay, some gravel, trace rock fragments, trace rootlets, organic odour, loose, dark brown, wet (REWORKED)		1	SS	7
248.7					
0.8	**SAND AND GRAVEL**, some silt, trace clay, some rock fragments (inferred cobbles), compact to dense, brown and orange, wet		2	SS	37
	...at 1.5 m, moist		3	SS	44
	...at 2.3 m, trace rock fragments		4	SS	35
	...at 3.0 m, gravelly, brown and orange		5	SS	26
244.9					
4.6	**SAND**, some silt, trace clay, trace gravel, very dense, brown, wet		6	SS	57
			7	SS	50
			8	SS	52
241.3					
8.2	**END OF BOREHOLE**				



Unstabilized water level measured at 0.8 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jun 15, 2022	1.2	248.3
Aug 31, 2022	2.2	247.3
Sep 9, 2022	2.5	247.0
Oct 31, 2022	2.8	246.7
Nov 29, 2022	3.0	246.5
Dec 31, 2022	2.9	246.6
Jan 31, 2023	2.6	246.9
Feb 28, 2023	2.0	247.5
Apr 20, 2023	0.9	248.6

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

BOREHOLE LOG 113

Date Started : Apr 19, 2022
Position : E: 572881, N: 4908395 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : hollow stem augers OD=215 mm, D50

elev depth (m)	description	graphic log	number	type	SPT N-value
249.4	**GROUND SURFACE**				
249.2 / 0.2	200mm **TOPSOIL**		1	SS	11
	SANDY SILT, some clay, trace gravel, trace rock fragments (inferred cobbles), trace rootlets, organic odour, compact, dark brown, moist (REWORKED)				
248.6 / 0.8	**SAND AND GRAVEL**, some silt, some rock fragments (inferred cobbles), compact to dense, brown, moist		2	SS	48
			3	SS	26
			4	SS	39
			5	SS	39
244.8 / 4.6	**SAND**, some silt, trace clay, some gravel, trace rock fragments, compact, brown, wet		6	SS	20
	...at 6.1 m, gravelly sand, trace silt		7	SS	20
	...at 7.6 m, trace gravel, very dense		8	SS	59
241.2 / 8.2	**END OF BOREHOLE**				

depth scale (m): 0 1 2 3 4 5 6 7 8

well details

elevation (m): 249 248 247 246 245 244 243 242

undrained shear strength (kPa)
○ unconfined + field vane
● pocket penetrometer ■ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
⊠ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS1: H-Ms, Metals, ORPs
Insufficient soil recovery for a moisture content test

SS2: PAHs, OCs

SS3: BTEX, PHCs, VOCs

3 92 3 2

Unstabilized water level measured at 0.8 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
May 5, 2022	1.0	248.4
Jun 15, 2022	1.3	248.1
Jun 16, 2022	1.2	248.2
Aug 31, 2022	2.3	247.1
Sep 9, 2022	2.6	246.8
Oct 31, 2022	2.9	246.5
Nov 29, 2022	3.1	246.3
Dec 31, 2022	3.1	246.3
Jan 31, 2023	2.7	246.7
Feb 28, 2023	2.2	247.2
Apr 20, 2023	1.0	248.4

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

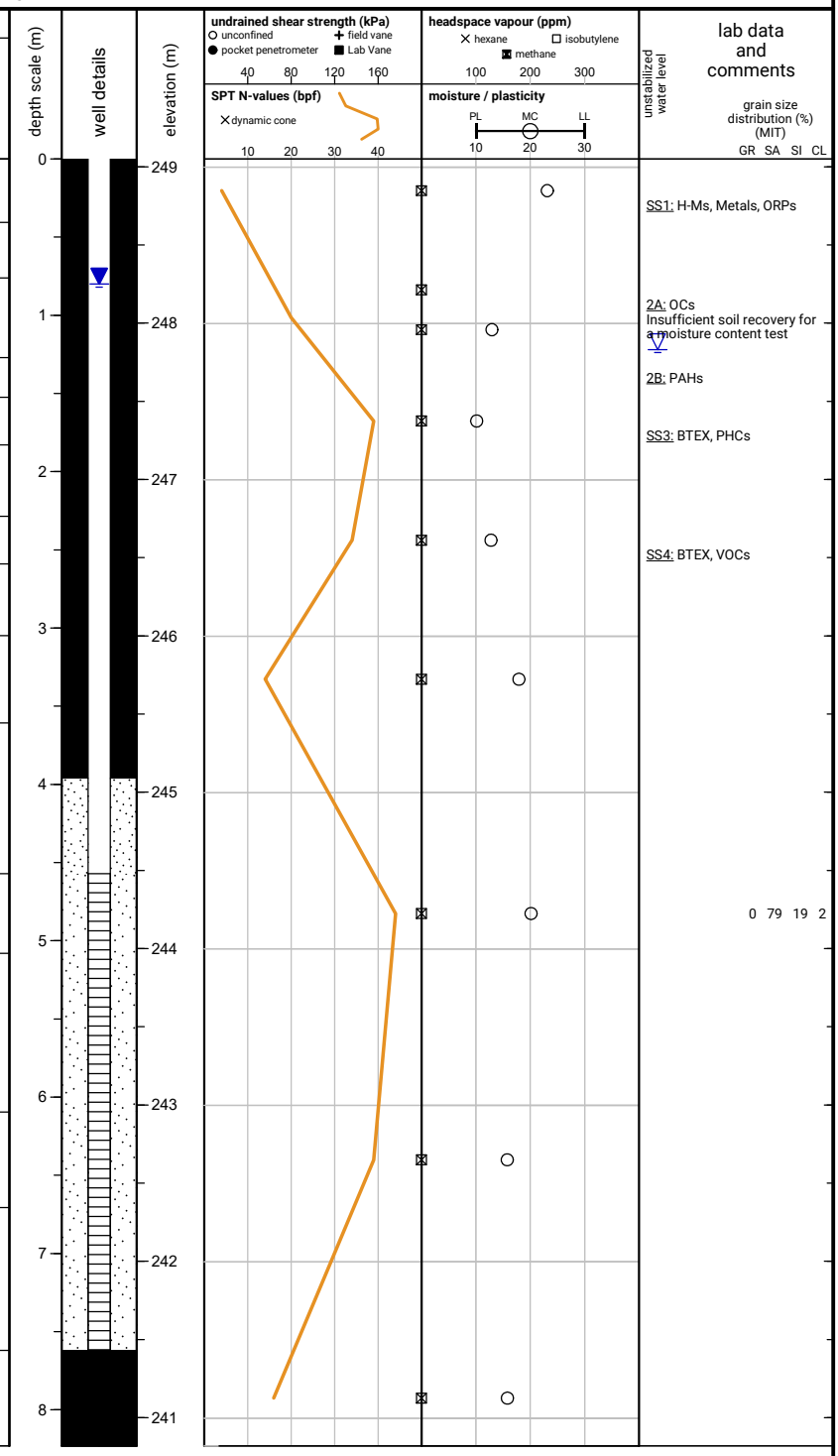
BOREHOLE LOG 114

Date Started : Apr 19, 2022
Position : E: 572972, N: 4908551 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : hollow stem augers OD=215 mm, D50

elev depth (m)	description	graphic log	number	type	SPT N-value
249.1	**GROUND SURFACE**				
248.9 / 0.2	175mm **TOPSOIL**				
	SANDY SILT, clayey, trace gravel, trace rock fragments, trace rootlets, organic odour, soft, dark brown, wet (REWORKED)		1	SS	4
248.2 / 0.9	...at 0.8 m, clayey silt, sandy, stiff, brown and grey		2A	SS	20
	SAND AND GRAVEL, trace silt, some rock fragments (inferred cobbles), compact to dense, brown, moist		2B		
			3	SS	39
			4	SS	34
246.1 / 3.0	**GRAVELLY SAND**, trace silt, trace clay, compact, brown, wet		5	SS	14
244.5 / 4.6	**SAND**, some silt, trace clay, dense to compact, greyish brown, wet		6	SS	44
			7	SS	39
			8	SS	16
240.9 / 8.2	**END OF BOREHOLE**				



Unstabilized water level measured at 1.2 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jun 15, 2022	1.3	247.8
Aug 31, 2022	2.2	246.9
Sep 9, 2022	2.6	246.5
Oct 31, 2022	2.9	246.2
Nov 29, 2022	3.1	246.0
Dec 31, 2022	3.1	246.0
Jan 31, 2023	2.8	246.3
Feb 28, 2023	2.2	246.9
Apr 20, 2023	0.8	248.3

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

BOREHOLE LOG 115

Date Started : Apr 18, 2022
Position : E: 572851, N: 4908673 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : hollow stem augers OD=215 mm, D50

elev depth (m)	description	graphic log	number	type	SPT N-value
249.7	**GROUND SURFACE**				
249.5 / 0.2	150mm **TOPSOIL**		1A	SS	12
	SANDY SILT, some clay, trace gravel, trace rootlets, trace rock fragments, organic odour, compact, dark brown, moist (REWORKED)		1B		
248.9 / 0.8	**SAND AND GRAVEL**, trace silt, trace rock fragments (inferred cobbles), very dense, brown, moist		2	SS	50
			3	SS	50
	...at 2.3 m, gravelly sand, dense		4	SS	33
	...at 3.0 m, some silt, trace clay		5	SS	35
245.0 / 4.7	**SILT**, some clay, some sand, trace gravel, very stiff, brown, moist		6A	SS	23
			6B	SS	
243.6 / 6.1	**SAND**, some silt, trace clay, trace gravel, compact, greyish brown, wet		7	SS	18
	...at 7.6 m, loose		8	SS	9
			9	SS	8
239.9 / 9.8					

depth scale (m) | well details | elevation (m)

undrained shear strength (kPa): unconfined, field vane, pocket penetrometer, Lab Vane; 40 80 120 160
SPT N-values (bpf): dynamic cone; 10 20 30 40
headspace vapour (ppm): hexane, isobutylene, methane; 100 200 300
moisture / plasticity: PL MC LL; 10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT) GR SA SI CL

SS1: OCs
SS2: BTEX, VOCs
SS3: BTEX, PHCs
SS4: PAHs
SS5: H-Ms, Metals, ORPs
1 16 67 16

END OF BOREHOLE

Unstabilized water level measured at 0.6 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
May 5, 2022	0.5	249.2
Jun 15, 2022	0.8	248.9
Jun 16, 2022	0.6	249.1
Aug 31, 2022	2.0	247.7
Sep 9, 2022	2.4	247.3
Oct 31, 2022	2.7	247.0
Nov 29, 2022	3.0	246.7
Dec 31, 2022	3.0	246.7
Jan 31, 2023	2.7	247.0
Feb 28, 2023	2.0	247.7
Apr 20, 2023	0.4	249.3

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

BOREHOLE LOG 116

Date Started : Apr 27, 2022
Position : E: 572925, N: 4908801 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-052 **Project** : 163-164 Edward St, Creemore, ON **Client** : Lamb Development Corp.

drill method : B-57

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
250.1	**GROUND SURFACE**				
	100mm **TOPSOIL**		1	SS	8
	SILT AND SAND, some clay, trace gravel, trace rootlets, trace wood fragments, trace rock fragments, organic odour, loose, dark brown, wet (REWORKED)				
249.2 / 0.9			2A	SS	67
	SAND AND GRAVEL, trace silt, trace clay, some rock fragments (inferred cobbles), very dense, brown, moist		2B		
			3	SS	54
			4	SS	51
247.1 / 3.0					
	GRAVELLY SAND, trace silt, compact, brown, moist		5	SS	23
245.5 / 4.6					
	SAND, some gravel, some silt, loose to compact, brown, wet		6	SS	8
			7	SS	14
	...at 7.6 m, trace gravel, trace silt		8	SS	18
241.9 / 8.2					

depth scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8
elevation (m): 250, 249, 248, 247, 246, 245, 244, 243, 242

well details

undrained shear strength (kPa): unconfined, field vane, pocket penetrometer, Lab Vane; 40, 80, 120, 160
SPT N-values (bpf): dynamic cone; 10, 20, 30, 40
headspace vapour (ppm): hexane, isobutylene, methane; 100, 200, 300
moisture / plasticity: PL, MC, LL; 10, 20, 30
unstabilized water level

lab data and comments
grain size distribution (%) (MIT)
GR SA SI CL
2 39 40 19

2B: OCs
SS3: H-Ms, Metals, ORPs, PAHs
SS4: BTEX, PHCs
SS7: BTEX, VOCs

END OF BOREHOLE

Unstabilized water level measured at 1.5 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

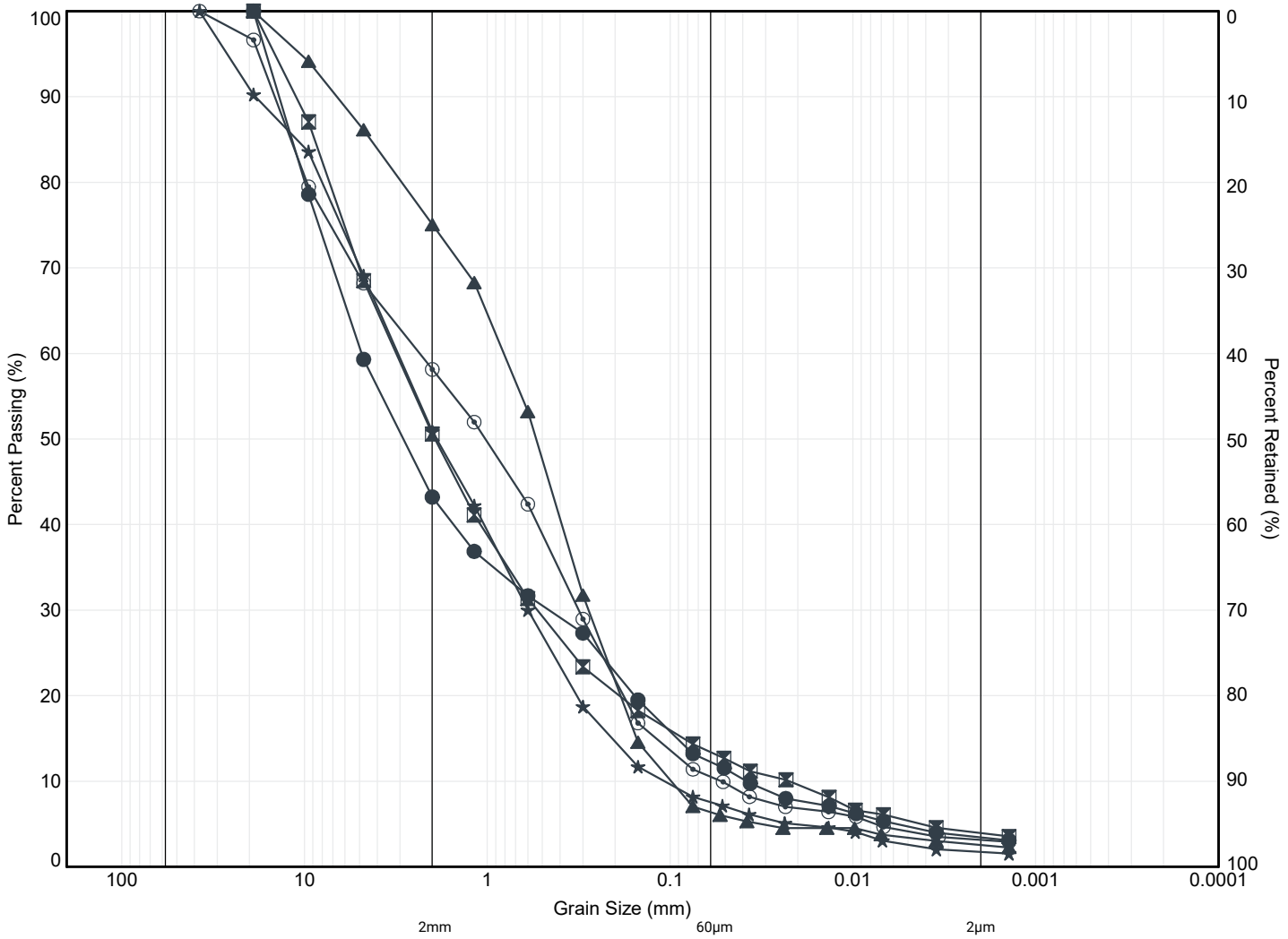
date	depth (m)	elevation (m)
Jun 15, 2022	2.1	248.0
Jun 16, 2022	0.6	249.5
Aug 31, 2022	3.1	247.0
Sep 9, 2022	3.5	246.6
Oct 31, 2022	3.9	246.2
Nov 29, 2022	4.2	245.9
Dec 31, 2022	4.2	245.9
Jan 31, 2023	3.9	246.2
Feb 28, 2023	3.1	247.0
Apr 20, 2023	1.6	248.5

file: 22-052 creemore.gpj

Tech : VT | **PM** : JR/KF | **Rev** : MD

APPENDIX G





MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**103**	SS5	3.4		57	31	9	3
⊠	**105**	1B	0.4		49	37	10	4
▲	**106**	SS6	4.9		25	68	4	3
★	**108**	SS6	4.9		49	43	6	2
⊙	**109**	SS5	3.4		42	48	7	3

GROUNDED ENGINEERING

Title: **GRAIN SIZE DISTRIBUTION GRAVELS AND SANDS**

File No.: **22-052**

file: 22-052 creemore.gpj

K from Grain Size Analysis Report

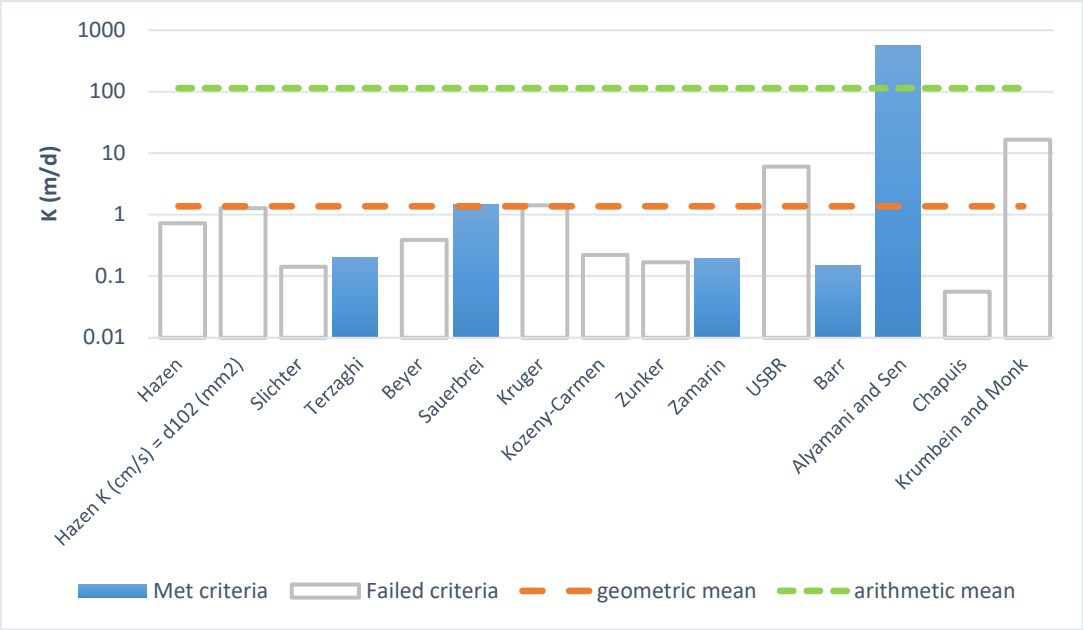
Date: 27-Jun-22

Sample Name: BH103 SS5

Mass Sample (g): 100

T (oC) 20

Poorly sorted sandy gravel low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	8.4E-04	8.4E-06	0.72	
Hazen K (cm/s) = d_{10} (mm)	1.5E-03	1.5E-05	1.28	
Slichter	1.6E-04	1.6E-06	0.14	
Terzaghi	2.3E-04	2.3E-06	0.20	
Beyer	4.5E-04	4.5E-06	0.39	
Sauerbrei	1.7E-03	1.7E-05	1.46	
Kruger	1.6E-03	1.6E-05	1.42	
Kozeny-Carmen	2.6E-04	2.6E-06	0.22	
Zunker	1.9E-04	1.9E-06	0.17	
Zamarin	2.3E-04	2.3E-06	0.20	
USBR	7.0E-03	7.0E-05	6.07	
Barr	1.8E-04	1.8E-06	0.15	
Alyamani and Sen	6.6E-01	6.6E-03	573.40	
Chapuis	6.5E-05	6.5E-07	0.06	
Krumbein and Monk	1.9E-02	1.9E-04	16.53	
geometric mean	1.6E-03	1.6E-05	1.38	
arithmetic mean	1.3E-01	1.3E-03	115.08	

K from Grain Size Analysis Report

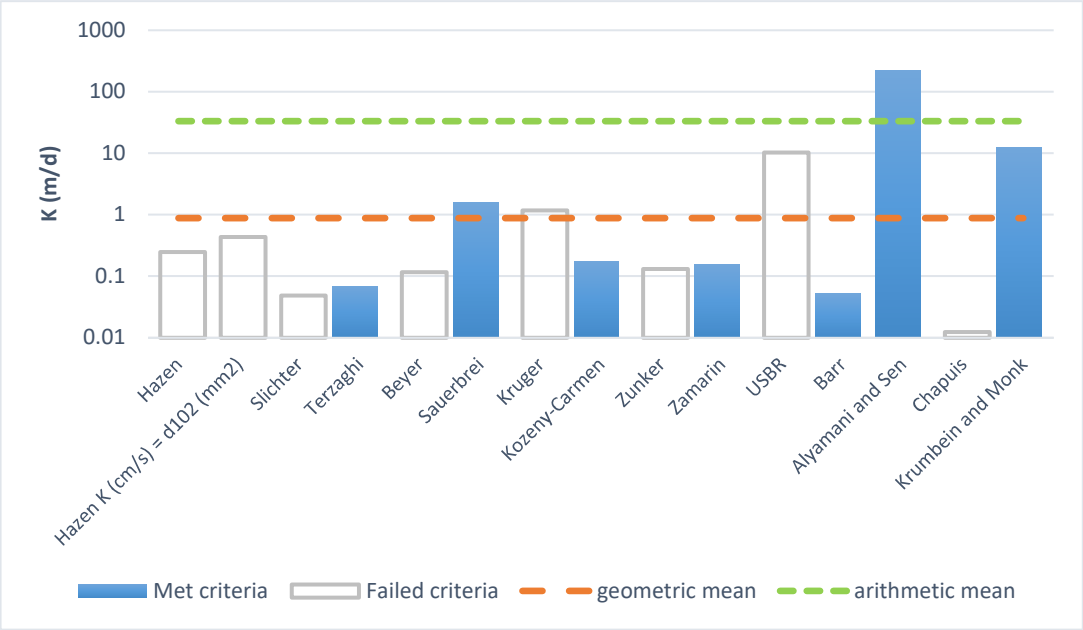
Date: 27-Jun-22

Sample Name: BH105 SS1B

Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	2.9E-04	2.9E-06	0.25	
Hazen K (cm/s) = d_{10} (mm)	5.0E-04	5.0E-06	0.44	
Slichter	5.6E-05	5.6E-07	0.05	
Terzaghi	8.0E-05	8.0E-07	0.07	
Beyer	1.3E-04	1.3E-06	0.12	
Sauerbrei	1.9E-03	1.9E-05	1.60	
Kruger	1.3E-03	1.3E-05	1.17	
Kozeny-Carmen	2.0E-04	2.0E-06	0.17	
Zunker	1.5E-04	1.5E-06	0.13	
Zamarin	1.8E-04	1.8E-06	0.15	
USBR	1.2E-02	1.2E-04	10.30	
Barr	6.0E-05	6.0E-07	0.05	
Alyamani and Sen	2.5E-01	2.5E-03	219.86	
Chapuis	1.4E-05	1.4E-07	0.01	
Krumbein and Monk	1.4E-02	1.4E-04	12.37	
geometric mean	1.0E-03	1.0E-05	0.88	
arithmetic mean	3.9E-02	3.9E-04	33.47	

K from Grain Size Analysis Report

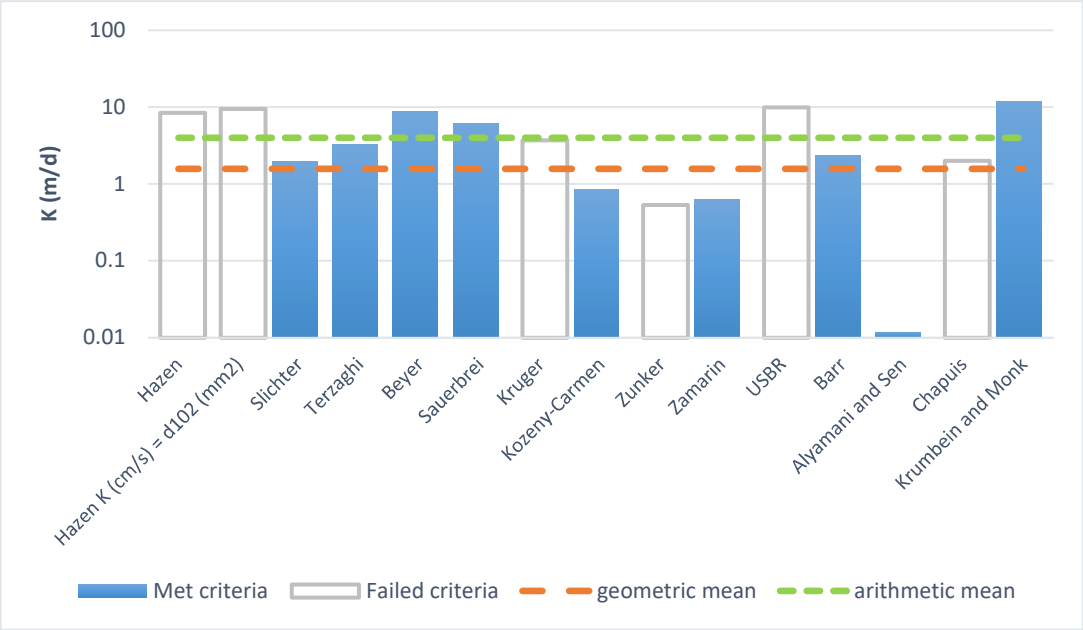
Date: 27-Jun-22

Sample Name: BH106 SS6

Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s		de
Hazen	9.7E-03	9.7E-05		
Hazen K (cm/s) = d_{10} (mm)	1.1E-02	1.1E-04		
Slichter	2.3E-03	2.3E-05		
Terzaghi	3.8E-03	3.8E-05		
Beyer	1.0E-02	1.0E-04		
Sauerbrei	7.2E-03	7.2E-05		
Kruger	4.3E-03	4.3E-05	3.68	
Kozeny-Carmen	9.9E-04	9.9E-06	0.85	
Zunker	6.2E-04	6.2E-06	0.53	
Zamarin	7.2E-04	7.2E-06	0.63	
USBR	1.1E-02	1.1E-04	9.88	
Barr	2.7E-03	2.7E-05	2.35	
Alyamani and Sen	1.4E-05	1.4E-07	0.01	
Chapuis	2.3E-03	2.3E-05	2.00	
Krumbein and Monk	1.4E-02	1.4E-04	12.11	
geometric mean	1.8E-03	1.8E-05	1.58	
arithmetic mean	4.6E-03	4.6E-05	4.01	

K from Grain Size Analysis Report

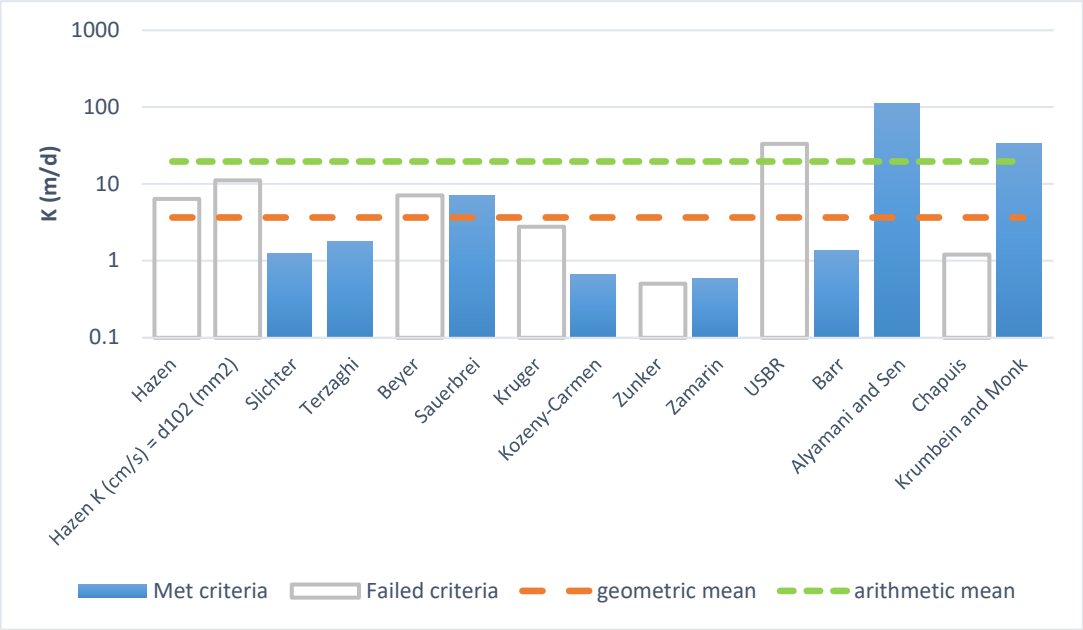
Date: 27-Jun-22

Sample Name: BH108 SS6

Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s		de
Hazen	7.4E-03	7.4E-05		
Hazen K (cm/s) = d_{10} (mm)	1.3E-02	1.3E-04		
Slichter	1.5E-03	1.5E-05		
Terzaghi	2.1E-03	2.1E-05		
Beyer	8.2E-03	8.2E-05		
Sauerbrei	8.2E-03	8.2E-05		
Kruger	3.2E-03	3.2E-05	2.77	
Kozeny-Carmen	7.7E-04	7.7E-06	0.67	
Zunker	5.8E-04	5.8E-06	0.50	
Zamarin	6.8E-04	6.8E-06	0.59	
USBR	3.8E-02	3.8E-04	33.09	
Barr	1.6E-03	1.6E-05	1.35	
Alyamani and Sen	1.3E-01	1.3E-03	111.08	
Chapuis	1.4E-03	1.4E-05	1.20	
Krumbein and Monk	3.9E-02	3.9E-04	33.60	
geometric mean	4.2E-03	4.2E-05	3.66	
arithmetic mean	2.3E-02	2.3E-04	19.68	

K from Grain Size Analysis Report

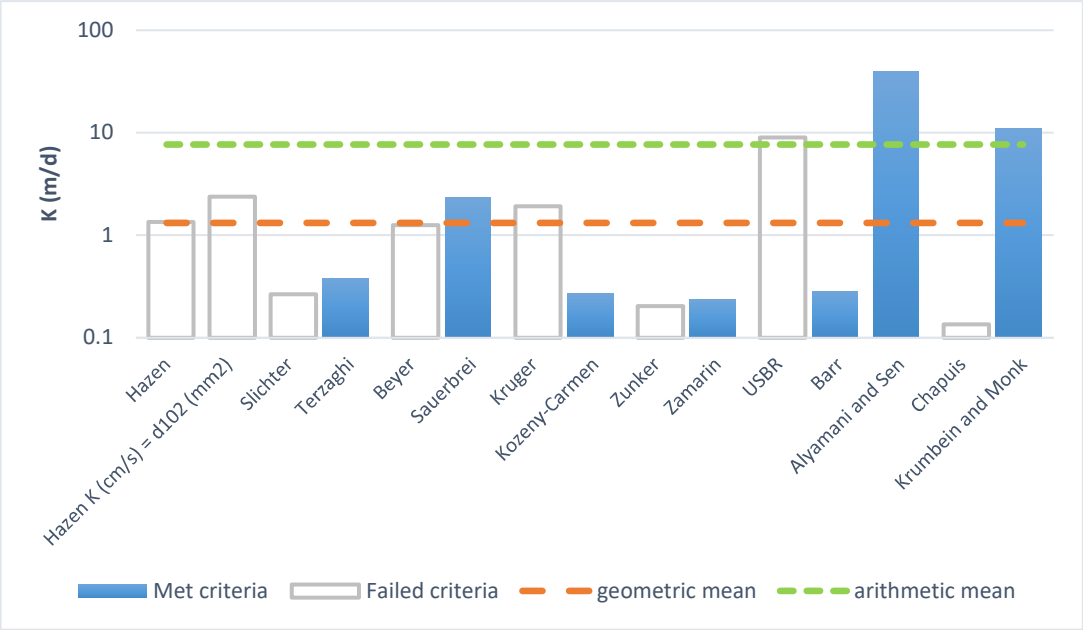
Date: 27-Jun-22

Sample Name: BH109 SS5

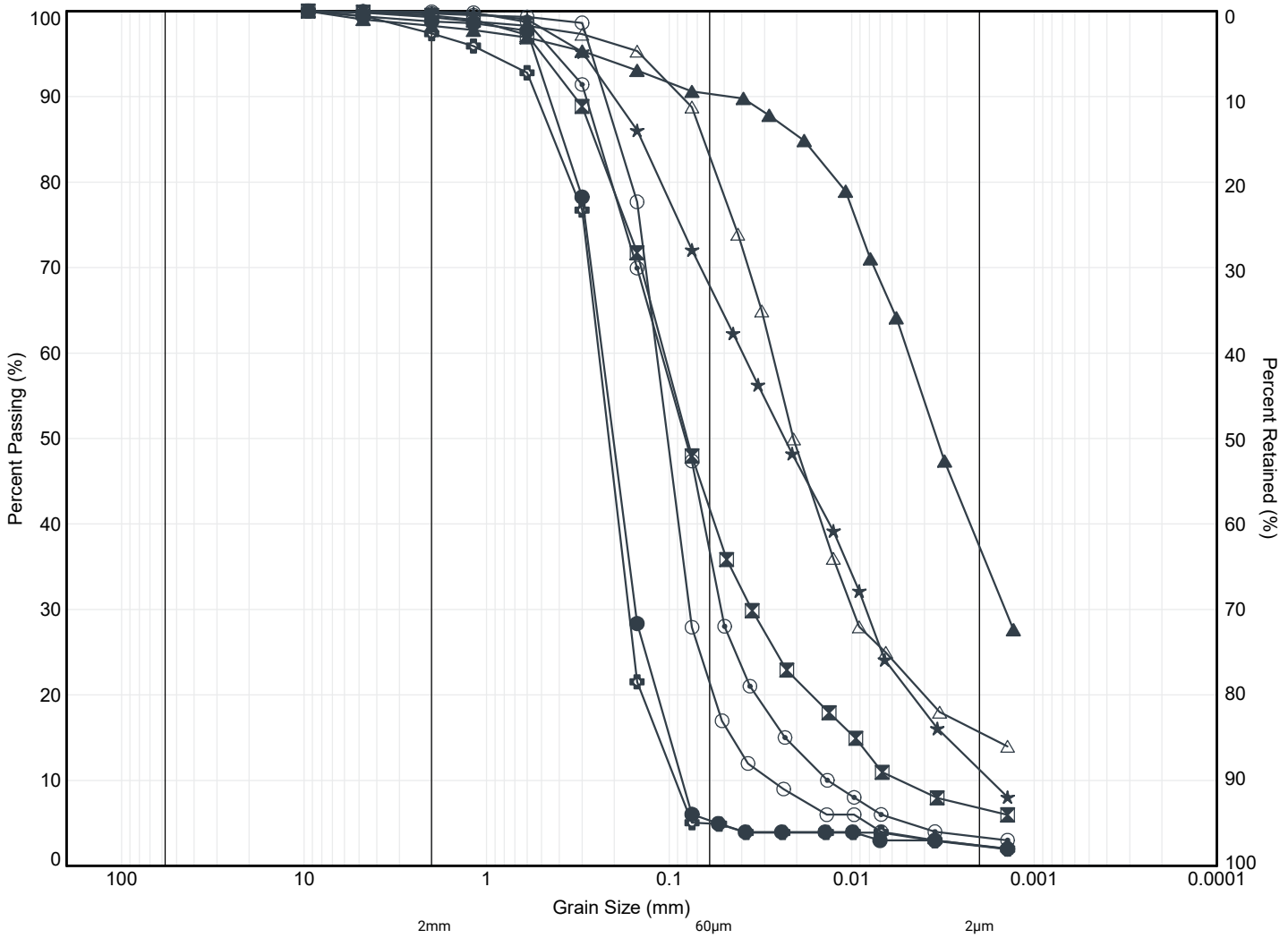
Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s		de
Hazen	1.6E-03	1.6E-05		
Hazen K (cm/s) = d_{10} (mm)	2.8E-03	2.8E-05		
Slichter	3.1E-04	3.1E-06		
Terzaghi	4.4E-04	4.4E-06		
Beyer	1.5E-03	1.5E-05		
Sauerbrei	2.7E-03	2.7E-05		
Kruger	2.2E-03	2.2E-05	1.91	
Kozeny-Carmen	3.1E-04	3.1E-06	0.27	
Zunker	2.4E-04	2.4E-06	0.20	
Zamarin	2.7E-04	2.7E-06	0.24	
USBR	1.0E-02	1.0E-04	8.98	
Barr	3.3E-04	3.3E-06	0.28	
Alyamani and Sen	4.6E-02	4.6E-04	39.52	
Chapuis	1.6E-04	1.6E-06	0.13	
Krumbein and Monk	1.3E-02	1.3E-04	10.93	
geometric mean	1.5E-03	1.5E-05	1.32	
arithmetic mean	8.9E-03	8.9E-05	7.71	



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**101**	SS6	4.9		1	94	3	2
⊠	**102**	SS6	4.9		1	57	35	7
▲	**104**	7B	6.5		2	8	53	37
★	**110**	SS7	4.9		0	32	57	11
⊙	**111**	SS6	4.9		0	63	34	3
✿	**113**	SS8	7.9		3	92	3	2
○	**114**	SS6	4.9		0	79	19	2
△	**115**	SS6B	5.0		1	16	67	16

GROUNDED ENGINEERING

Title: **GRAIN SIZE DISTRIBUTION SANDS**

File No.: **22-052**

file: 22-052 creemore.gpj

K from Grain Size Analysis Report

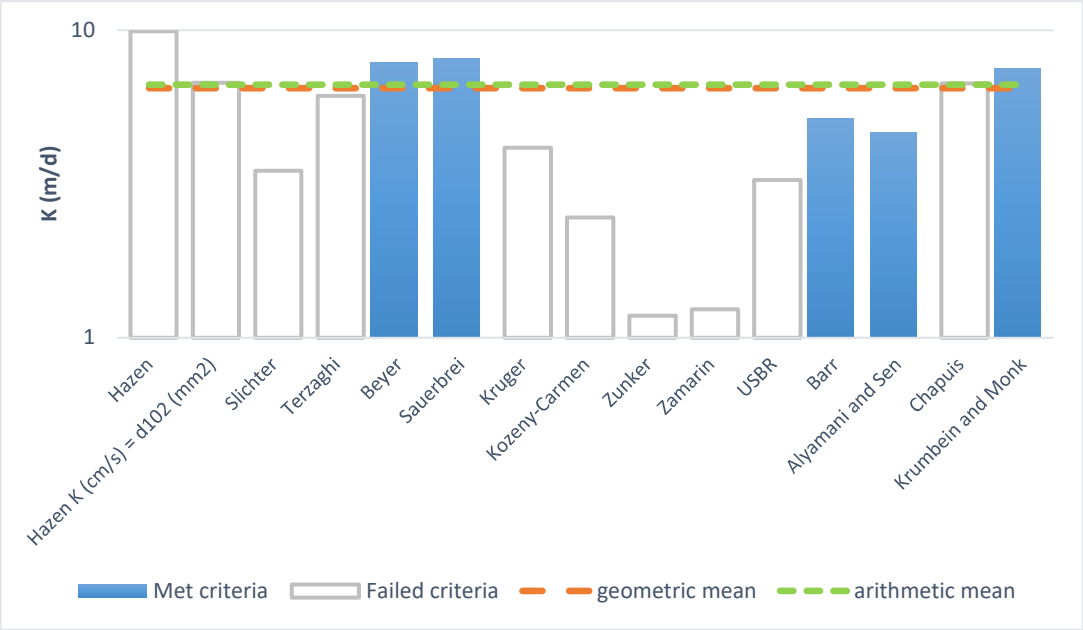
Date: 27-Jun-22

Sample Name: BH101 SS6

Mass Sample (g): 100

T (oC) 20

Moderately well sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	1.1E-02	1.1E-04	9.93	
Hazen K (cm/s) = d_{10} (mm)	7.8E-03	7.8E-05	6.74	
Slichter	4.0E-03	4.0E-05	3.49	
Terzaghi	7.1E-03	7.1E-05	6.12	
Beyer	9.1E-03	9.1E-05	7.86	
Sauerbrei	9.4E-03	9.4E-05	8.13	
Kruger	4.8E-03	4.8E-05	4.15	
Kozeny-Carmen	2.8E-03	2.8E-05	2.46	
Zunker	1.4E-03	1.4E-05	1.18	
Zamarin	1.4E-03	1.4E-05	1.24	
USBR	3.8E-03	3.8E-05	3.26	
Barr	6.0E-03	6.0E-05	5.17	
Alyamani and Sen	5.4E-03	5.4E-05	4.65	
Chapuis	7.8E-03	7.8E-05	6.71	
Krumbein and Monk	8.7E-03	8.7E-05	7.50	
geometric mean	7.5E-03	7.5E-05	6.49	
arithmetic mean	7.7E-03	7.7E-05	6.66	

K from Grain Size Analysis Report

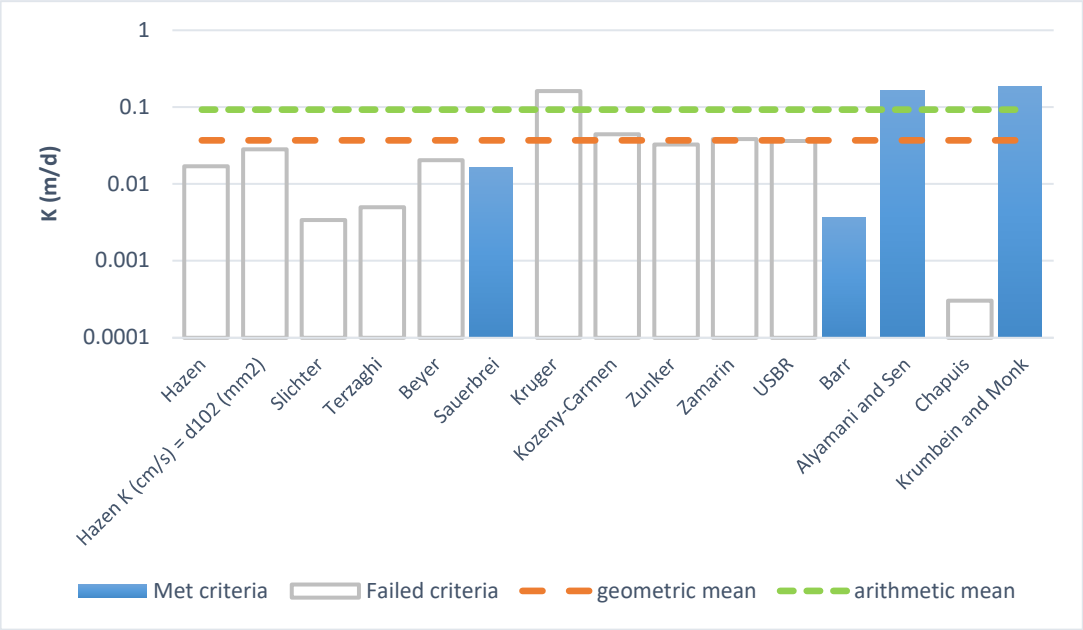
Date: 27-Jun-22

Sample Name: BH102 SS6

Mass Sample (g): 100

T (oC) 20

Poorly sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	2.0E-05	2.0E-07	0.02	
Hazen K (cm/s) = d_{10} (mm)	3.3E-05	3.3E-07	0.03	
Slichter	3.9E-06	3.9E-08	0.00	
Terzaghi	5.8E-06	5.8E-08	0.00	
Beyer	2.4E-05	2.4E-07	0.02	
Sauerbrei	1.9E-05	1.9E-07	0.02	
Kruger	1.9E-04	1.9E-06	0.16	
Kozeny-Carmen	5.1E-05	5.1E-07	0.04	
Zunker	3.8E-05	3.8E-07	0.03	
Zamarin	4.4E-05	4.4E-07	0.04	
USBR	4.2E-05	4.2E-07	0.04	
Barr	4.3E-06	4.3E-08	0.00	
Alyamani and Sen	1.9E-04	1.9E-06	0.17	
Chapuis	3.5E-07	3.5E-09	0.00	
Krumbein and Monk	2.2E-04	2.2E-06	0.19	
geometric mean	4.3E-05	4.3E-07	0.04	
arithmetic mean	1.1E-04	1.1E-06	0.09	

K from Grain Size Analysis Report

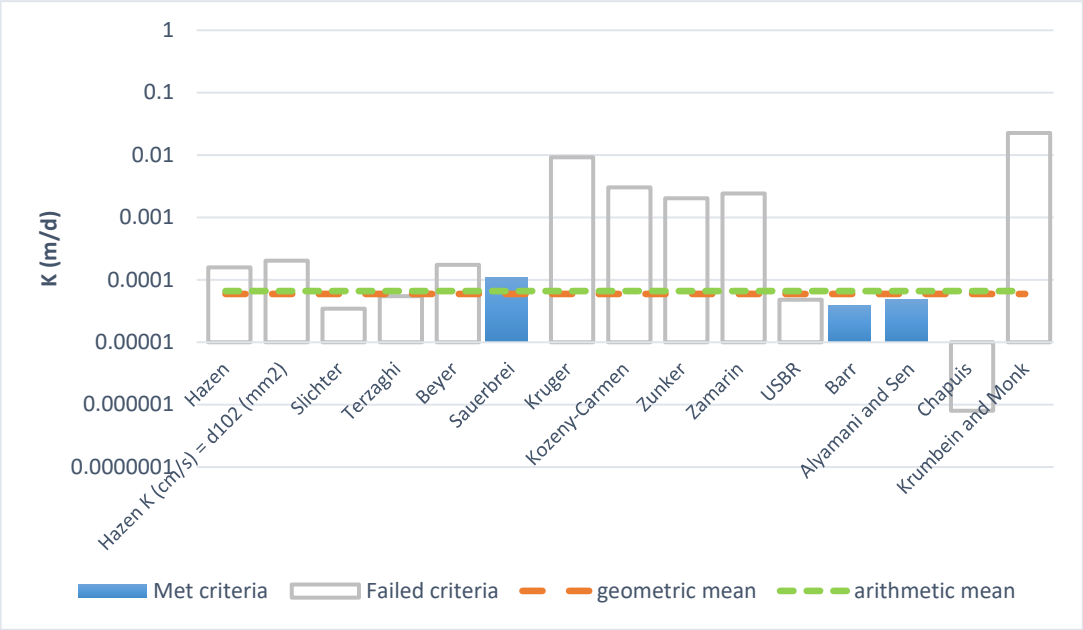
Date: 27-Jun-22

Sample Name: BH104 SS7B

Mass Sample (g): 100

T (oC) 20

Poorly sorted clay with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	1.8E-07	1.8E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	2.3E-07	2.3E-09	0.00	
Slichter	4.0E-08	4.0E-10	0.00	
Terzaghi	6.3E-08	6.3E-10	0.00	
Beyer	2.0E-07	2.0E-09	0.00	
Sauerbrei	1.3E-07	1.3E-09	0.00	
Kruger	1.1E-05	1.1E-07	0.01	
Kozeny-Carmen	3.5E-06	3.5E-08	0.00	
Zunker	2.3E-06	2.3E-08	0.00	
Zamarin	2.8E-06	2.8E-08	0.00	
USBR	5.5E-08	5.5E-10	0.00	
Barr	4.6E-08	4.6E-10	0.00	
Alyamani and Sen	5.6E-08	5.6E-10	0.00	
Chapuis	9.2E-10	9.2E-12	0.00	
Krumbein and Monk	2.6E-05	2.6E-07	0.02	
geometric mean	6.9E-08	6.9E-10	0.00	
arithmetic mean	7.7E-08	7.7E-10	0.00	

K from Grain Size Analysis Report

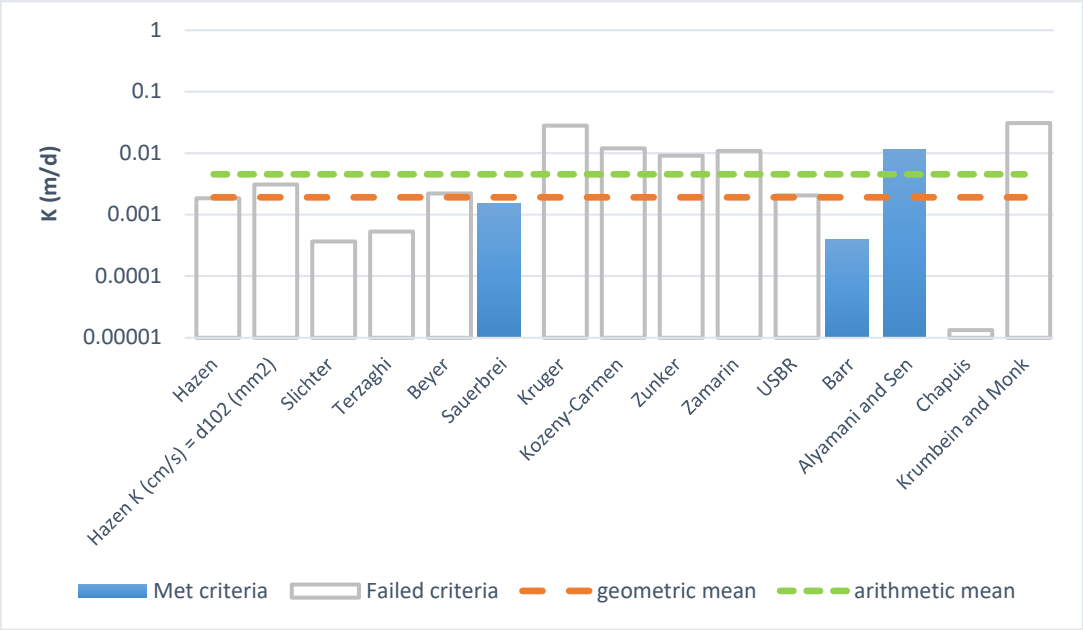
Date: 27-Jun-22

Sample Name: BH110 SS7

Mass Sample (g): 100

T (oC) 20

Poorly sorted sandy silt with fines



Estimation of Hydraulic Conductivity	cm/s	m/s		de
Hazen	2.1E-06	2.1E-08		
Hazen K (cm/s) = d_{10} (mm)	3.6E-06	3.6E-08		
Slichter	4.3E-07	4.3E-09		
Terzaghi	6.2E-07	6.2E-09		
Beyer	2.5E-06	2.5E-08		
Sauerbrei	1.8E-06	1.8E-08		
Kruger	3.2E-05	3.2E-07	0.03	
Kozeny-Carmen	1.4E-05	1.4E-07	0.01	
Zunker	1.1E-05	1.1E-07	0.01	
Zamarin	1.3E-05	1.3E-07	0.01	
USBR	2.4E-06	2.4E-08	0.00	
Barr	4.6E-07	4.6E-09	0.00	
Alyamani and Sen	1.4E-05	1.4E-07	0.01	
Chapuis	1.5E-08	1.5E-10	0.00	
Krumbein and Monk	3.6E-05	3.6E-07	0.03	
geometric mean	2.2E-06	2.2E-08	0.00	
arithmetic mean	5.3E-06	5.3E-08	0.00	

K from Grain Size Analysis Report

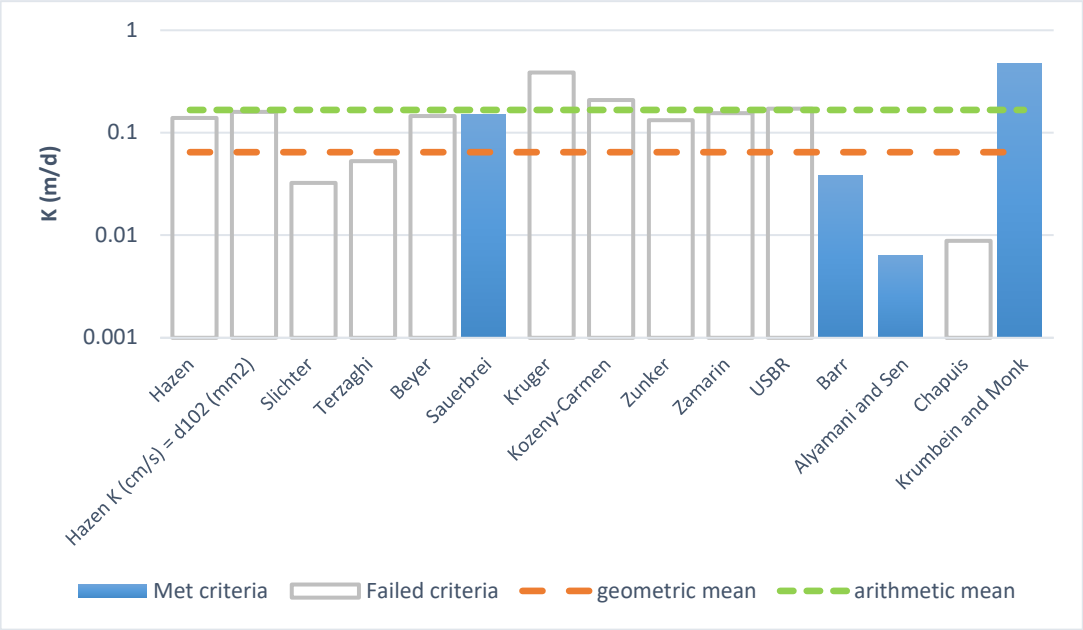
Date: 27-Jun-22

Sample Name: BH111 SS6

Mass Sample (g): 100

T (oC) 20

Poorly sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s		de
Hazen	1.6E-04	1.6E-06		
Hazen K (cm/s) = d_{10} (mm)	1.8E-04	1.8E-06		
Slichter	3.7E-05	3.7E-07		
Terzaghi	6.1E-05	6.1E-07		
Beyer	1.7E-04	1.7E-06		
Sauerbrei	1.8E-04	1.8E-06		
Kruger	4.5E-04	4.5E-06	0.39	
Kozeny-Carmen	2.4E-04	2.4E-06	0.21	
Zunker	1.5E-04	1.5E-06	0.13	
Zamarin	1.8E-04	1.8E-06	0.16	
USBR	2.0E-04	2.0E-06	0.17	
Barr	4.4E-05	4.4E-07	0.04	
Alyamani and Sen	7.4E-06	7.4E-08	0.01	
Chapuis	1.0E-05	1.0E-07	0.01	
Krumbein and Monk	5.4E-04	5.4E-06	0.47	
geometric mean	7.5E-05	7.5E-07	0.06	
arithmetic mean	1.9E-04	1.9E-06	0.17	

K from Grain Size Analysis Report

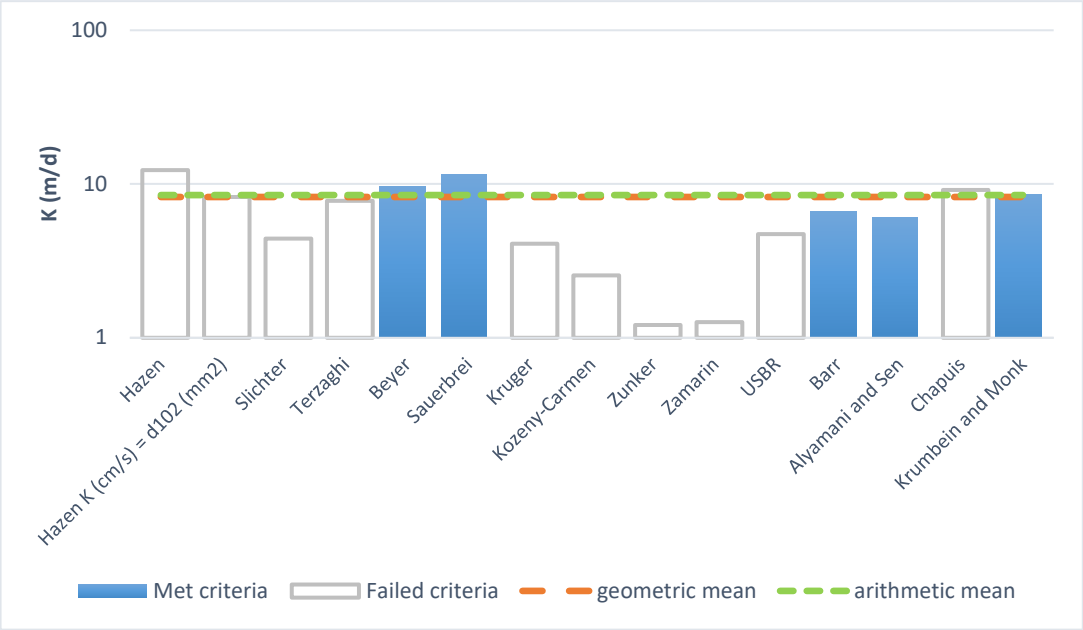
Date: 27-Jun-22

Sample Name: BH113 SS8

Mass Sample (g): 100

T (oC) 20

Moderately well sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s		de
Hazen	1.4E-02	1.4E-04		
Hazen K (cm/s) = d_{10} (mm)	9.5E-03	9.5E-05		
Slichter	5.1E-03	5.1E-05		
Terzaghi	9.0E-03	9.0E-05		
Beyer	1.1E-02	1.1E-04		
Sauerbrei	1.3E-02	1.3E-04		
Kruger	4.7E-03	4.7E-05	4.07	
Kozeny-Carmen	2.9E-03	2.9E-05	2.54	
Zunker	1.4E-03	1.4E-05	1.21	
Zamarin	1.5E-03	1.5E-05	1.26	
USBR	5.4E-03	5.4E-05	4.71	
Barr	7.7E-03	7.7E-05	6.62	
Alyamani and Sen	7.0E-03	7.0E-05	6.06	
Chapuis	1.1E-02	1.1E-04	9.13	
Krumbein and Monk	9.9E-03	9.9E-05	8.59	
geometric mean	9.5E-03	9.5E-05	8.25	
arithmetic mean	9.8E-03	9.8E-05	8.48	

K from Grain Size Analysis Report

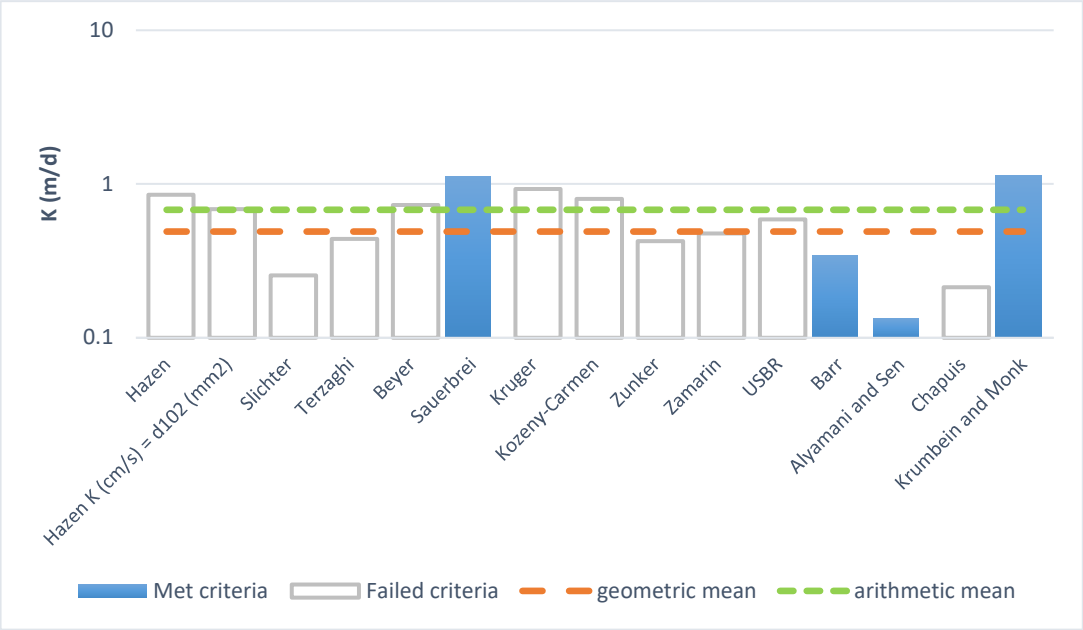
Date: 27-Jun-22

Sample Name: BH114 SS6

Mass Sample (g): 100

T (oC) 20

Moderately well sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s		de
Hazen	9.8E-04	9.8E-06		
Hazen K (cm/s) = d_{10} (mm)	7.9E-04	7.9E-06		
Slichter	2.9E-04	2.9E-06		
Terzaghi	5.1E-04	5.1E-06		
Beyer	8.4E-04	8.4E-06		
Sauerbrei	1.3E-03	1.3E-05		
Kruger	1.1E-03	1.1E-05	0.93	
Kozeny-Carmen	9.2E-04	9.2E-06	0.80	
Zunker	4.9E-04	4.9E-06	0.42	
Zamarin	5.5E-04	5.5E-06	0.48	
USBR	6.8E-04	6.8E-06	0.59	
Barr	3.9E-04	3.9E-06	0.34	
Alyamani and Sen	1.5E-04	1.5E-06	0.13	
Chapuis	2.5E-04	2.5E-06	0.21	
Krumbein and Monk	1.3E-03	1.3E-05	1.14	
geometric mean	5.7E-04	5.7E-06	0.49	
arithmetic mean	7.9E-04	7.9E-06	0.68	

K from Grain Size Analysis Report

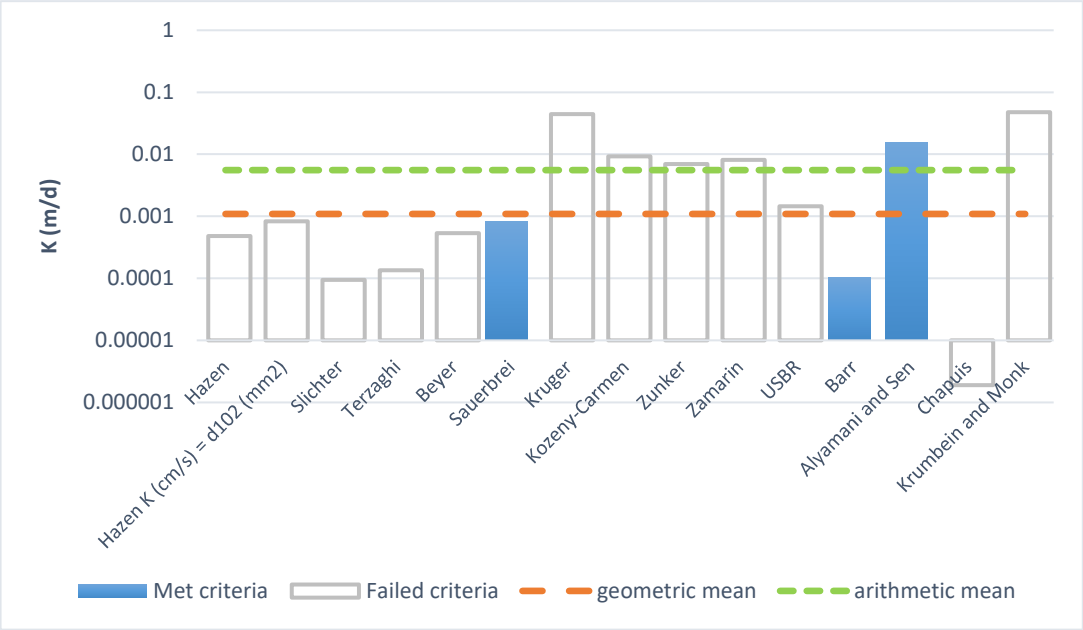
Date: 27-Jun-22

Sample Name: BH115 SS6B

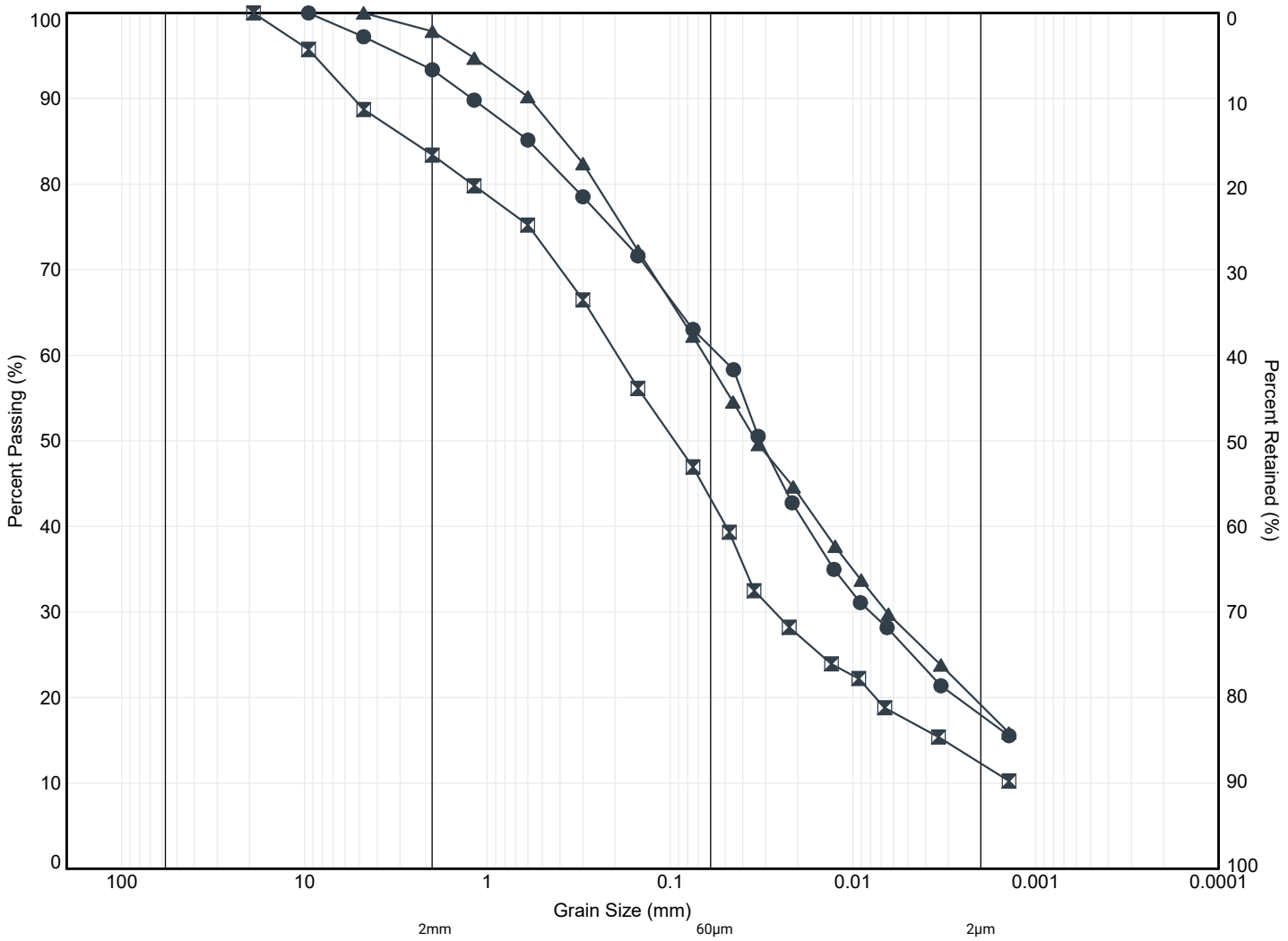
Mass Sample (g): 100

T (oC) 20

Poorly sorted sandy silt with fines



Estimation of Hydraulic Conductivity	cm/s	m/s		de
Hazen	5.5E-07	5.5E-09		
Hazen K (cm/s) = d_{10} (mm)	9.6E-07	9.6E-09		
Slichter	1.1E-07	1.1E-09		
Terzaghi	1.6E-07	1.6E-09		
Beyer	6.2E-07	6.2E-09		
Sauerbrei	9.7E-07	9.7E-09		
Kruger	5.2E-05	5.2E-07	0.04	
Kozeny-Carmen	1.1E-05	1.1E-07	0.01	
Zunker	8.1E-06	8.1E-08	0.01	
Zamarin	9.4E-06	9.4E-08	0.01	
USBR	1.7E-06	1.7E-08	0.00	
Barr	1.2E-07	1.2E-09	0.00	
Alyamani and Sen	1.8E-05	1.8E-07	0.02	
Chapuis	2.2E-09	2.2E-11	0.00	
Krumbein and Monk	5.5E-05	5.5E-07	0.05	
geometric mean	1.3E-06	1.3E-08	0.00	
arithmetic mean	6.4E-06	6.4E-08	0.01	



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**104**	SS1	0.3		7	32	43	18
⊠	**112**	SS1	0.3		17	40	31	12
▲	**116**	SS1	0.3		2	39	40	19

GROUNDED ENGINEERING

Title: **GRAIN SIZE DISTRIBUTION**
FILL

File No.: **22-052**

file: 22-052 creemore.gpj

K from Grain Size Analysis Report

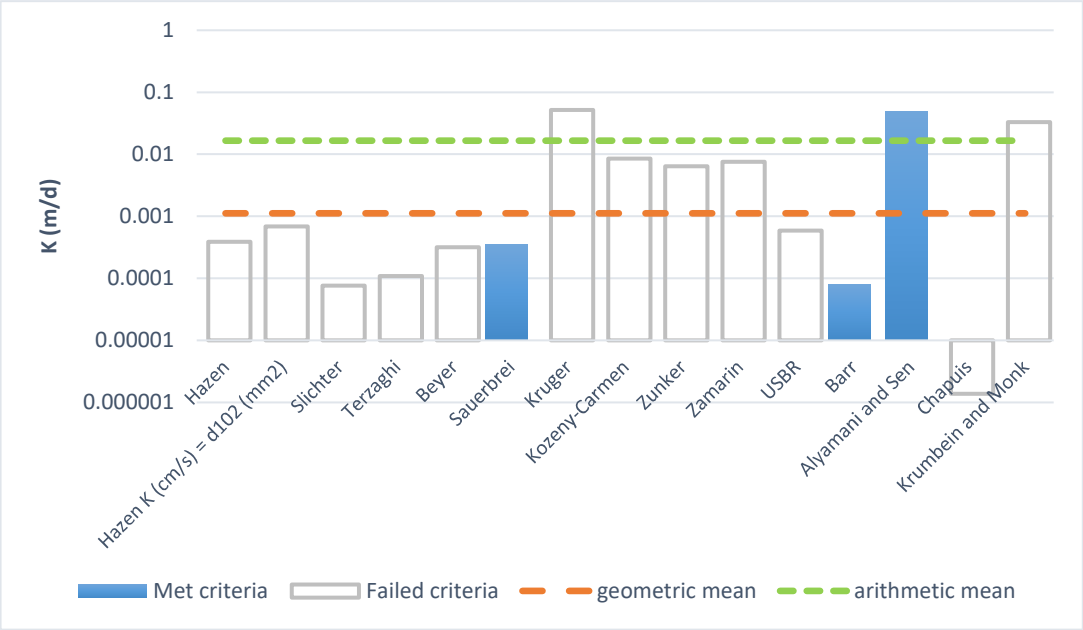
Date: 27-Jun-22

Sample Name: BH104 SS1

Mass Sample (g): 100

T (oC) 20

Poorly sorted sandy silt with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	4.5E-07	4.5E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	7.9E-07	7.9E-09	0.00	
Slichter	8.8E-08	8.8E-10	0.00	
Terzaghi	1.3E-07	1.3E-09	0.00	
Beyer	3.7E-07	3.7E-09	0.00	
Sauerbrei	4.1E-07	4.1E-09	0.00	
Kruger	6.0E-05	6.0E-07	0.05	
Kozeny-Carmen	9.8E-06	9.8E-08	0.01	
Zunker	7.4E-06	7.4E-08	0.01	
Zamarin	8.7E-06	8.7E-08	0.01	
USBR	6.8E-07	6.8E-09	0.00	
Barr	9.4E-08	9.4E-10	0.00	
Alyamani and Sen	5.7E-05	5.7E-07	0.05	
Chapuis	1.6E-09	1.6E-11	0.00	
Krumbein and Monk	3.8E-05	3.8E-07	0.03	
geometric mean	1.3E-06	1.3E-08	0.00	
arithmetic mean	1.9E-05	1.9E-07	0.02	

K from Grain Size Analysis Report

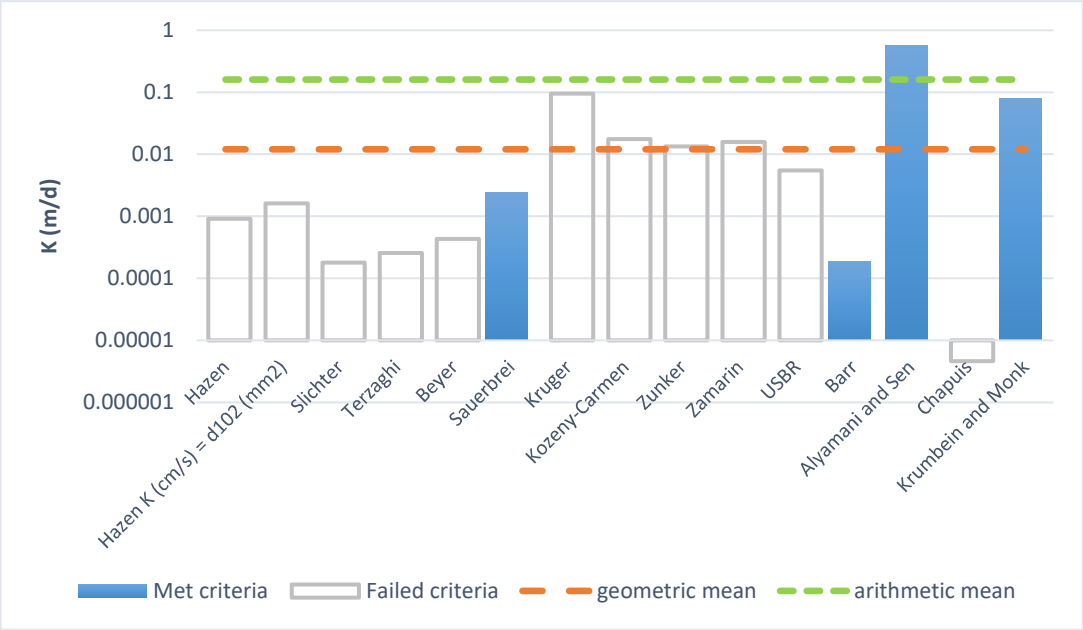
Date: 27-Jun-22

Sample Name: BH112 SS1

Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand with fines



Estimation of Hydraulic Conductivity	cm/s	m/s		de
Hazen	1.1E-06	1.1E-08		
Hazen K (cm/s) = d_{10} (mm)	1.9E-06	1.9E-08		
Slichter	2.1E-07	2.1E-09		
Terzaghi	2.9E-07	2.9E-09		
Beyer	5.0E-07	5.0E-09		
Sauerbrei	2.8E-06	2.8E-08		
Kruger	1.1E-04	1.1E-06	0.09	
Kozeny-Carmen	2.0E-05	2.0E-07	0.02	
Zunker	1.5E-05	1.5E-07	0.01	
Zamarin	1.8E-05	1.8E-07	0.02	
USBR	6.3E-06	6.3E-08	0.01	
Barr	2.2E-07	2.2E-09	0.00	
Alyamani and Sen	6.5E-04	6.5E-06	0.56	
Chapuis	5.3E-09	5.3E-11	0.00	
Krumbein and Monk	9.3E-05	9.3E-07	0.08	
geometric mean	1.4E-05	1.4E-07	0.01	
arithmetic mean	1.9E-04	1.9E-06	0.16	

K from Grain Size Analysis Report

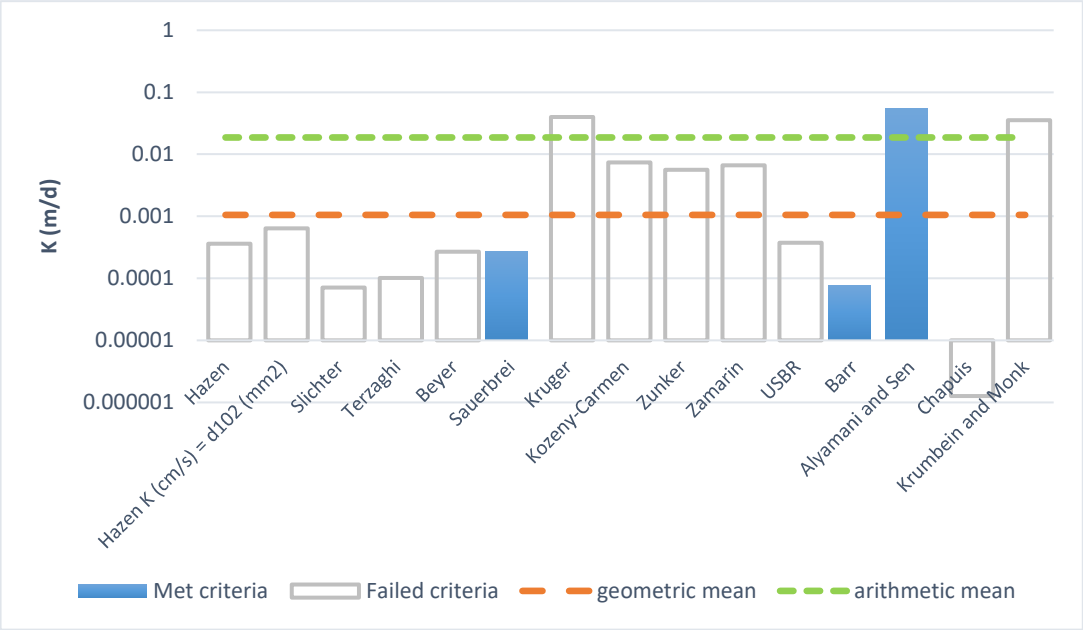
Date: 27-Jun-22

Sample Name: BH116 SS1

Mass Sample (g): 100

T (oC) 20

Poorly sorted sandy silt with fines



Estimation of Hydraulic Conductivity	cm/s	m/s		de
Hazen	4.2E-07	4.2E-09		
Hazen K (cm/s) = d_{10} (mm)	7.4E-07	7.4E-09		
Slichter	8.2E-08	8.2E-10		
Terzaghi	1.2E-07	1.2E-09		
Beyer	3.1E-07	3.1E-09		
Sauerbrei	3.1E-07	3.1E-09		
Kruger	4.6E-05	4.6E-07	0.04	
Kozeny-Carmen	8.5E-06	8.5E-08	0.01	
Zunker	6.5E-06	6.5E-08	0.01	
Zamarin	7.6E-06	7.6E-08	0.01	
USBR	4.3E-07	4.3E-09	0.00	
Barr	8.8E-08	8.8E-10	0.00	
Alyamani and Sen	6.5E-05	6.5E-07	0.06	
Chapuis	1.5E-09	1.5E-11	0.00	
Krumbein and Monk	4.1E-05	4.1E-07	0.04	
geometric mean	1.2E-06	1.2E-08	0.00	
arithmetic mean	2.2E-05	2.2E-07	0.02	

APPENDIX H



Grounded Engineering Inc
ATTN: Bailey Walters
1 Banigan Drive
TORONTO ON M4H 1G3

Date Received: 04-MAY-22
Report Date: 12-MAY-22 14:54 (MT)
Version: FINAL

Client Phone: 647-264-7928

Certificate of Analysis

Lab Work Order #: L2703606

Project P.O. #:	NOT SUBMITTED
Job Reference:	22-052
C of C Numbers:	20-951339
Legal Site Desc:	163-164 EDWARD ST. E

Comments: ADDITIONAL 05-MAY-22 12:32

Amanda Overholster
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2703606-1 SEW-UF-BH108 Sampled By: VT on 04-MAY-22 @ 10:00 Matrix: WATER							
Physical Tests							
pH	7.78		0.10	pH units		07-MAY-22	R5775721
Total Suspended Solids	114		3.0	mg/L	08-MAY-22	09-MAY-22	R5774198
Anions and Nutrients							
Fluoride (F)	0.038		0.020	mg/L		09-MAY-22	R5775421
Phosphorus, Total	0.0589		0.0030	mg/L	10-MAY-22	11-MAY-22	R5777110
Cyanides							
Cyanide, Total	<0.0020		0.0020	mg/L		09-MAY-22	R5775778
Total Metals							
Aluminum (Al)-Total	2.08	DLHC	0.050	mg/L	06-MAY-22	06-MAY-22	R5772998
Antimony (Sb)-Total	<0.0010	DLHC	0.0010	mg/L	06-MAY-22	06-MAY-22	R5772998
Arsenic (As)-Total	0.0012	DLHC	0.0010	mg/L	06-MAY-22	06-MAY-22	R5772998
Barium (Ba)-Total	0.103	DLHC	0.0010	mg/L	06-MAY-22	06-MAY-22	R5772998
Beryllium (Be)-Total	<0.0010	DLHC	0.0010	mg/L	06-MAY-22	06-MAY-22	R5772998
Bismuth (Bi)-Total	<0.00050	DLHC	0.00050	mg/L	06-MAY-22	06-MAY-22	R5772998
Boron (B)-Total	<0.10	DLHC	0.10	mg/L	06-MAY-22	06-MAY-22	R5772998
Cadmium (Cd)-Total	<0.000050	DLHC	0.000050	mg/L	06-MAY-22	06-MAY-22	R5772998
Calcium (Ca)-Total	115	DLHC	0.50	mg/L	06-MAY-22	06-MAY-22	R5772998
Cesium (Cs)-Total	0.00018	DLHC	0.00010	mg/L	06-MAY-22	06-MAY-22	R5772998
Chromium (Cr)-Total	<0.0050	DLHC	0.0050	mg/L	06-MAY-22	06-MAY-22	R5772998
Cobalt (Co)-Total	0.0016	DLHC	0.0010	mg/L	06-MAY-22	06-MAY-22	R5772998
Copper (Cu)-Total	0.0092	DLHC	0.0050	mg/L	06-MAY-22	06-MAY-22	R5772998
Iron (Fe)-Total	3.07	DLHC	0.10	mg/L	06-MAY-22	06-MAY-22	R5772998
Lead (Pb)-Total	0.00211	DLHC	0.00050	mg/L	06-MAY-22	06-MAY-22	R5772998
Lithium (Li)-Total	<0.010	DLHC	0.010	mg/L	06-MAY-22	06-MAY-22	R5772998
Magnesium (Mg)-Total	22.3	DLHC	0.050	mg/L	06-MAY-22	06-MAY-22	R5772998
Manganese (Mn)-Total	0.183	DLHC	0.0050	mg/L	06-MAY-22	06-MAY-22	R5772998
Mercury (Hg)-Total	<0.0000050		0.0000050	mg/L		06-MAY-22	R5773077
Molybdenum (Mo)-Total	<0.00050	DLHC	0.00050	mg/L	06-MAY-22	06-MAY-22	R5772998
Nickel (Ni)-Total	<0.0050	DLHC	0.0050	mg/L	06-MAY-22	06-MAY-22	R5772998
Phosphorus (P)-Total	<0.50	DLHC	0.50	mg/L	06-MAY-22	06-MAY-22	R5772998
Potassium (K)-Total	2.27	DLHC	0.50	mg/L	06-MAY-22	06-MAY-22	R5772998
Rubidium (Rb)-Total	0.0034	DLHC	0.0020	mg/L	06-MAY-22	06-MAY-22	R5772998
Selenium (Se)-Total	<0.00050	DLHC	0.00050	mg/L	06-MAY-22	06-MAY-22	R5772998
Silicon (Si)-Total	7.2	DLHC	1.0	mg/L	06-MAY-22	06-MAY-22	R5772998
Silver (Ag)-Total	<0.00050	DLHC	0.00050	mg/L	06-MAY-22	06-MAY-22	R5772998
Sodium (Na)-Total	35.3	DLHC	0.50	mg/L	06-MAY-22	06-MAY-22	R5772998
Strontium (Sr)-Total	0.267	DLHC	0.010	mg/L	06-MAY-22	06-MAY-22	R5772998
Sulfur (S)-Total	5.1	DLHC	5.0	mg/L	06-MAY-22	06-MAY-22	R5772998
Tellurium (Te)-Total	<0.0020	DLHC	0.0020	mg/L	06-MAY-22	06-MAY-22	R5772998
Thallium (Tl)-Total	<0.00010	DLHC	0.00010	mg/L	06-MAY-22	06-MAY-22	R5772998
Thorium (Th)-Total	0.0013	DLHC	0.0010	mg/L	06-MAY-22	06-MAY-22	R5772998
Tin (Sn)-Total	0.0031	DLHC	0.0010	mg/L	06-MAY-22	06-MAY-22	R5772998

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2703606-1 SEW-UF-BH108 Sampled By: VT on 04-MAY-22 @ 10:00 Matrix: WATER							
Total Metals							
Titanium (Ti)-Total	0.0728	DLHC	0.0030	mg/L	06-MAY-22	06-MAY-22	R5772998
Tungsten (W)-Total	<0.0010	DLHC	0.0010	mg/L	06-MAY-22	06-MAY-22	R5772998
Uranium (U)-Total	0.00077	DLHC	0.00010	mg/L	06-MAY-22	06-MAY-22	R5772998
Vanadium (V)-Total	<0.0050	DLHC	0.0050	mg/L	06-MAY-22	06-MAY-22	R5772998
Zinc (Zn)-Total	<0.030	DLHC	0.030	mg/L	06-MAY-22	06-MAY-22	R5772998
Zirconium (Zr)-Total	<0.0020	DLHC	0.0020	mg/L	06-MAY-22	06-MAY-22	R5772998
Aggregate Organics							
BOD	<3.0	BODL	3.0	mg/L		06-MAY-22	R5778786
Oil and Grease, Total	<5.0		5.0	mg/L	09-MAY-22	09-MAY-22	R5778019
Animal/Veg Oil & Grease	<5.0		5.0	mg/L		12-MAY-22	
Mineral Oil and Grease	<2.5		2.5	mg/L	09-MAY-22	09-MAY-22	R5778019
Phenols (4AAP)	<0.0010		0.0010	mg/L		10-MAY-22	R5777246
Volatile Organic Compounds							
Acetone	<20	OWP	20	ug/L		10-MAY-22	R5777157
Benzene	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
Bromodichloromethane	<1.0	OWP	1.0	ug/L		10-MAY-22	R5777157
Bromoform	<1.0	OWP	1.0	ug/L		10-MAY-22	R5777157
Bromomethane	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
Carbon Disulfide	<1.0	OWP	1.0	ug/L		10-MAY-22	R5777157
Carbon tetrachloride	<0.20	OWP	0.20	ug/L		10-MAY-22	R5777157
Chlorobenzene	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
Dibromochloromethane	<1.0	OWP	1.0	ug/L		10-MAY-22	R5777157
Chloroethane	<1.0	OWP	1.0	ug/L		10-MAY-22	R5777157
Chloroform	<1.0	OWP	1.0	ug/L		10-MAY-22	R5777157
Chloromethane	<2.0	OWP	2.0	ug/L		10-MAY-22	R5777157
1,2-Dibromoethane	<0.20	OWP	0.20	ug/L		10-MAY-22	R5777157
1,2-Dichlorobenzene	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
1,3-Dichlorobenzene	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
1,4-Dichlorobenzene	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
Dichlorodifluoromethane	<1.0	OWP	1.0	ug/L		10-MAY-22	R5777157
1,1-Dichloroethane	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
1,2-Dichloroethane	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
1,1-Dichloroethylene	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
cis-1,2-Dichloroethylene	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
trans-1,2-Dichloroethylene	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
Dichloromethane	<2.0	OWP	2.0	ug/L		10-MAY-22	R5777157
1,2-Dichloropropane	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
cis-1,3-Dichloropropene	<0.30	OWP	0.30	ug/L		10-MAY-22	R5777157
trans-1,3-Dichloropropene	<0.30	OWP	0.30	ug/L		10-MAY-22	R5777157
Ethylbenzene	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
n-Hexane	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2703606-1 SEW-UF-BH108 Sampled By: VT on 04-MAY-22 @ 10:00 Matrix: WATER							
Volatile Organic Compounds							
2-Hexanone	<20	OWP	20	ug/L		10-MAY-22	R5777157
Methyl Ethyl Ketone	<20	OWP	20	ug/L		10-MAY-22	R5777157
Methyl Isobutyl Ketone	<20	OWP	20	ug/L		10-MAY-22	R5777157
MTBE	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
Styrene	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
1,1,1,2-Tetrachloroethane	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
1,1,2,2-Tetrachloroethane	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
Tetrachloroethylene	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
Toluene	<0.40	OWP	0.40	ug/L		10-MAY-22	R5777157
1,1,1-Trichloroethane	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
1,1,2-Trichloroethane	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
Trichloroethylene	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
Trichlorofluoromethane	<1.0	OWP	1.0	ug/L		10-MAY-22	R5777157
Vinyl chloride	<0.50	OWP	0.50	ug/L		10-MAY-22	R5777157
o-Xylene	<0.30	OWP	0.30	ug/L		10-MAY-22	R5777157
m+p-Xylenes	<0.40	OWP	0.40	ug/L		10-MAY-22	R5777157
Xylenes (Total)	<0.50		0.50	ug/L		11-MAY-22	
Surrogate: 4-Bromofluorobenzene	77.0		70-130	%		10-MAY-22	R5777157
Surrogate: 1,4-Difluorobenzene	98.9		70-130	%		10-MAY-22	R5777157
Trihalomethanes							
Total THMs	<2.0		2.0	ug/L		11-MAY-22	
Polychlorinated Biphenyls							
Aroclor 1242	<0.020		0.020	ug/L	09-MAY-22	09-MAY-22	R5775219
Aroclor 1248	<0.020		0.020	ug/L	09-MAY-22	09-MAY-22	R5775219
Aroclor 1254	<0.020		0.020	ug/L	09-MAY-22	09-MAY-22	R5775219
Aroclor 1260	<0.020		0.020	ug/L	09-MAY-22	09-MAY-22	R5775219
Surrogate: Decachlorobiphenyl	52.6		50-150	%	09-MAY-22	09-MAY-22	R5775219
Total PCBs	<0.040		0.040	ug/L	09-MAY-22	09-MAY-22	R5775219
Surrogate: Tetrachloro-m-xylene	72.4		50-150	%	09-MAY-22	09-MAY-22	R5775219

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Boron (B)-Total	MS-B	L2703606-1
Matrix Spike	Silicon (Si)-Total	MS-B	L2703606-1
Matrix Spike	Sodium (Na)-Total	MS-B	L2703606-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L2703606-1
Matrix Spike	Sulfur (S)-Total	MS-B	L2703606-1
Matrix Spike	Uranium (U)-Total	MS-B	L2703606-1

Sample Parameter Qualifier key listed:

Qualifier	Description
BODL	Limit of Reporting for BOD was increased to account for the largest volume of sample tested.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
OWP	Organic water sample contained visible sediment (must be included as part of analysis). Measured concentrations of organic substances in water can be biased high due to presence of sediment.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BOD-WT	Water	BOD	APHA 5210 B

This analysis is carried out using procedures adapted from APHA Method 5210B - "Biochemical Oxygen Demand (BOD)". All forms of biochemical oxygen demand (BOD) are determined by diluting and incubating a sample for a specified time period, and measuring the oxygen depletion using a dissolved oxygen meter. Dissolved BOD (SOLUBLE) is determined by filtering the sample through a glass fibre filter prior to dilution. Carbonaceous BOD (CBOD) is determined by adding a nitrification inhibitor to the diluted sample prior to incubation.

CN-TOT-WT	Water	Cyanide, Total	ISO 14403-2

Total cyanide is determined by the combination of UV digestion and distillation. Cyanide is converted to cyanogen chloride by reacting with chloramine-T, the cyanogen chloride then reacts with a combination of barbituric acid and isonicotinic acid to form a highly colored complex.

When using this method, high levels of thiocyanate in samples can cause false positives at ~1-2% of the thiocyanate concentration. For samples with detectable cyanide analyzed by this method, ALS recommends analysis for thiocyanate to check for this potential interference

EC-SCREEN-WT	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-WT	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HG-T-CVAA-WT	Water	Total Mercury in Water by CVAAS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.

MET-T-CCMS-WT	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

OGG-SPEC-CALC-WT	Water	Speciated Oil and Grease A/V Calc	CALCULATION

Sample is extracted with hexane, sample speciation into mineral and animal/vegetable fractions is achieved via silica gel separation and is then determined gravimetrically.

OGG-SPEC-WT	Water	Speciated Oil and Grease-Gravimetric	APHA 5520 B

The procedure involves an extraction of the entire water sample with hexane. Sample speciation into mineral and animal/vegetable fractions is achieved via silica gel separation and is then determined gravimetrically.

P-T-COL-WT	Water	Total P in Water by Colour	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is deteremined colourimetrically

Reference Information

after persulphate digestion of the sample.

PCB-WT	Water	Polychlorinated Biphenyls	EPA 8082

PCBs are extracted from an aqueous sample at neutral pH with aliquots of dichloromethane using a modified separatory funnel technique. The extracts are analyzed by GC/MSD.

PH-WT	Water	pH	APHA 4500 H-Electrode

Water samples are analyzed directly by a calibrated pH meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days

PHENOLS-4AAP-WT	Water	Phenol (4AAP)	EPA 9066

An automated method is used to distill the sample. The distillate is then buffered to pH 9.4 which reacts with 4AAP and potassium ferricyanide to form a red complex which is measured colorimetrically.

SOLIDS-TSS-WT	Water	Suspended solids	APHA 2540 D-Gravimetric

A well-mixed sample is filtered through a weighed standard glass fibre filter and the residue retained is dried in an oven at 104–1°C for a minimum of four hours or until a constant weight is achieved.

THM-SUM-PPB-CALC-WT	Water	Total Trihalomethanes (THMs)	CALCULATION

Total Trihalomethanes (THMs) represents the sum of bromodichloromethane, bromoform, chlorodibromomethane and chloroform. For the purpose of calculation, results less than the detection limit (DL) are treated as zero.

VOC-ROU-HS-WT	Water	Volatile Organic Compounds	SW846 8260

Aqueous samples are analyzed by headspace-GC/MS.

XYLENES-SUM-CALC-WT	Water	Sum of Xylene Isomer Concentrations	CALCULATION

Total xylenes represents the sum of o-xylene and m&p-xylene.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

20-951339

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2703606 Report Date: 12-MAY-22

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BOD-WT	**Water**							
Batch R5778786								
WG3724515-2 DUP		**L2703606-1**						
BOD		<3.0	<3.0	RPD-NA	mg/L	N/A	30	06-MAY-22
WG3724515-3 LCS								
BOD			87.9		%		85-115	06-MAY-22
WG3724515-1 MB								
BOD			<2.0		mg/L		2	06-MAY-22
CN-TOT-WT	**Water**							
Batch R5775778								
WG3725111-3 DUP		**WG3725111-5**						
Cyanide, Total		<0.0020	<0.0020	RPD-NA	mg/L	N/A	20	09-MAY-22
WG3725111-2 LCS								
Cyanide, Total			102.0		%		80-120	09-MAY-22
WG3725111-1 MB								
Cyanide, Total			<0.0020		mg/L		0.002	09-MAY-22
WG3725111-4 MS		**WG3725111-5**						
Cyanide, Total			101.7		%		70-130	09-MAY-22
F-IC-N-WT	**Water**							
Batch R5775421								
WG3725119-4 DUP		**WG3725119-3**						
Fluoride (F)		0.236	0.233		mg/L	1.4	20	09-MAY-22
WG3725119-2 LCS								
Fluoride (F)			102.7		%		90-110	09-MAY-22
WG3725119-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	09-MAY-22
WG3725119-5 MS		**WG3725119-3**						
Fluoride (F)			104.6		%		75-125	09-MAY-22
HG-T-CVAA-WT	**Water**							
Batch R5773077								
WG3724313-4 DUP		**WG3724313-3**						
Mercury (Hg)-Total		0.0000258	0.0000316	J	mg/L	0.0000058	0.00001	06-MAY-22
WG3724313-2 LCS								
Mercury (Hg)-Total			104.0		%		80-120	06-MAY-22
WG3724313-1 MB								
Mercury (Hg)-Total			<0.000005(		mg/L		0.000005	06-MAY-22
WG3724313-6 MS		**WG3724313-5**						
Mercury (Hg)-Total			99.9		%		70-130	06-MAY-22
MET-T-CCMS-WT	**Water**							

Quality Control Report

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5772998								
WG3724246-4 DUP		**WG3724246-3**						
Aluminum (Al)-Total		<0.050	<0.050	RPD-NA	mg/L	N/A	20	06-MAY-22
Antimony (Sb)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	06-MAY-22
Arsenic (As)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	06-MAY-22
Barium (Ba)-Total		0.119	0.123		mg/L	3.2	20	06-MAY-22
Beryllium (Be)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	06-MAY-22
Bismuth (Bi)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	06-MAY-22
Boron (B)-Total		0.81	0.84		mg/L	3.6	20	06-MAY-22
Cadmium (Cd)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	06-MAY-22
Calcium (Ca)-Total		64.6	67.5		mg/L	4.3	20	06-MAY-22
Chromium (Cr)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	06-MAY-22
Cesium (Cs)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	06-MAY-22
Cobalt (Co)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	06-MAY-22
Copper (Cu)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	06-MAY-22
Iron (Fe)-Total		<0.10	<0.10	RPD-NA	mg/L	N/A	20	06-MAY-22
Lead (Pb)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	06-MAY-22
Lithium (Li)-Total		0.018	0.019		mg/L	5.6	20	06-MAY-22
Magnesium (Mg)-Total		15.2	16.0		mg/L	4.9	20	06-MAY-22
Manganese (Mn)-Total		0.0214	0.0223		mg/L	4.1	20	06-MAY-22
Molybdenum (Mo)-Total		0.00057	0.00063		mg/L	9.4	20	06-MAY-22
Nickel (Ni)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	06-MAY-22
Phosphorus (P)-Total		<0.50	<0.50	RPD-NA	mg/L	N/A	20	06-MAY-22
Potassium (K)-Total		4.62	4.82		mg/L	4.3	20	06-MAY-22
Rubidium (Rb)-Total		0.0065	0.0070		mg/L	8.7	20	06-MAY-22
Selenium (Se)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	06-MAY-22
Silicon (Si)-Total		28.5	29.7		mg/L	4.2	20	06-MAY-22
Silver (Ag)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	06-MAY-22
Sodium (Na)-Total		42.1	44.3		mg/L	5.0	20	06-MAY-22
Strontium (Sr)-Total		2.90	2.98		mg/L	2.9	20	06-MAY-22
Sulfur (S)-Total		13.0	13.6		mg/L	5.1	20	06-MAY-22
Thallium (Tl)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	06-MAY-22
Tellurium (Te)-Total		<0.0020	<0.0020	RPD-NA	mg/L	N/A	20	06-MAY-22
Thorium (Th)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	06-MAY-22
Tin (Sn)-Total		<0.0010	<0.0010		mg/L			06-MAY-22

Quality Control Report

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5772998								
WG3724246-4 DUP		**WG3724246-3**						
Tin (Sn)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	06-MAY-22
Titanium (Ti)-Total		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	06-MAY-22
Tungsten (W)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	06-MAY-22
Uranium (U)-Total		0.00084	0.00092		mg/L	9.0	20	06-MAY-22
Vanadium (V)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	06-MAY-22
Zinc (Zn)-Total		<0.030	<0.030	RPD-NA	mg/L	N/A	20	06-MAY-22
Zirconium (Zr)-Total		<0.0020	<0.0020	RPD-NA	mg/L	N/A	20	06-MAY-22
WG3724246-2 LCS								
Aluminum (Al)-Total			101.1		%		80-120	06-MAY-22
Antimony (Sb)-Total			98.8		%		80-120	06-MAY-22
Arsenic (As)-Total			98.0		%		80-120	06-MAY-22
Barium (Ba)-Total			102.1		%		80-120	06-MAY-22
Beryllium (Be)-Total			102.0		%		80-120	06-MAY-22
Bismuth (Bi)-Total			98.4		%		80-120	06-MAY-22
Boron (B)-Total			98.9		%		80-120	06-MAY-22
Cadmium (Cd)-Total			101.1		%		80-120	06-MAY-22
Calcium (Ca)-Total			100.3		%		80-120	06-MAY-22
Chromium (Cr)-Total			99.2		%		80-120	06-MAY-22
Cesium (Cs)-Total			104.1		%		80-120	06-MAY-22
Cobalt (Co)-Total			97.9		%		80-120	06-MAY-22
Copper (Cu)-Total			97.0		%		80-120	06-MAY-22
Iron (Fe)-Total			105.6		%		80-120	06-MAY-22
Lead (Pb)-Total			98.0		%		80-120	06-MAY-22
Lithium (Li)-Total			107.5		%		80-120	06-MAY-22
Magnesium (Mg)-Total			98.6		%		80-120	06-MAY-22
Manganese (Mn)-Total			101.4		%		80-120	06-MAY-22
Molybdenum (Mo)-Total			98.2		%		80-120	06-MAY-22
Nickel (Ni)-Total			99.1		%		80-120	06-MAY-22
Phosphorus (P)-Total			103.3		%		70-130	06-MAY-22
Potassium (K)-Total			100.5		%		80-120	06-MAY-22
Rubidium (Rb)-Total			100.2		%		80-120	06-MAY-22
Selenium (Se)-Total			95.3		%		80-120	06-MAY-22
Silicon (Si)-Total			98.3		%		60-140	06-MAY-22

Quality Control Report

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5772998								
WG3724246-2 LCS								
Silver (Ag)-Total			94.2		%		80-120	06-MAY-22
Sodium (Na)-Total			102.9		%		80-120	06-MAY-22
Strontium (Sr)-Total			102.8		%		80-120	06-MAY-22
Sulfur (S)-Total			99.8		%		80-120	06-MAY-22
Thallium (Tl)-Total			99.0		%		80-120	06-MAY-22
Tellurium (Te)-Total			97.6		%		80-120	06-MAY-22
Thorium (Th)-Total			100.2		%		80-120	06-MAY-22
Tin (Sn)-Total			97.8		%		80-120	06-MAY-22
Titanium (Ti)-Total			94.9		%		80-120	06-MAY-22
Tungsten (W)-Total			94.1		%		80-120	06-MAY-22
Uranium (U)-Total			100.9		%		80-120	06-MAY-22
Vanadium (V)-Total			99.1		%		80-120	06-MAY-22
Zinc (Zn)-Total			99.7		%		80-120	06-MAY-22
Zirconium (Zr)-Total			101.4		%		80-120	06-MAY-22
WG3724246-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	06-MAY-22
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	06-MAY-22
Arsenic (As)-Total			<0.00010		mg/L		0.0001	06-MAY-22
Barium (Ba)-Total			<0.00010		mg/L		0.0001	06-MAY-22
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	06-MAY-22
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	06-MAY-22
Boron (B)-Total			<0.010		mg/L		0.01	06-MAY-22
Cadmium (Cd)-Total			<0.000005(		mg/L		0.000005	06-MAY-22
Calcium (Ca)-Total			<0.050		mg/L		0.05	06-MAY-22
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	06-MAY-22
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	06-MAY-22
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	06-MAY-22
Copper (Cu)-Total			<0.00050		mg/L		0.0005	06-MAY-22
Iron (Fe)-Total			<0.010		mg/L		0.01	06-MAY-22
Lead (Pb)-Total			<0.000050		mg/L		0.00005	06-MAY-22
Lithium (Li)-Total			<0.0010		mg/L		0.001	06-MAY-22
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	06-MAY-22
Manganese (Mn)-Total			<0.00050		mg/L		0.0005	06-MAY-22
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	06-MAY-22

Quality Control Report

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5772998								
WG3724246-1 MB								
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	06-MAY-22
Phosphorus (P)-Total			<0.050		mg/L		0.05	06-MAY-22
Potassium (K)-Total			<0.050		mg/L		0.05	06-MAY-22
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	06-MAY-22
Selenium (Se)-Total			<0.000050		mg/L		0.00005	06-MAY-22
Silicon (Si)-Total			<0.10		mg/L		0.1	06-MAY-22
Silver (Ag)-Total			<0.000050		mg/L		0.00005	06-MAY-22
Sodium (Na)-Total			<0.050		mg/L		0.05	06-MAY-22
Strontium (Sr)-Total			<0.0010		mg/L		0.001	06-MAY-22
Sulfur (S)-Total			<0.50		mg/L		0.5	06-MAY-22
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	06-MAY-22
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	06-MAY-22
Thorium (Th)-Total			<0.00010		mg/L		0.0001	06-MAY-22
Tin (Sn)-Total			<0.00010		mg/L		0.0001	06-MAY-22
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	06-MAY-22
Tungsten (W)-Total			<0.00010		mg/L		0.0001	06-MAY-22
Uranium (U)-Total			<0.000010		mg/L		0.00001	06-MAY-22
Vanadium (V)-Total			<0.00050		mg/L		0.0005	06-MAY-22
Zinc (Zn)-Total			<0.0030		mg/L		0.003	06-MAY-22
Zirconium (Zr)-Total			<0.00020		mg/L		0.0002	06-MAY-22
WG3724246-5 MS		**WG3724246-6**						
Aluminum (Al)-Total			108.5		%		70-130	06-MAY-22
Antimony (Sb)-Total			103.5		%		70-130	06-MAY-22
Arsenic (As)-Total			102.2		%		70-130	06-MAY-22
Barium (Ba)-Total			105.8		%		70-130	06-MAY-22
Beryllium (Be)-Total			106.4		%		70-130	06-MAY-22
Bismuth (Bi)-Total			90.4		%		70-130	06-MAY-22
Boron (B)-Total			N/A	MS-B	%		-	06-MAY-22
Cadmium (Cd)-Total			98.7		%		70-130	06-MAY-22
Calcium (Ca)-Total			102.2		%		70-130	06-MAY-22
Chromium (Cr)-Total			106.1		%		70-130	06-MAY-22
Cesium (Cs)-Total			105.9		%		70-130	06-MAY-22
Cobalt (Co)-Total			101.7		%		70-130	06-MAY-22
Copper (Cu)-Total			93.8		%		70-130	06-MAY-22

Quality Control Report

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5772998								
WG3724246-5 MS		**WG3724246-6**						
Iron (Fe)-Total			107.5		%		70-130	06-MAY-22
Lead (Pb)-Total			91.0		%		70-130	06-MAY-22
Lithium (Li)-Total			110.0		%		70-130	06-MAY-22
Magnesium (Mg)-Total			105.3		%		70-130	06-MAY-22
Manganese (Mn)-Total			102.7		%		70-130	06-MAY-22
Molybdenum (Mo)-Total			103.0		%		70-130	06-MAY-22
Nickel (Ni)-Total			99.2		%		70-130	06-MAY-22
Phosphorus (P)-Total			104.5		%		70-130	06-MAY-22
Potassium (K)-Total			101.6		%		70-130	06-MAY-22
Rubidium (Rb)-Total			102.9		%		70-130	06-MAY-22
Selenium (Se)-Total			99.5		%		70-130	06-MAY-22
Silicon (Si)-Total			N/A	MS-B	%		-	06-MAY-22
Silver (Ag)-Total			87.5		%		70-130	06-MAY-22
Sodium (Na)-Total			N/A	MS-B	%		-	06-MAY-22
Strontium (Sr)-Total			N/A	MS-B	%		-	06-MAY-22
Sulfur (S)-Total			N/A	MS-B	%		-	06-MAY-22
Thallium (Tl)-Total			94.5		%		70-130	06-MAY-22
Tellurium (Te)-Total			90.4		%		70-130	06-MAY-22
Thorium (Th)-Total			101.4		%		70-130	06-MAY-22
Tin (Sn)-Total			99.8		%		70-130	06-MAY-22
Titanium (Ti)-Total			102.7		%		70-130	06-MAY-22
Tungsten (W)-Total			97.2		%		70-130	06-MAY-22
Uranium (U)-Total			N/A	MS-B	%		-	06-MAY-22
Vanadium (V)-Total			107.9		%		70-130	06-MAY-22
Zinc (Zn)-Total			97.1		%		70-130	06-MAY-22
Zirconium (Zr)-Total			108.6		%		70-130	06-MAY-22
OGG-SPEC-WT	**Water**							
Batch R5778019								
WG3725149-2 LCS								
Oil and Grease, Total			89.8		%		70-130	09-MAY-22
Mineral Oil and Grease			87.3		%		70-130	09-MAY-22
WG3725149-1 MB								
Oil and Grease, Total			<5.0		mg/L		5	09-MAY-22
Mineral Oil and Grease			<2.5		mg/L		2.5	09-MAY-22

Quality Control Report

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
P-T-COL-WT	**Water**							
Batch R5777110								
WG3725476-3 DUP		**L2703606-1**						
Phosphorus, Total		0.0589	0.0604		mg/L	2.5	20	11-MAY-22
WG3725476-2 LCS								
Phosphorus, Total			95.8		%		80-120	11-MAY-22
WG3725476-1 MB								
Phosphorus, Total			<0.0030		mg/L		0.003	11-MAY-22
WG3725476-4 MS		**L2703606-1**						
Phosphorus, Total			85.8		%		70-130	11-MAY-22
PCB-WT	**Water**							
Batch R5775219								
WG3724830-2 LCS								
Aroclor 1242			91.3		%		65-130	09-MAY-22
Aroclor 1248			91.9		%		65-130	09-MAY-22
Aroclor 1254			86.8		%		65-130	09-MAY-22
Aroclor 1260			83.4		%		65-130	09-MAY-22
WG3724830-1 MB								
Aroclor 1242			<0.020		ug/L		0.02	09-MAY-22
Aroclor 1248			<0.020		ug/L		0.02	09-MAY-22
Aroclor 1254			<0.020		ug/L		0.02	09-MAY-22
Aroclor 1260			<0.020		ug/L		0.02	09-MAY-22
Surrogate: Decachlorobiphenyl			79.3		%		50-150	09-MAY-22
Surrogate: Tetrachloro-m-xylene			70.8		%		50-150	09-MAY-22
PH-WT	**Water**							
Batch R5775721								
WG3724728-4 DUP		**WG3724728-3**						
pH		8.01	8.05	J	pH units	0.04	0.2	07-MAY-22
WG3724728-2 LCS								
pH			7.03		pH units		6.9-7.1	07-MAY-22
PHENOLS-4AAP-WT	**Water**							
Batch R5777246								
WG3725508-3 DUP		**L2703918-1**						
Phenols (4AAP)		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	10-MAY-22
WG3725508-2 LCS								
Phenols (4AAP)			98.0		%		85-115	10-MAY-22
WG3725508-1 MB								
Phenols (4AAP)			<0.0010		mg/L		0.001	10-MAY-22
WG3725508-4 MS		**L2703918-1**						

Quality Control Report

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PHENOLS-4AAP-WT	**Water**							
Batch R5777246								
WG3725508-4 MS		**L2703918-1**						
Phenols (4AAP)			88.1		%		75-125	10-MAY-22
SOLIDS-TSS-WT	**Water**							
Batch R5774198								
WG3724786-3 DUP		**L2703847-1**						
Total Suspended Solids		<3.0	<3.0	RPD-NA	mg/L	N/A	20	09-MAY-22
WG3724786-2 LCS								
Total Suspended Solids			106.7		%		85-115	09-MAY-22
WG3724786-1 MB								
Total Suspended Solids			<3.0		mg/L		3	09-MAY-22
VOC-ROU-HS-WT	**Water**							
Batch R5777157								
WG3725454-4 DUP		**WG3725454-3**						
1,1,1,2-Tetrachloroethane		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
1,1,2,2-Tetrachloroethane		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
1,1,1-Trichloroethane		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
1,1,2-Trichloroethane		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
1,2-Dibromoethane		<0.20	<0.20	RPD-NA	ug/L	N/A	30	10-MAY-22
1,1-Dichloroethane		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
1,1-Dichloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
1,2-Dichlorobenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
1,2-Dichloroethane		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
1,2-Dichloropropane		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
1,3-Dichlorobenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
1,4-Dichlorobenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
2-Hexanone		<20	<20	RPD-NA	ug/L	N/A	30	10-MAY-22
Acetone		<20	<20	RPD-NA	ug/L	N/A	30	10-MAY-22
Benzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
Bromodichloromethane		1.0	<1.0	RPD-NA	ug/L	N/A	30	10-MAY-22
Bromoform		<1.0	<1.0	RPD-NA	ug/L	N/A	30	10-MAY-22
Bromomethane		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
Carbon Disulfide		<1.0	<1.0	RPD-NA	ug/L	N/A	30	10-MAY-22
Carbon tetrachloride		<0.50	<0.20	RPD-NA	ug/L	N/A	30	10-MAY-22
Chlorobenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22

Quality Control Report

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-HS-WT	**Water**							
Batch R5777157								
WG3725454-4 DUP		**WG3725454-3**						
Chloroethane		<1.0	<1.0	RPD-NA	ug/L	N/A	30	10-MAY-22
Chloroform		2.0	1.7		ug/L	15	30	10-MAY-22
Chloromethane		<2.0	<2.0	RPD-NA	ug/L	N/A	30	10-MAY-22
cis-1,2-Dichloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
cis-1,3-Dichloropropene		<0.30	<0.30	RPD-NA	ug/L	N/A	30	10-MAY-22
Dibromochloromethane		<1.0	<1.0	RPD-NA	ug/L	N/A	30	10-MAY-22
Dichlorodifluoromethane		<1.0	<1.0	RPD-NA	ug/L	N/A	30	10-MAY-22
Dichloromethane		<2.0	<2.0	RPD-NA	ug/L	N/A	30	10-MAY-22
Ethylbenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
m+p-Xylenes		<0.40	<0.40	RPD-NA	ug/L	N/A	30	10-MAY-22
Methyl Ethyl Ketone		<20	<20	RPD-NA	ug/L	N/A	30	10-MAY-22
Methyl Isobutyl Ketone		<20	<20	RPD-NA	ug/L	N/A	30	10-MAY-22
n-Hexane		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
MTBE		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
o-Xylene		<0.30	<0.30	RPD-NA	ug/L	N/A	30	10-MAY-22
Styrene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
Tetrachloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
Toluene		<0.40	<0.40	RPD-NA	ug/L	N/A	30	10-MAY-22
trans-1,2-Dichloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
trans-1,3-Dichloropropene		<0.30	<0.30	RPD-NA	ug/L	N/A	30	10-MAY-22
Trichloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
Trichlorofluoromethane		<1.0	<1.0	RPD-NA	ug/L	N/A	30	10-MAY-22
Vinyl chloride		<0.50	<0.50	RPD-NA	ug/L	N/A	30	10-MAY-22
WG3725454-1 LCS								
1,1,1,2-Tetrachloroethane			80.2		%		70-130	10-MAY-22
1,1,2,2-Tetrachloroethane			78.7		%		70-130	10-MAY-22
1,1,1-Trichloroethane			85.8		%		70-130	10-MAY-22
1,1,2-Trichloroethane			84.0		%		70-130	10-MAY-22
1,2-Dibromoethane			78.5		%		70-130	10-MAY-22
1,1-Dichloroethane			81.8		%		70-130	10-MAY-22
1,1-Dichloroethylene			90.1		%		70-130	10-MAY-22
1,2-Dichlorobenzene			97.7		%		70-130	10-MAY-22
1,2-Dichloroethane			82.3		%		70-130	10-MAY-22

Quality Control Report

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-HS-WT	**Water**							
Batch R5777157								
WG3725454-1 LCS								
1,2-Dichloropropane			95.8		%		70-130	10-MAY-22
1,3-Dichlorobenzene			99.6		%		70-130	10-MAY-22
1,4-Dichlorobenzene			99.1		%		70-130	10-MAY-22
2-Hexanone			84.2		%		60-140	10-MAY-22
Acetone			88.7		%		60-140	10-MAY-22
Benzene			98.1		%		70-130	10-MAY-22
Bromodichloromethane			86.0		%		70-130	10-MAY-22
Bromoform			86.4		%		70-130	10-MAY-22
Bromomethane			80.1		%		60-140	10-MAY-22
Carbon Disulfide			77.0		%		70-130	10-MAY-22
Carbon tetrachloride			89.2		%		70-130	10-MAY-22
Chlorobenzene			95.0		%		70-130	10-MAY-22
Chloroethane			105.2		%		70-130	10-MAY-22
Chloroform			85.7		%		70-130	10-MAY-22
Chloromethane			89.3		%		60-140	10-MAY-22
cis-1,2-Dichloroethylene			91.4		%		70-130	10-MAY-22
cis-1,3-Dichloropropene			85.6		%		70-130	10-MAY-22
Dibromochloromethane			81.5		%		70-130	10-MAY-22
Dichlorodifluoromethane			73.8		%		50-140	10-MAY-22
Dichloromethane			83.7		%		70-130	10-MAY-22
Ethylbenzene			99.8		%		70-130	10-MAY-22
m+p-Xylenes			105.5		%		70-130	10-MAY-22
Methyl Ethyl Ketone			87.7		%		60-140	10-MAY-22
Methyl Isobutyl Ketone			80.5		%		50-150	10-MAY-22
n-Hexane			94.1		%		70-130	10-MAY-22
MTBE			103.8		%		70-130	10-MAY-22
o-Xylene			98.4		%		70-130	10-MAY-22
Styrene			90.5		%		70-130	10-MAY-22
Tetrachloroethylene			95.5		%		70-130	10-MAY-22
Toluene			103.2		%		70-130	10-MAY-22
trans-1,2-Dichloroethylene			90.6		%		70-130	10-MAY-22
trans-1,3-Dichloropropene			84.6		%		70-130	10-MAY-22
Trichloroethylene			86.4		%		70-130	10-MAY-22

Quality Control Report

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-HS-WT	**Water**							
Batch R5777157								
WG3725454-1 LCS								
Trichlorofluoromethane			83.3		%		60-140	10-MAY-22
Vinyl chloride			91.3		%		60-140	10-MAY-22
WG3725454-2 MB								
1,1,1,2-Tetrachloroethane			<0.50		ug/L		0.5	10-MAY-22
1,1,2,2-Tetrachloroethane			<0.50		ug/L		0.5	10-MAY-22
1,1,1-Trichloroethane			<0.50		ug/L		0.5	10-MAY-22
1,1,2-Trichloroethane			<0.50		ug/L		0.5	10-MAY-22
1,2-Dibromoethane			<0.20		ug/L		0.2	10-MAY-22
1,1-Dichloroethane			<0.50		ug/L		0.5	10-MAY-22
1,1-Dichloroethylene			<0.50		ug/L		0.5	10-MAY-22
1,2-Dichlorobenzene			<0.50		ug/L		0.5	10-MAY-22
1,2-Dichloroethane			<0.50		ug/L		0.5	10-MAY-22
1,2-Dichloropropane			<0.50		ug/L		0.5	10-MAY-22
1,3-Dichlorobenzene			<0.50		ug/L		0.5	10-MAY-22
1,4-Dichlorobenzene			<0.50		ug/L		0.5	10-MAY-22
2-Hexanone			<20		ug/L		20	10-MAY-22
Acetone			<20		ug/L		20	10-MAY-22
Benzene			<0.50		ug/L		0.5	10-MAY-22
Bromodichloromethane			<1.0		ug/L		1	10-MAY-22
Bromoform			<1.0		ug/L		1	10-MAY-22
Bromomethane			<0.50		ug/L		0.5	10-MAY-22
Carbon Disulfide			<1.0		ug/L		1	10-MAY-22
Carbon tetrachloride			<0.20		ug/L		0.2	10-MAY-22
Chlorobenzene			<0.50		ug/L		0.5	10-MAY-22
Chloroethane			<1.0		ug/L		1	10-MAY-22
Chloroform			<1.0		ug/L		1	10-MAY-22
Chloromethane			<2.0		ug/L		2	10-MAY-22
cis-1,2-Dichloroethylene			<0.50		ug/L		0.5	10-MAY-22
cis-1,3-Dichloropropene			<0.30		ug/L		0.3	10-MAY-22
Dibromochloromethane			<1.0		ug/L		1	10-MAY-22
Dichlorodifluoromethane			<1.0		ug/L		1	10-MAY-22
Dichloromethane			<2.0		ug/L		2	10-MAY-22
Ethylbenzene			<0.50		ug/L		0.5	10-MAY-22
m+p-Xylenes			<0.40		ug/L		0.4	10-MAY-22

Quality Control Report

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-HS-WT	**Water**							
Batch	**R5777157**							
WG3725454-2	**MB**							
Methyl Ethyl Ketone			<20		ug/L		20	10-MAY-22
Methyl Isobutyl Ketone			<20		ug/L		20	10-MAY-22
n-Hexane			<0.50		ug/L		0.5	10-MAY-22
MTBE			<0.50		ug/L		0.5	10-MAY-22
o-Xylene			<0.30		ug/L		0.3	10-MAY-22
Styrene			<0.50		ug/L		0.5	10-MAY-22
Tetrachloroethylene			<0.50		ug/L		0.5	10-MAY-22
Toluene			<0.40		ug/L		0.4	10-MAY-22
trans-1,2-Dichloroethylene			<0.50		ug/L		0.5	10-MAY-22
trans-1,3-Dichloropropene			<0.30		ug/L		0.3	10-MAY-22
Trichloroethylene			<0.50		ug/L		0.5	10-MAY-22
Trichlorofluoromethane			<1.0		ug/L		1	10-MAY-22
Vinyl chloride			<0.50		ug/L		0.5	10-MAY-22
Surrogate: 1,4-Difluorobenzene			99.1		%		70-130	10-MAY-22
Surrogate: 4-Bromofluorobenzene			75.1		%		70-130	10-MAY-22
WG3725454-5	**MS**	**WG3725454-3**						
1,1,1,2-Tetrachloroethane			76.9		%		50-150	10-MAY-22
1,1,2,2-Tetrachloroethane			74.6		%		50-150	10-MAY-22
1,1,1-Trichloroethane			84.6		%		50-150	10-MAY-22
1,1,2-Trichloroethane			79.4		%		50-150	10-MAY-22
1,2-Dibromoethane			73.4		%		50-150	10-MAY-22
1,1-Dichloroethane			93.1		%		50-150	10-MAY-22
1,1-Dichloroethylene			90.2		%		50-150	10-MAY-22
1,2-Dichlorobenzene			95.7		%		50-150	10-MAY-22
1,2-Dichloroethane			79.2		%		50-150	10-MAY-22
1,2-Dichloropropane			93.5		%		50-150	10-MAY-22
1,3-Dichlorobenzene			99.6		%		50-150	10-MAY-22
1,4-Dichlorobenzene			99.2		%		50-150	10-MAY-22
2-Hexanone			70.9		%		50-150	10-MAY-22
Acetone			73.8		%		50-150	10-MAY-22
Benzene			96.1		%		50-150	10-MAY-22
Bromodichloromethane			83.8		%		50-150	10-MAY-22
Bromoform			81.4		%		50-150	10-MAY-22
Bromomethane			81.0		%		50-150	10-MAY-22

Quality Control Report

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-HS-WT	**Water**							
Batch R5777157								
WG3725454-5 MS		**WG3725454-3**						
Carbon Disulfide			78.7		%		50-150	10-MAY-22
Carbon tetrachloride			87.7		%		50-150	10-MAY-22
Chlorobenzene			93.0		%		50-150	10-MAY-22
Chloroethane			106.0		%		50-150	10-MAY-22
Chloroform			83.5		%		50-150	10-MAY-22
Chloromethane			96.8		%		50-150	10-MAY-22
cis-1,2-Dichloroethylene			89.7		%		50-150	10-MAY-22
cis-1,3-Dichloropropene			84.4		%		50-150	10-MAY-22
Dibromochloromethane			76.8		%		50-150	10-MAY-22
Dichlorodifluoromethane			91.9		%		50-150	10-MAY-22
Dichloromethane			81.0		%		50-150	10-MAY-22
Ethylbenzene			98.0		%		50-150	10-MAY-22
m+p-Xylenes			104.5		%		50-150	10-MAY-22
Methyl Ethyl Ketone			73.5		%		50-150	10-MAY-22
Methyl Isobutyl Ketone			69.4		%		50-150	10-MAY-22
n-Hexane			92.9		%		50-150	10-MAY-22
MTBE			103.3		%		50-150	10-MAY-22
o-Xylene			96.6		%		50-150	10-MAY-22
Styrene			87.3		%		50-150	10-MAY-22
Tetrachloroethylene			94.0		%		50-150	10-MAY-22
Toluene			100.2		%		50-150	10-MAY-22
trans-1,2-Dichloroethylene			91.2		%		50-150	10-MAY-22
trans-1,3-Dichloropropene			81.6		%		50-150	10-MAY-22
Trichloroethylene			85.4		%		50-150	10-MAY-22
Trichlorofluoromethane			83.5		%		50-150	10-MAY-22
Vinyl chloride			95.4		%		50-150	10-MAY-22

Quality Control Report

Workorder: L2703606 Report Date: 12-MAY-22

Client: Grounded Engineering Inc
1 Banigan Drive
TORONTO ON M4H 1G3
Contact: Bailey Walters

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC)

L2703606-COFC

COC Number: 20 - 951339

Page 1 of 1

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HD

Report To	Contact and company name below will appear on the final report
Company:	Grounded Engineering
Contact:	Baily Walters
Phone:	
Company address below will appear on the final report	
Street:	1 Bangian Dr
City/Province:	Toronto, ON
Postal Code:	M4H 1G3
Invoice To	Same as Report To ☒ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☒ YES ☐ NO ☐ N/A

☒ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: bwalters@groundedeng.ca

Email 2: jryback@groundedeng.ca

Email 3:

Invoice Recipients

Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Turnaround Time (TAT) Requested

☒ Routine [R] if received by 3pm M-F - no surcharges apply

☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum

☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum

☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum

☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum

☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional fees may apply to rush requests on weekends, statutory holidays and non-routine tests.

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Date and Time Required for all E&P TATs:

For all tests with rush TATs requested, please contact your AM to confirm availability.

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	22-052	Major/Minor Code:	Routing Code:
PO / AFE:	2	Requisitioner:	
LSD:	163-164 Edward St E	Location:	
ALS Lab Work Order # (ALS use only):	L2703606 JD	ALS Contact:	Sampler: VT

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Sewer Sat	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	SEW-VF-BH108	04-MAY-22	10:00	GW	12	X			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

Compare to Clearview storm and sanitary / combined criteria

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				6.6			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)		
Released by: Vivi Tran	Date: 2022/05/04	Time: 13:30	Received by:	Date:	Time:	Received by: TS	Date: May 4/22	Time: 3pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

APPENDIX I



GROUNDED ENGINEERING

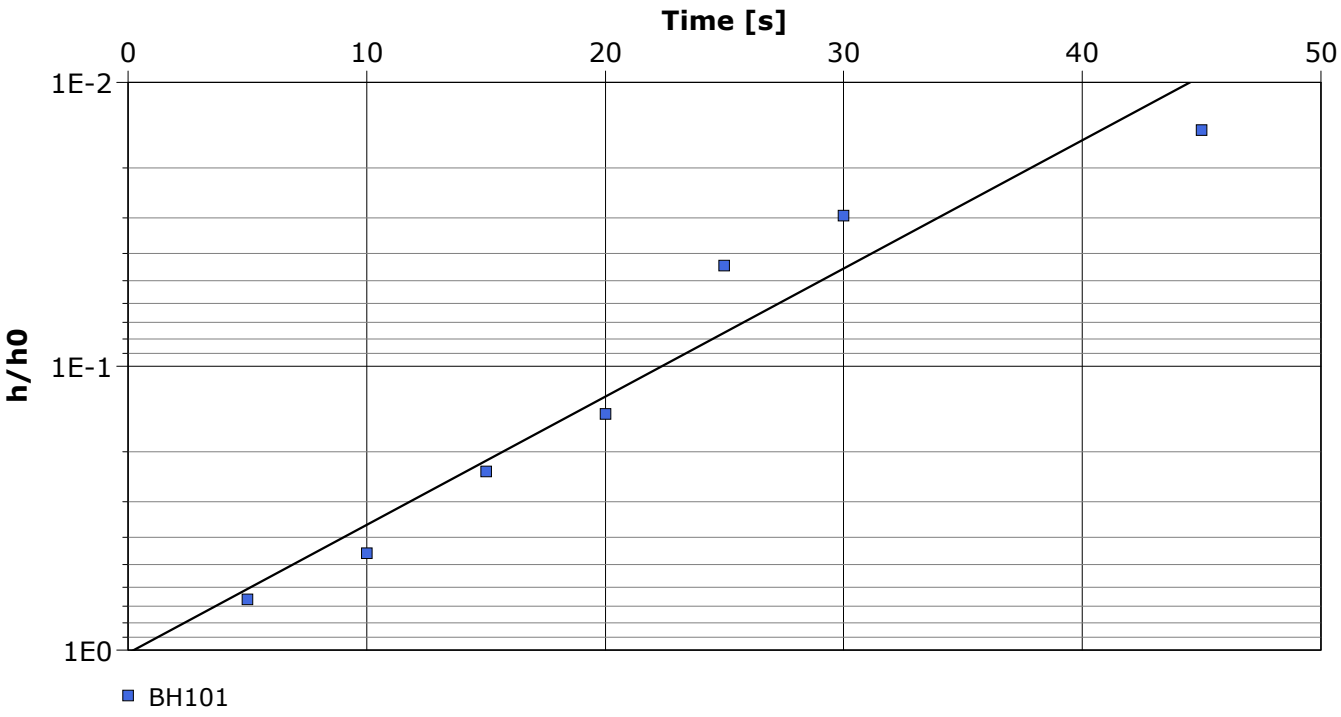
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH101 Test 1	Test Well: BH101
Test Conducted by: VT		Test Date: 2022-05-05
Analysis Performed by: JR	RHT 1	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH101	4.18×10^{-5}	

GROUNDED ENGINEERING

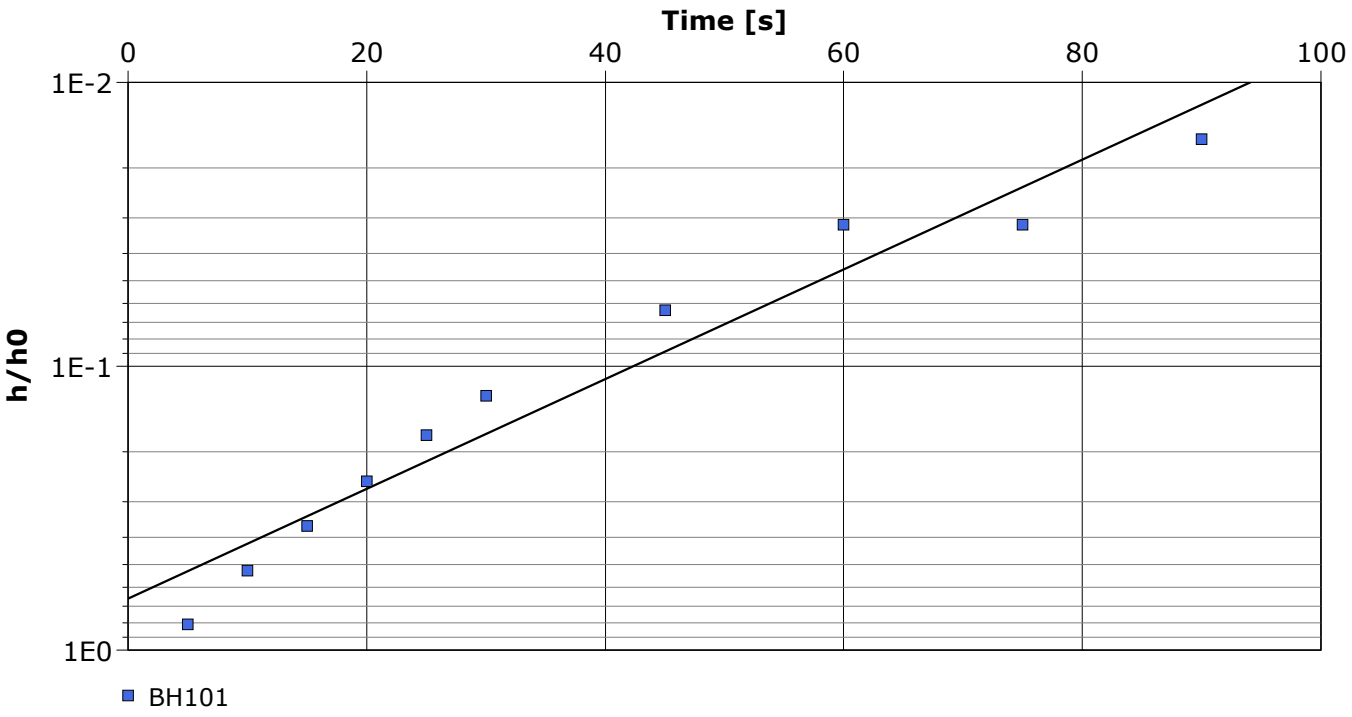
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH101 Test 2	Test Well: BH101
Test Conducted by: VT		Test Date: 2022-05-05
Analysis Performed by: JR	RHT 2	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH101	1.79×10^{-5}	

GROUNDED ENGINEERING

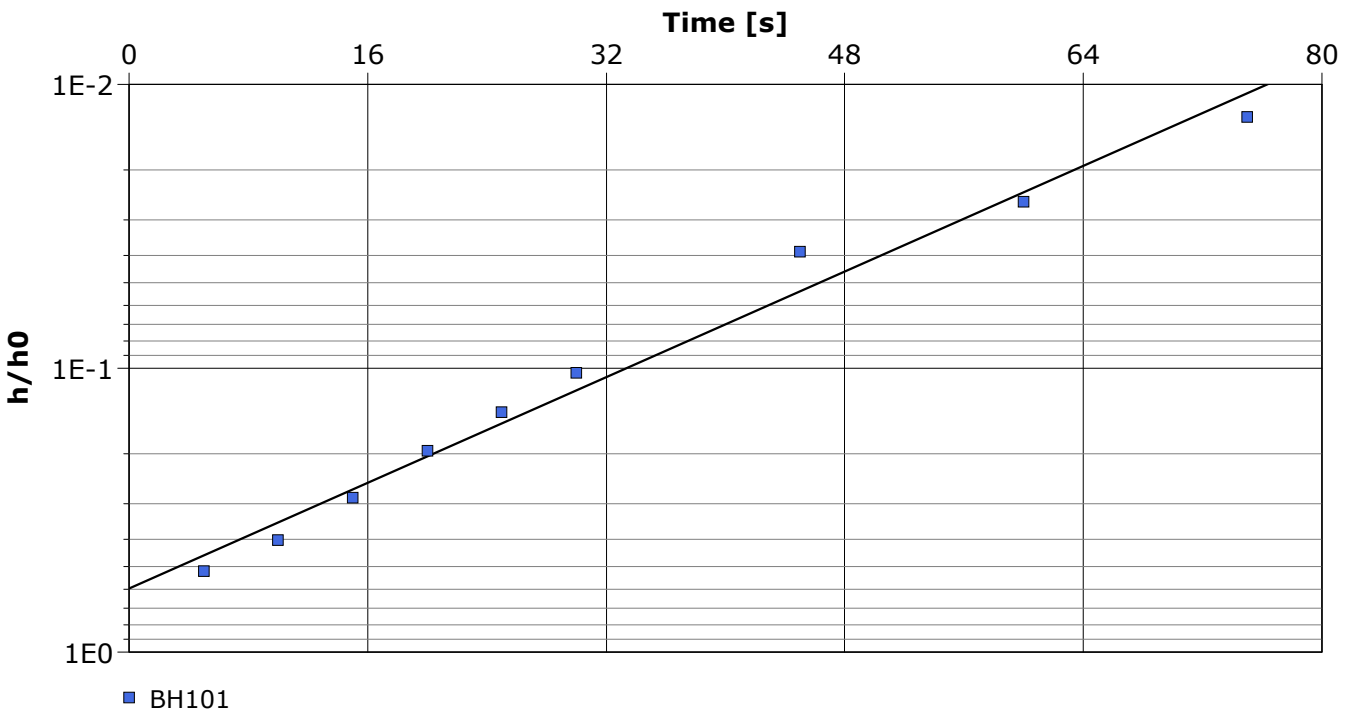
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH101 Test 3	Test Well: BH101
Test Conducted by: VT		Test Date: 2022-05-05
Analysis Performed by: JR	RHT 3	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH101	2.15×10^{-5}	

GROUNDED ENGINEERING

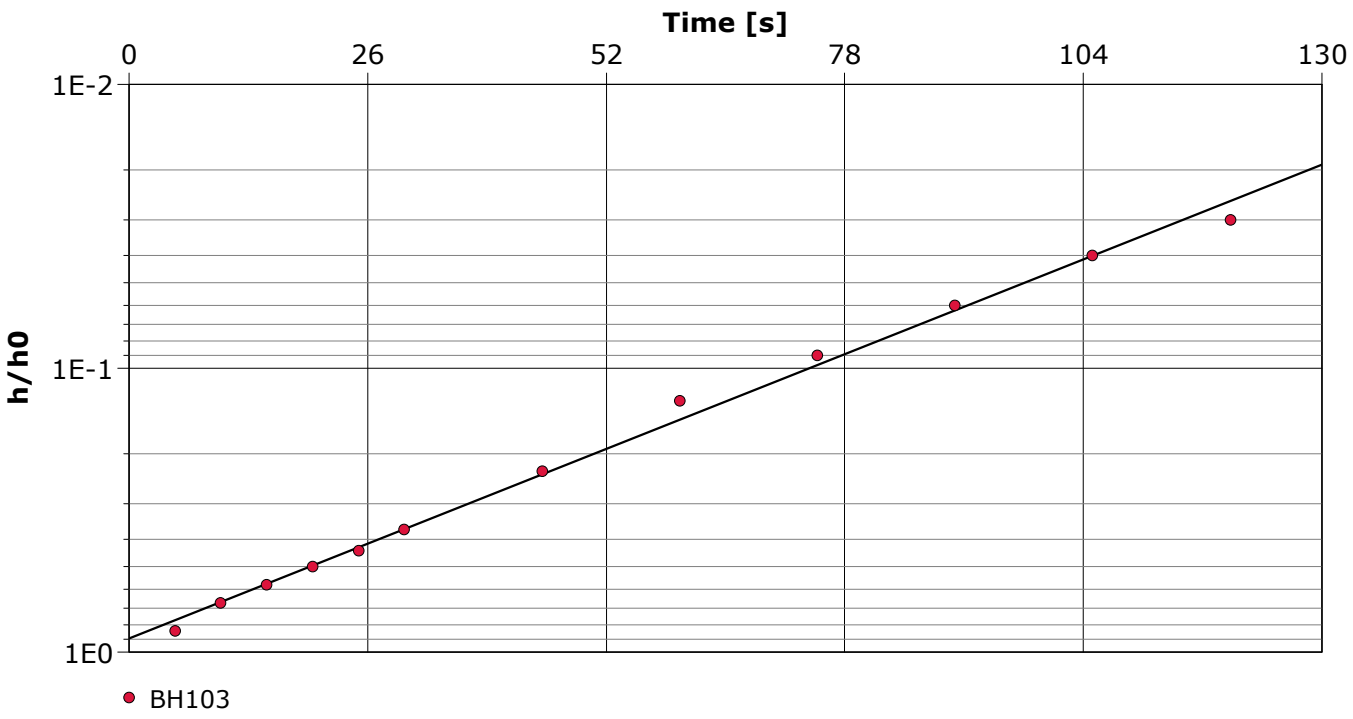
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH103	Test Well: BH103
Test Conducted by: VT		Test Date: 2022-05-05
Analysis Performed by: JR	RHT 1	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH103	1.19×10^{-5}	

GROUNDED ENGINEERING

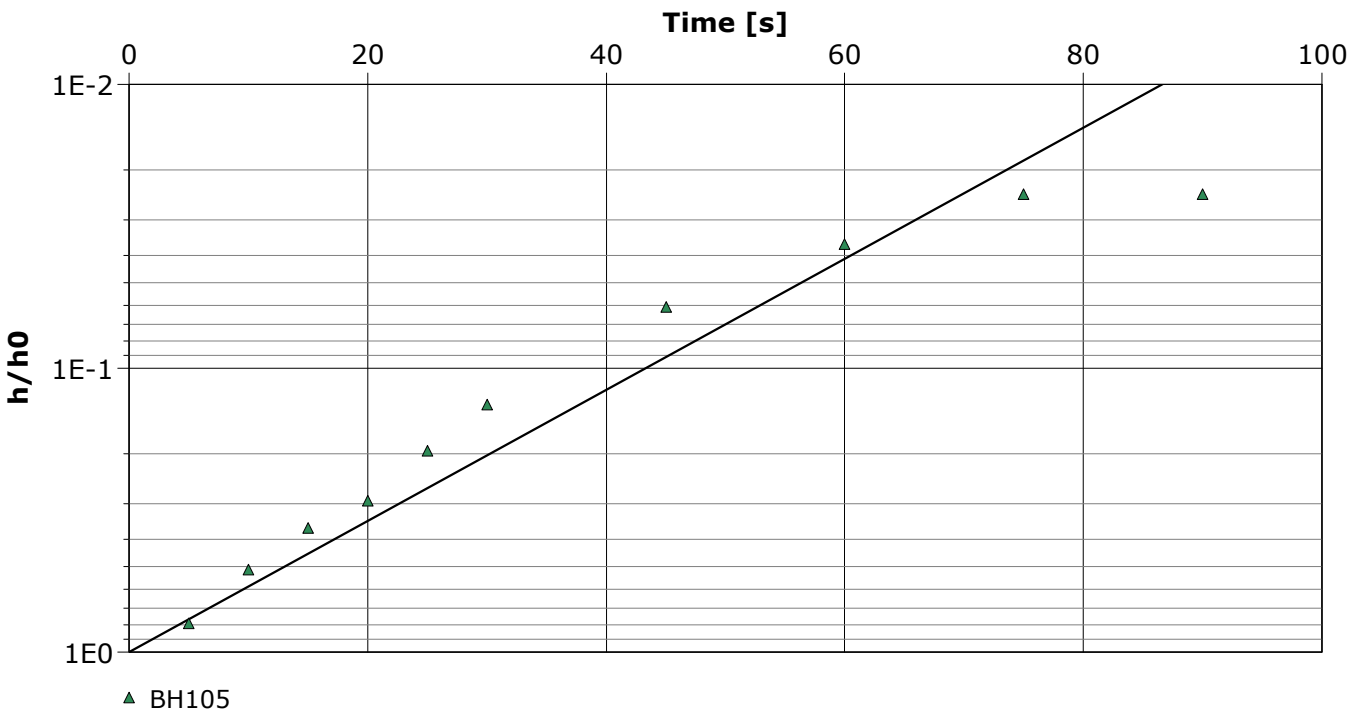
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH105 Test 1	Test Well: BH105
Test Conducted by: VT		Test Date: 2022-05-05
Analysis Performed by: JR	RHT 1	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH105	2.14×10^{-5}	

GROUNDED ENGINEERING

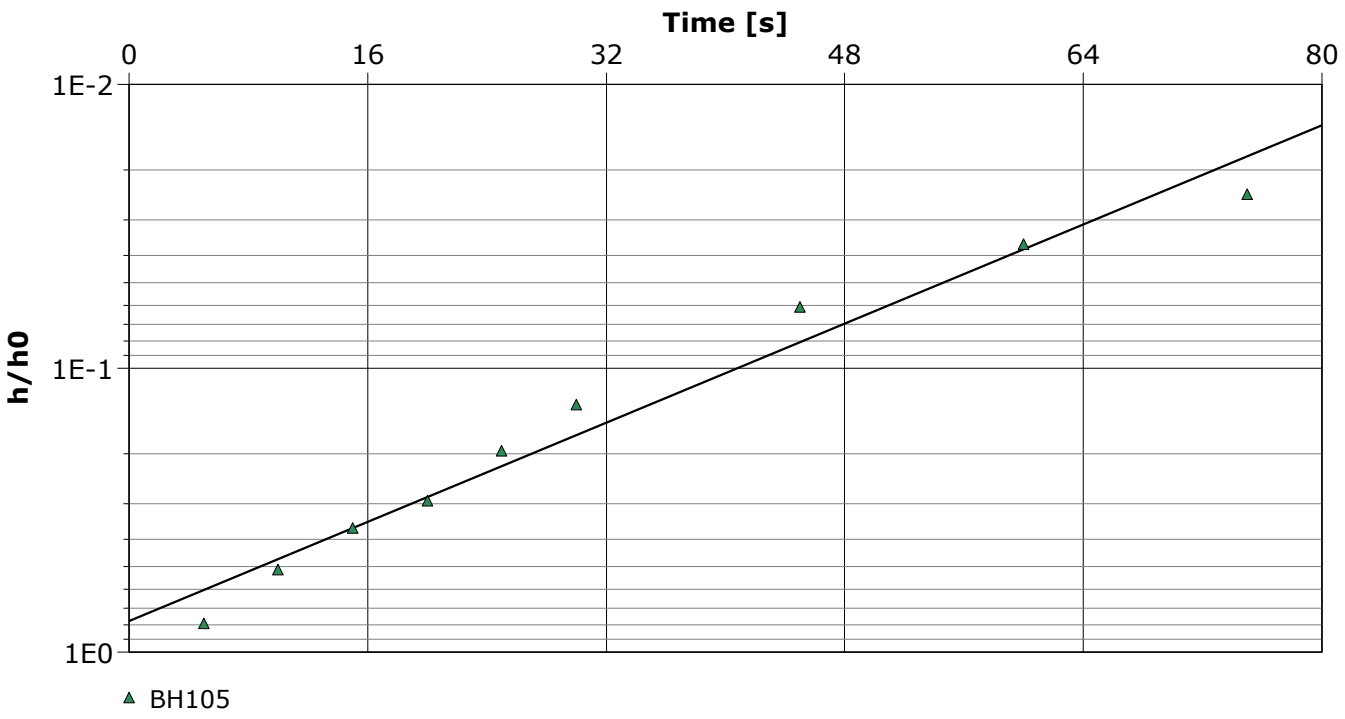
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH105 Test 2	Test Well: BH105
Test Conducted by: VT		Test Date: 2022-05-05
Analysis Performed by: JR	RHT 2	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH105	2.02×10^{-5}	

GROUNDED ENGINEERING

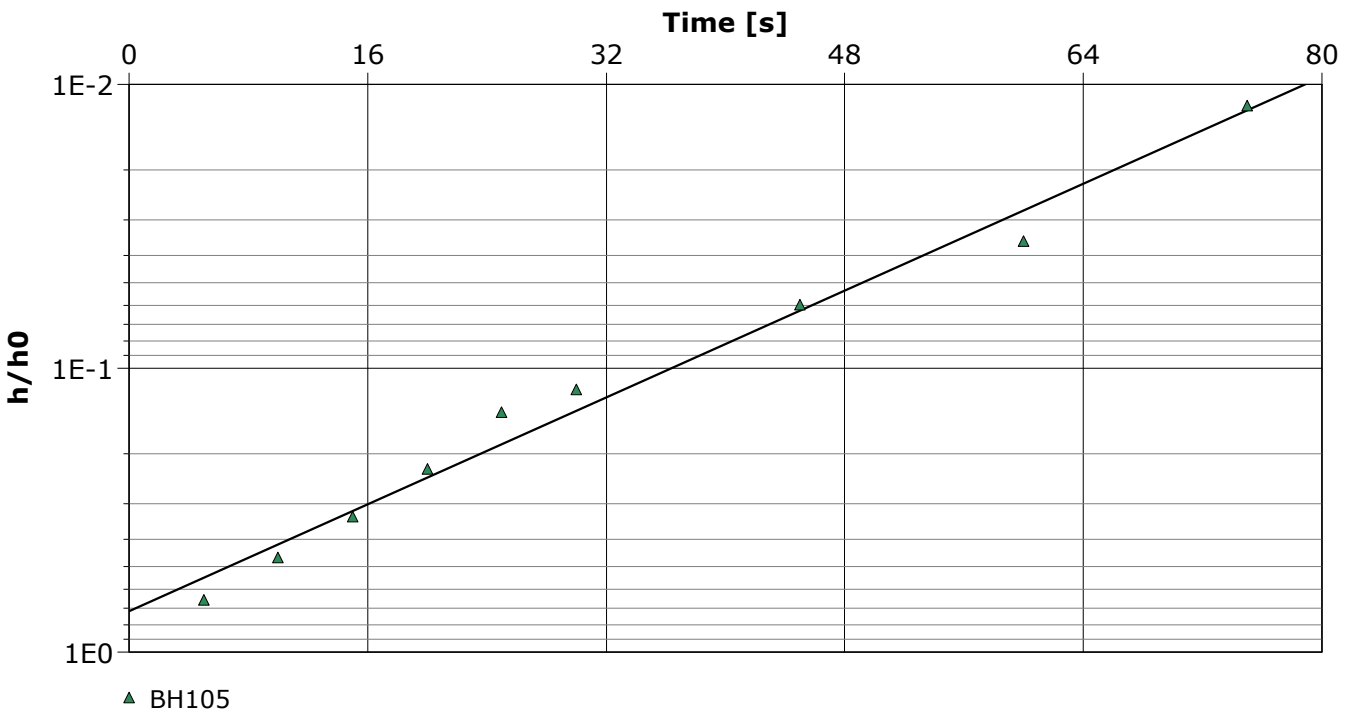
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH105 Test 3	Test Well: BH105
Test Conducted by: VT		Test Date: 2022-05-05
Analysis Performed by: JR	RHT 3	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH105	2.18×10^{-5}	

GROUNDED ENGINEERING

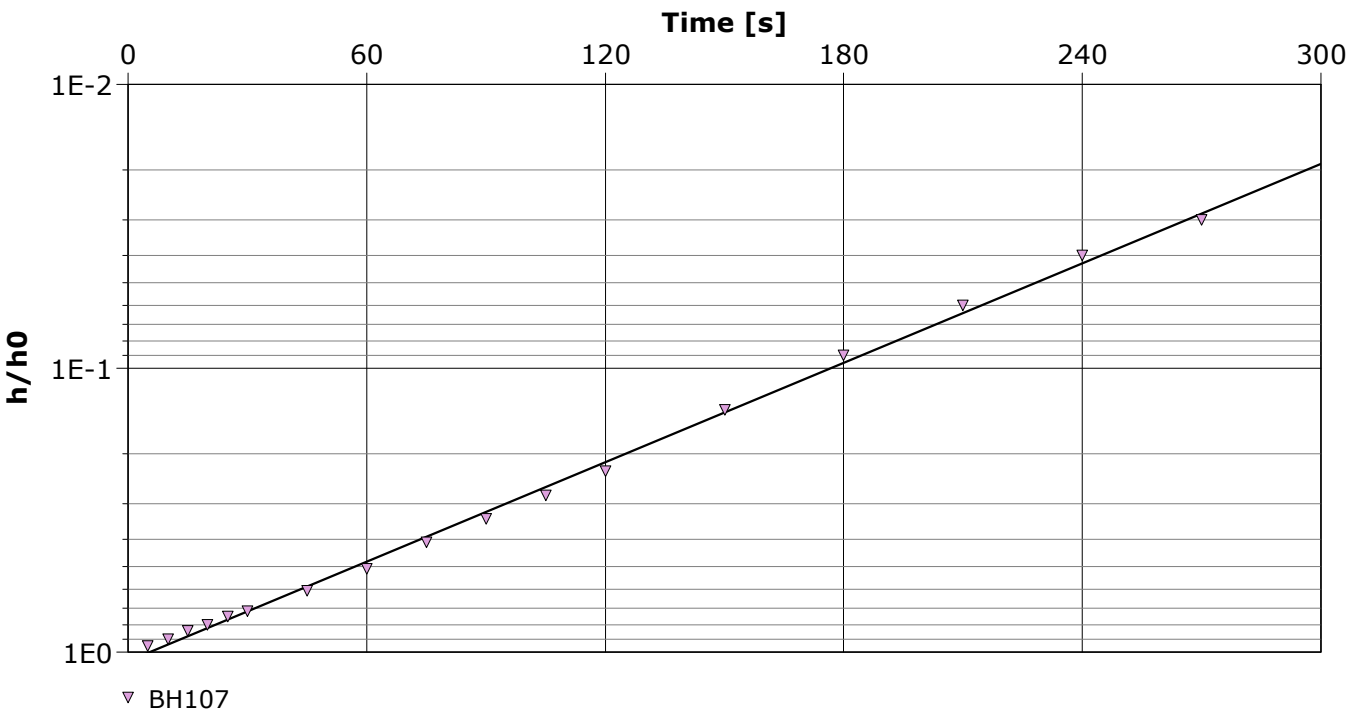
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH107	Test Well: BH107
Test Conducted by: VT		Test Date: 2022-06-24
Analysis Performed by: JR	RHT 1	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH107	5.41×10^{-6}	

GROUNDED ENGINEERING

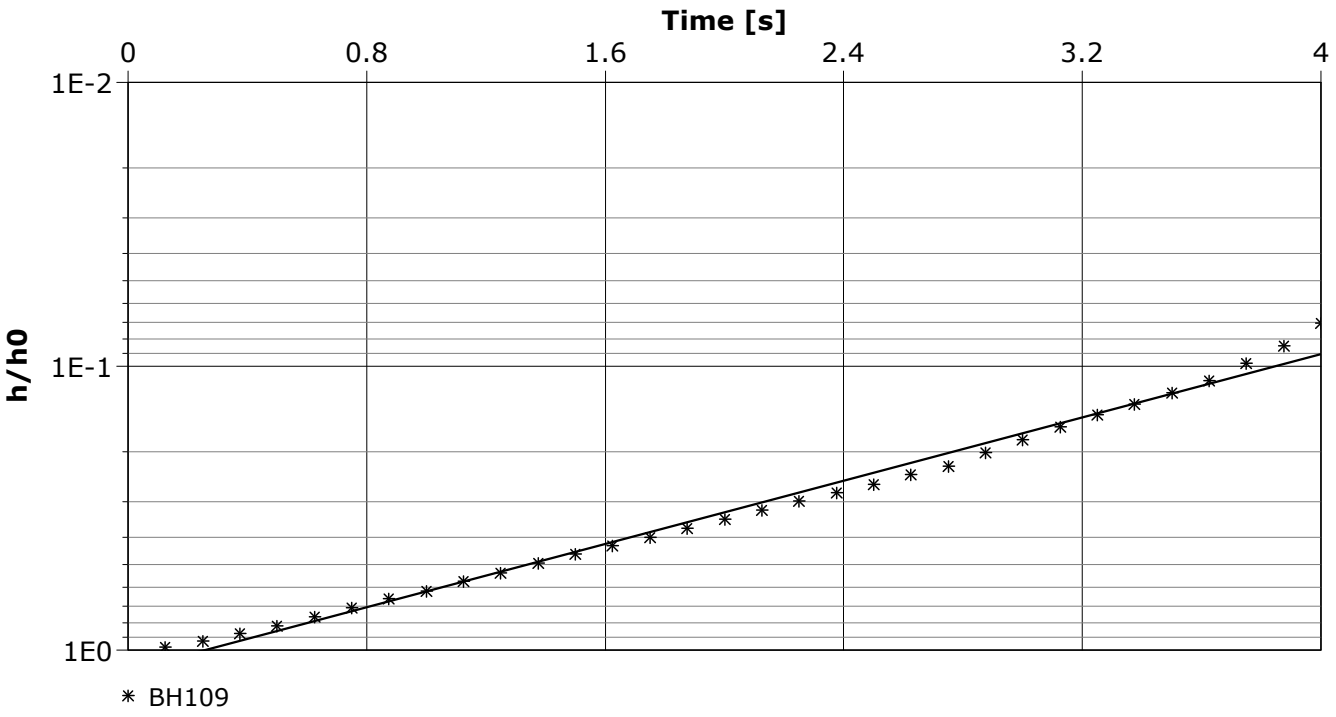
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH109 Test 1	Test Well: BH109
Test Conducted by: MC		Test Date: 2022-05-05
Analysis Performed by: JR	RHT 1	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH109	2.58×10^{-4}	

GROUNDED ENGINEERING

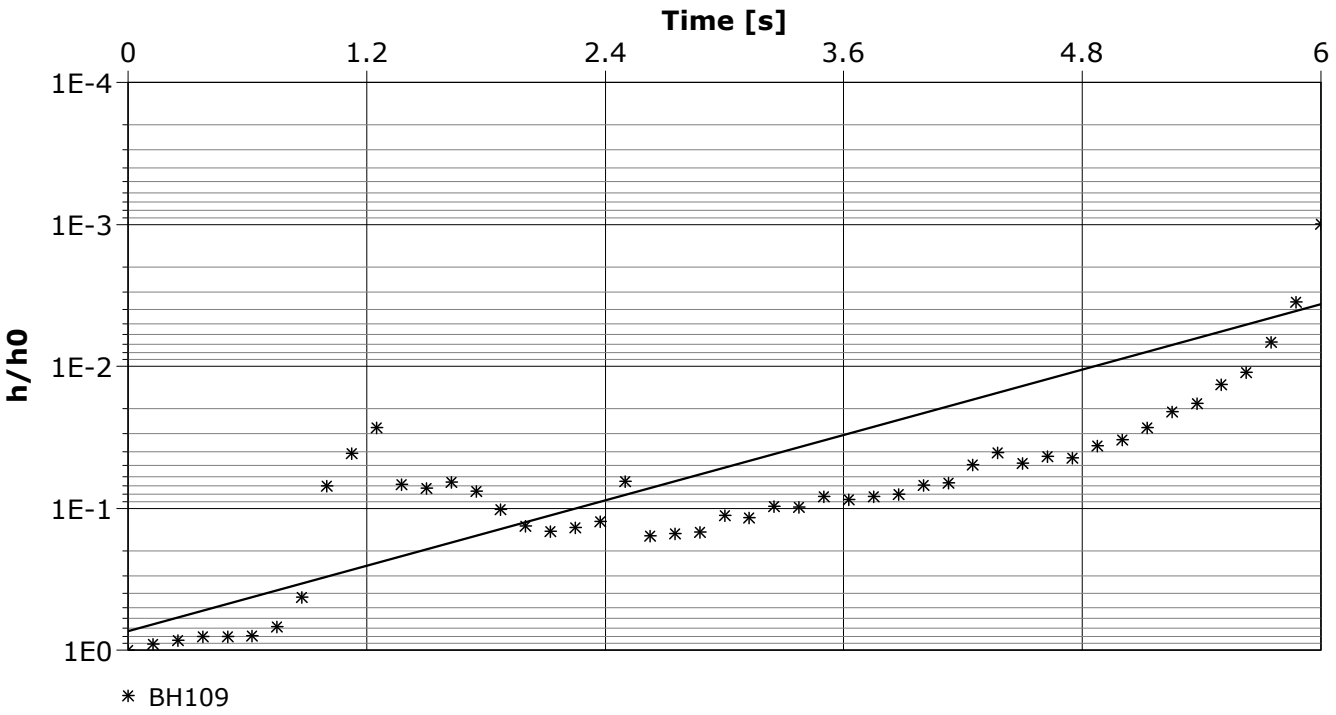
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH109 Test 2	Test Well: BH109
Test Conducted by: MC		Test Date: 2022-05-05
Analysis Performed by: JR	FHT 1	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH109	3.55×10^{-4}	

GROUNDED ENGINEERING

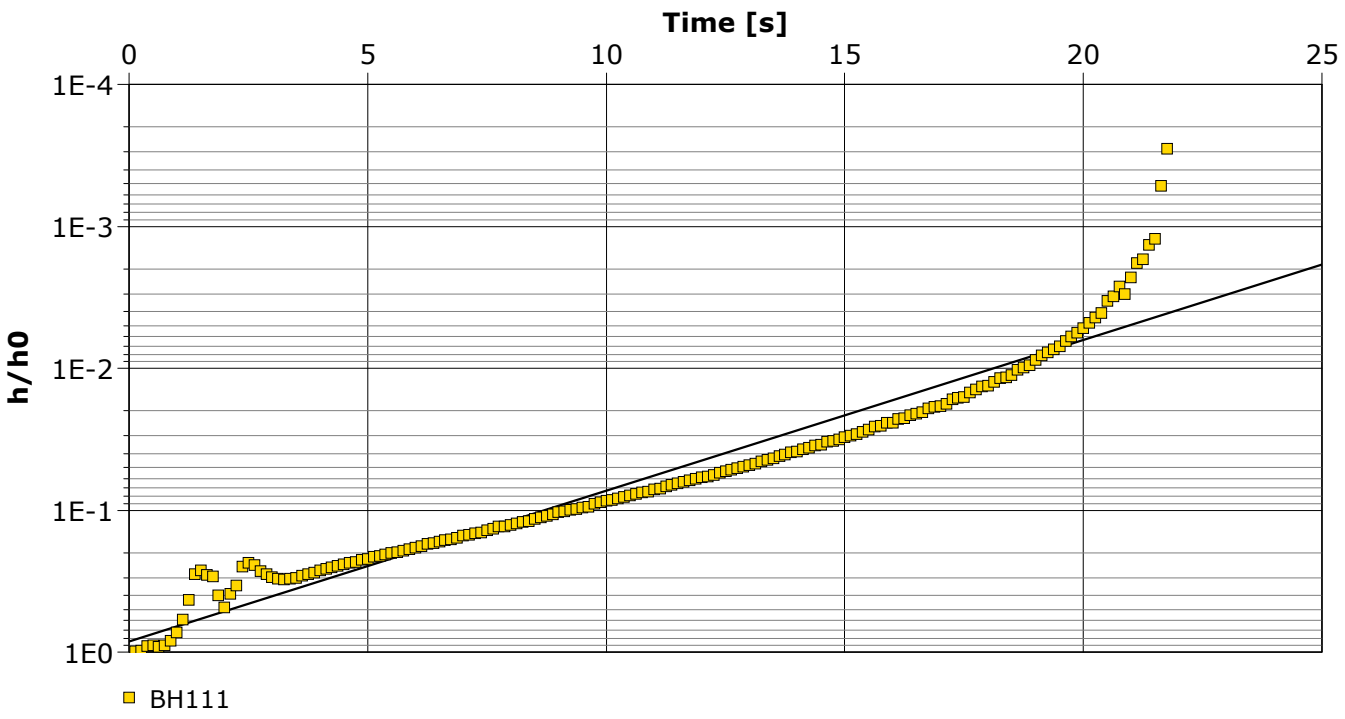
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH111 Test 1	Test Well: BH111
Test Conducted by: MC		Test Date: 2022-05-05
Analysis Performed by: JR	FHT 1	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH111	9.82×10^{-5}	

GROUNDED ENGINEERING

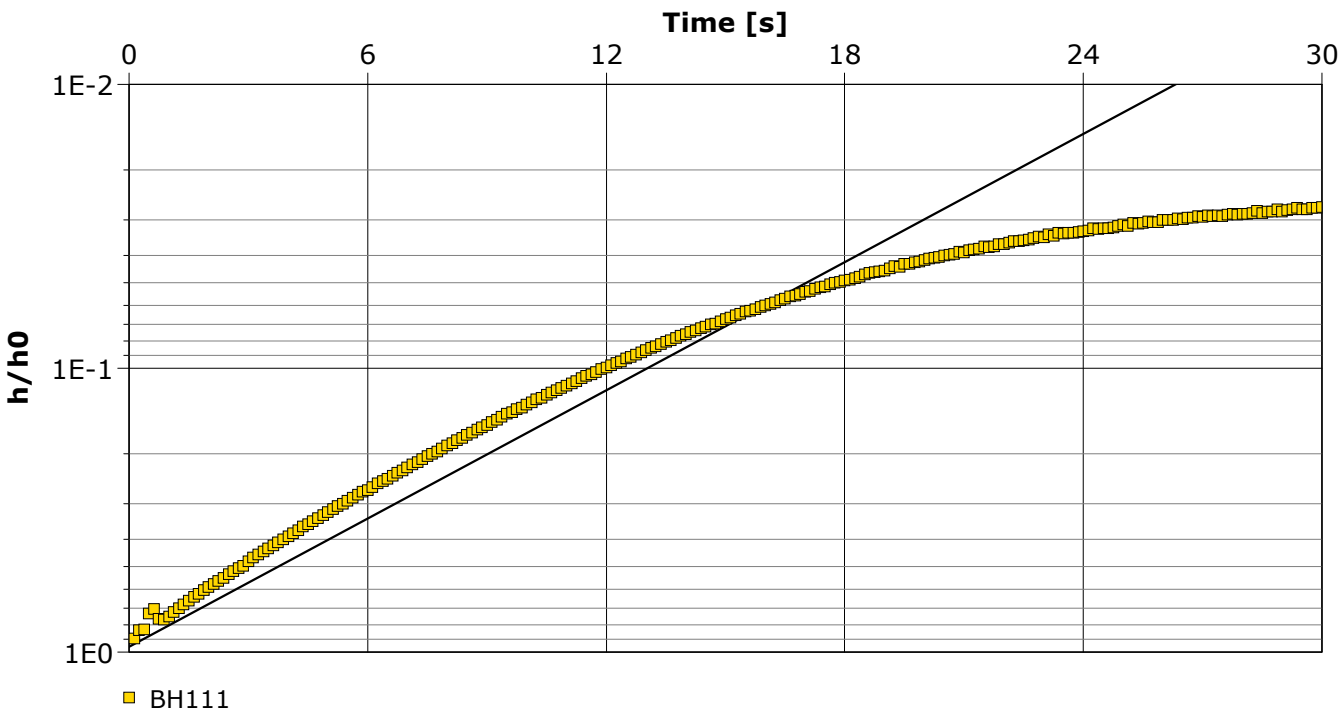
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH111 Test 2	Test Well: BH111
Test Conducted by: MC		Test Date: 2022-05-05
Analysis Performed by: JR	RHT 1	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH111	6.96×10^{-5}	

GROUNDED ENGINEERING

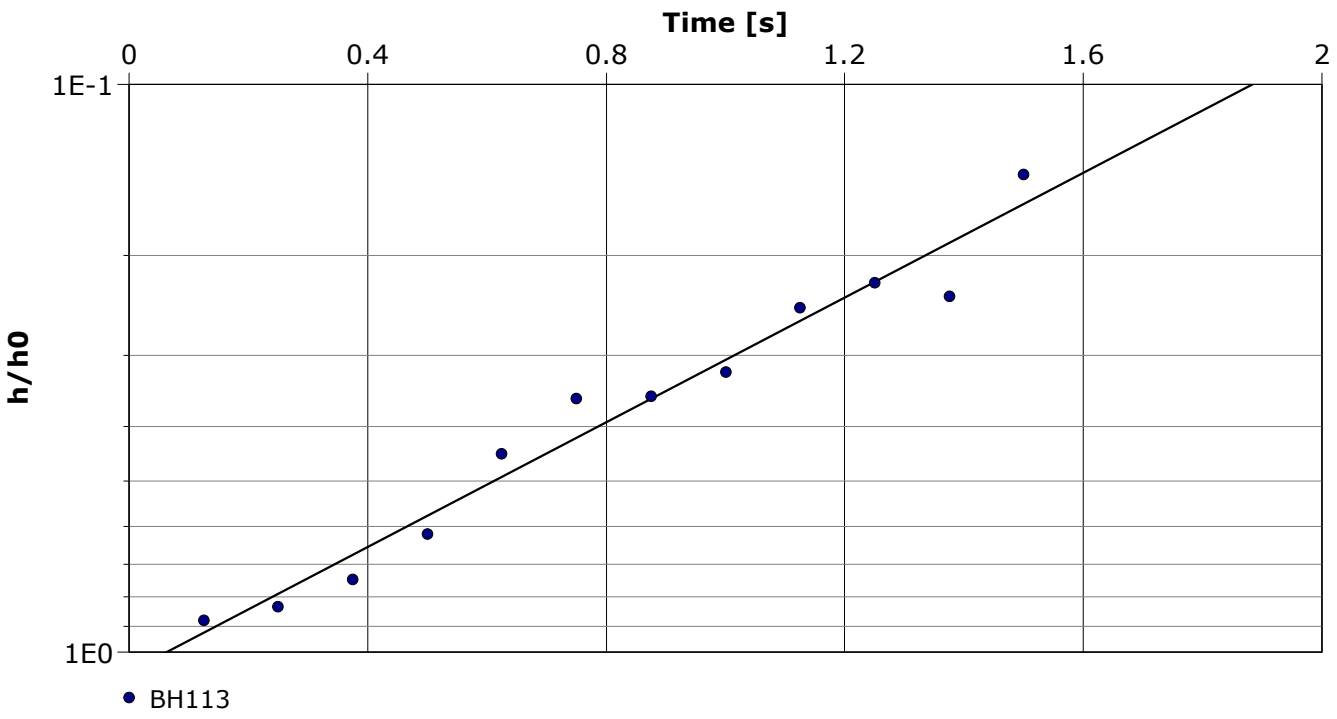
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH113 Test 1	Test Well: BH113
Test Conducted by: MC		Test Date: 2022-05-05
Analysis Performed by: JR	FHT 1	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH113	5.09×10^{-4}	

GROUNDED ENGINEERING

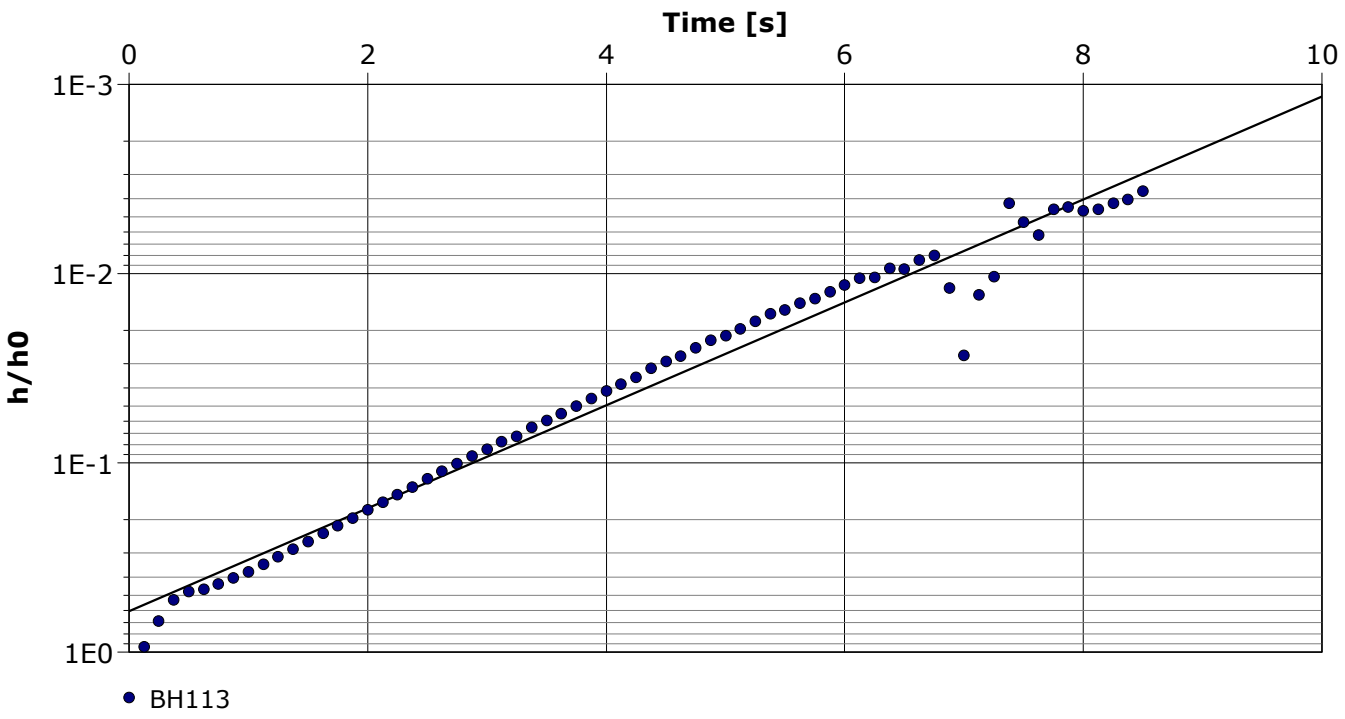
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH113 Test 2	Test Well: BH113
Test Conducted by: MC		Test Date: 2022-05-05
Analysis Performed by: JR	RHT 1	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH113	2.52×10^{-4}	

GROUNDED ENGINEERING

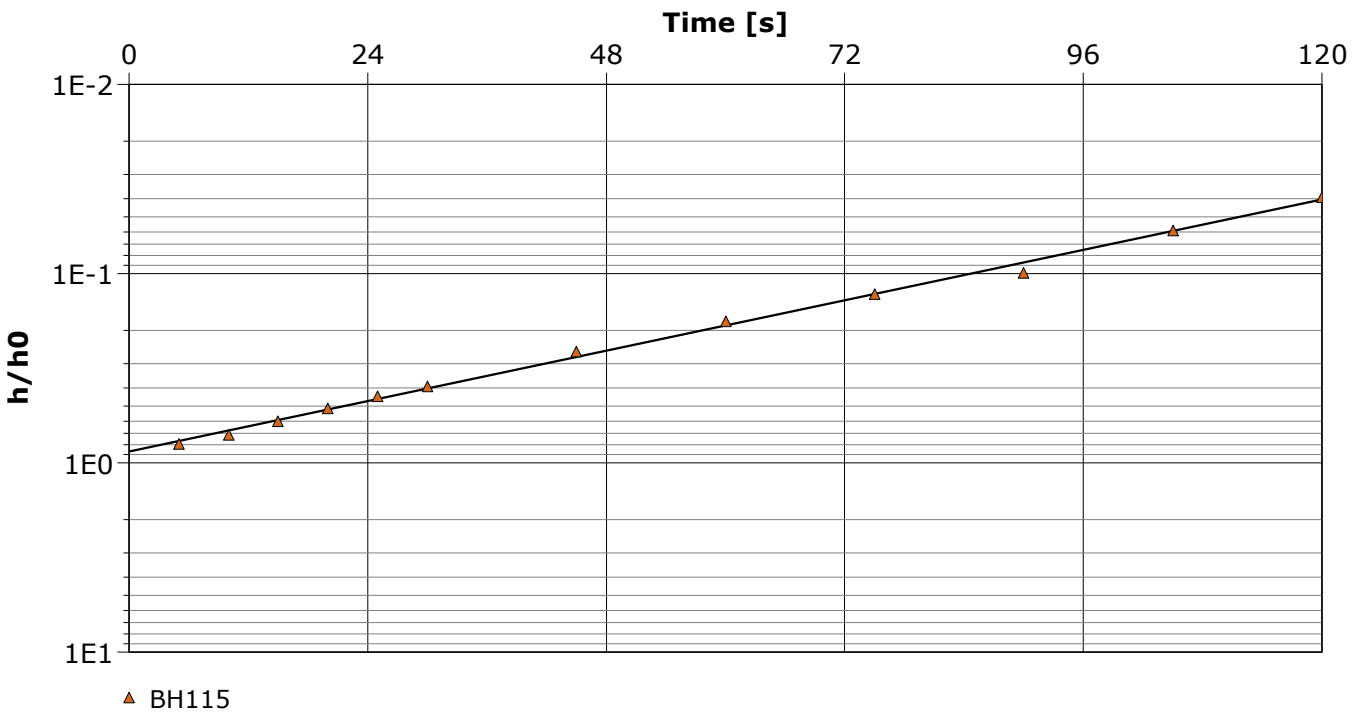
Slug Test Analysis Report

Project: 163-164 Edward St E

Number: 22-052

Client: Lamb Creemore Corp.

Location: Creemore, ON	Slug Test: BH115	Test Well: BH115
Test Conducted by: VT		Test Date: 2022-05-05
Analysis Performed by: JR	RHT 1	Analysis Date: 2022-06-24
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH115	1.08×10^{-5}	

APPENDIX J



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10 TOWNSHIP OF CLEARVIEW

10.1 INTRODUCTION

This chapter contains information on six drinking water systems for the Township of Clearview. Various consultants have completed the work presented, all of which was reviewed by South Georgian Bay Lake Simcoe Source Water Protection staff and members of the Technical Work Group. In this chapter, each of the groundwater systems and surface water systems is discussed separately for easier readability.

Each municipal system section begins with an introduction of the characteristics of the drinking water system. This includes an overview of the location, number of people served, and source of the water supply. The sections following the system introductions are comprised of a Vulnerability Assessment and Issues and Threats evaluation of the system. The Vulnerability assessment includes the delineation of the Vulnerable Area(s) (Wellhead Protection Area or Intake Protection Zone), and the assignment of Vulnerability Score for the delineated area. An Uncertainty Rating is also provided for the Vulnerable Area delineation and the Vulnerability Assessment as per Technical Rules 13-15 (Part I.4 – Uncertainty Analysis – Water Quality (MOE, 2008a)) to express the level of confidence in the results based on the information that was available for the study.

The Issues evaluation is intended to identify chemical parameters or pathogens in the raw drinking water that will limit the ability of the water to serve as a drinking water source either now, or in the future. Any Issues identified for the systems will be listed in this section, along with a map illustrating the Issues Contributing Area if an Issue is known. The Threats evaluation identifies potential Significant Drinking Water Threats within the delineated Vulnerable Areas. This process includes creating lists for Drinking Water Threats for Activities and Conditions, generating maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats, and a final enumeration of Significant Drinking Water Threats.

For more information, readers are encouraged to read Chapter 5: Methods Overview as well as, the responsible consultant reports and memos (found in Appendix MO and C) for a more in depth description of the methods used, as well as the Glossary for any unfamiliar terms.

10.2 DRINKING WATER SYSTEMS

The Township of Clearview, located in the northwest corner of Simcoe County, operates groundwater based water supplies in six (6) communities and does not have a surface water intake. As shown in Table 10-1 and Figure 10-1 all of the groundwater supplies are within the South Georgian Bay-Lake Simcoe (SGBLS) Source Protection Region (SPR). Table 10-1 also indicates the Source Protection Region and corresponding lead Source Protection Authority (SPA) for the municipal water supplies.

Table 10-1: Municipal Groundwater Supplies in the Township of Clearview.

Local Municipality	Community Water Supply	Drinking Water Information System (DWIS) Number	Source Water Aquifer	Number of Wells	Source Protection Region & Source Protection Authority (SPA)
Township of Clearview	Buckingham Woods	250001420	Confined overburden aquifer	3	SGBLS SPR & Nottawasaga Valley SPA
	Colling-Woodlands	260005398		5	
	Creemore	220001101		2	
	New Lowell	220003706		3	
	McKean Subdivision	260005411		4	
	Stayner	220001138		3	

10.3 BUCKINGHAM WOODS WELL SUPPLY

The Buckingham Woods Water Distribution System is on Lot 42, Concession 12 in the Township of Clearview and services an estimated 18 houses in the Buckingham Woods Subdivision. The water supply consists of three wells: Well 1, Well 2, and Well 3.

The Buckingham Woods Water Distribution System operates under Permit to Take Water 2214-6VARE6 issued on November 29, 2006 and valid to October 31, 2016. Wells 1 and 2 are permitted to pump at maximum rates of 91 L/min (131 m^3/day) and Well 3 is permitted to pump at a maximum rate of 85 L/min (122 m^3/day). Well 2 is a standby/backup well and has not recently been used. The wells can operate up to a maximum combined taking of 253 m^3/day. Well 3 has only been connected to the Buckingham Woods Water Distribution System more recently and therefore only limited information was provided on it.

Wells 1 and 2 were constructed in 1977 and 1978 respectively. Well 1 was drilled to a depth of 31.4 m below ground level (bgl) and screened from 13.1 mbgl to 15.5 mbgl. Well 2 was drilled to a depth of 16.8 mbgl and screened from 12.8 mbgl to 15.2 mbgl. Wells 1 and 2 were screened within a confined sand aquifer.

At the Buckingham Woods Water Distribution System, one aquifer was encountered. A clay aquitard extends from ground surface to approximately 12 mbgl. The aquitard confines a 4 m thick artesian sand aquifer. The aquifer is underlain by 15 m thick layer of clay which overlies limestone bedrock, observed at a depth of approximately 31 mbgl. Due to the flowing artesian conditions, the static water levels at Wells 1 and 2 are approximately at 0.6 m above ground level (agl) (2004).

The screen intervals for Wells 1, 2 and 3 have been assigned to the A3 Aquifer in the draft regional hydrostratigraphic model prepared by Golder and Aquaresource (2009). The Groundwater Vulnerability rating will be determined for the A3 Aquifer.

Information presented for the Buckingham Woods section of this Chapter is based on Genivar 2010a report.

10.3.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, which current (or future) Threats at the surface present the greatest risk to contaminate the water supply. The Vulnerability Analysis considers the WHPA and the Groundwater Vulnerability, as well as the potential for the vulnerability to be increased by man-made (anthropogenic) structures, through Transport Pathways, by developing a “Vulnerability Score” within the WHPA. Conversion of Vulnerability categories (High, Medium and Low) to Vulnerability Scores (10, 8, 6, 4 and 2) results in a new map for each WHPA that expresses the relative degree to which a Threat could affect the drinking water

supply. A higher value Vulnerability Score will always be assigned to the immediate vicinity of the well and to any areas that are shown to be vulnerable.

The Groundwater Vulnerability for the Buckingham Woods Water Supply has been delineated following the process recommended in the Technical Rules (MOE, 2008a). The areas that determined to contribute groundwater to the wells within 25 years were delineated as WHPA. The Groundwater Vulnerability within the WHPA was assessed and included consideration for the effects of man-made structures that may increase the vulnerability. The WHPA and the Vulnerability were considered together as per the Technical Rules to determine a Vulnerability Score for the Buckingham Woods WHPA. Details of the methods for the Vulnerability Analysis are provided in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO).

10.3.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for the Buckingham Woods Water Distribution System wells 1 and 2 were delineated in 2005 by Golder using a 2-dimensional analytical groundwater flow model. Well 3 was constructed and commissioned subsequent to the 2005 study. An updated survey of well locations was commissioned by SGBLS in 2009 to provide improved accuracy of the wells for delineation of the WHPA. Golder (2010) provided updated WHPA for Wells 1, Well 2 and Well 3 as shown in Figure 10a-1. WHPA delineation and adjustment details are documented in Genivar, 2010a.

WHPA-A has been added to include the 100 m radius from each municipal well. The Golder (2005) study delineated time-of-travel zones (TOT) for 50 days, 2 years, 10 years and 25 years. The updated WHPA as shown in Figure 10a-1 includes the 2 year, 5 year and 25 year TOT zones.

The WHPA reflect groundwater flow from southwest to northeast. This is reasonable based on available data describing regional groundwater flow patterns.

10.3.1.2 Groundwater Vulnerability

The Buckingham Woods Water Distribution System draws water from confined overburden aquifer layers (regional aquifer A3). The Groundwater Vulnerability for the municipal overburden aquifers was determined using the regional Aquifer Vulnerability Index (AVI methods outlined in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO). The regional Groundwater Vulnerability is illustrated in Technical Memorandum B1 – Regional Groundwater Vulnerability Mapping.

The Groundwater Vulnerability within the WHPA of the three municipal wells in the Buckingham Woods Water Distribution System is shown in Figure 10a-2. The Groundwater Vulnerability for the municipal water supply aquifers A3 within the WHPA is considered to be High beneath much of the delineated WHPA with areas of Medium Vulnerability observed near the municipal wells.

10.3.1.3 Transport Pathway Increase

Technical Memorandum A3 (Appendix MO) documents the consideration of Transport Pathways to increase the Vulnerability Rating as per the Technical Rules. The Vulnerability Rating can be increased from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial Transport Pathways to increase the observed vulnerability.

Private wells, and particularly wells that either do not contain seals that will prevent water from moving down around the outside of the well pipe, and wells that are no longer used and/or that have not been sealed present the greatest potential for increasing the rated Vulnerability. The available data from the Provincial Water Well Information System (WWIS) database was screened to identify wells that penetrate to the water supply aquifers and have potential to increase the Vulnerability of the natural stratigraphic profile. There is potential that other wells may exist that are not included in the database, particularly in areas now serviced by municipal water that formerly obtained water supply from private wells.

No wells were identified within the Buckingham Woods WHPA that are considered to have the potential to be a Transport Pathway. The majority of the delineated WHPA has a Vulnerability Rating of High and could not be increased further. The Groundwater Vulnerability map (Figure 10a-2) is therefore proposed to be used to generate the Vulnerability Scores.

10.3.1.4 WHPA-E / WHPA-F

None of the wells in this study have been identified as Groundwater Under the Direct Influence of surface water (GUDI), therefore delineation of a WHPA-E was not required. Since a WHPA-E was not required for any of the wells, the delineation of a WHPA-F was also not required.

10.3.1.5 Vulnerability Score

The WHPA zones for the Buckingham Woods Water Supply, as shown in Figure 10a-1, and the Groundwater Vulnerability, as shown in Figure 10a-2, were used to assign a Vulnerability Score by using the matrix from Table 5-3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 10a-3 illustrates the Vulnerability Scores for the Buckingham Woods WHPA. Figure 10a-3 will be used to assess Drinking Water Threats in Section 10.3.3.

10.3.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating of either High or Low be assigned with each Vulnerable Area as outlined in Technical Rules 13-15 (Part I.4 – Uncertainty Analysis – Water Quality (MOE, 2008a)). A component of the Uncertainty

Rating is to be provided for the WHPA delineation by the technical peer review consultant. A second component of the Uncertainty Rating is to be provided in association with the Vulnerability Assessment.

The uncertainty delineation of the Buckingham Woods WHPAs was determined by peer reviewers from Dillon Consulting using a standard scoring matrix (Table 1, Appendix MO). The Uncertainty Rating assigned for the Buckingham Woods WHPAs is High. The full results of the WHPA delineation Peer Review process, for Buckingham Woods is available in Appendix C and discussed in Chapter 5 (Methods Overview).

The assessment of the uncertainty for the Vulnerability Assessment considers the type, quantity and quality of available data, the methods used to determine the Groundwater Vulnerability, and the nature of the groundwater flow system.

The Uncertainty Rating assigned for the Vulnerability Assessment Component for the Buckingham Woods WHPA is High. The Vulnerability Rating for the Buckingham Woods Water Supply has been determined using decisions and assumptions that would err on the conservative side (higher Vulnerability Scores). In this case, the High Uncertainty Rating reflects that additional data to describe the continuity, thickness and types of soils within the delineated WHPA could potentially be used to improve the understanding of local hydrostratigraphy and to increase the confidence in the Vulnerability Analysis. For further information, refer to Technical Memorandum A1 (Appendix MO).

10.3.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals or pathogen) in the raw drinking water that will limit the ability of the water to serve as a drinking water source either now, or in the future. To be considered a Drinking Water Issue, a parameter needs to be at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water or if there is a trend of increasing concentrations of the parameter and a continuation of that trend that would result in the deterioration of the quality of the water as a source of drinking water (Technical Rule 114.(1)(a-b)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

Available data describing raw water quality and treated water quality for the Buckingham Woods Water Supply have been reviewed to identify Drinking Water Issues that are considered likely to result in a deterioration of the quality of water for use as a source of drinking water. Details of the Drinking Water Issues Evaluation for Buckingham Woods are provided in Technical Memorandum E1 – Drinking Water Issues Evaluation – Clearview (Appendix C).

No Drinking Water Issues were identified for the Buckingham Woods Water Supply.

Several parameters were observed on occasion or in low concentrations that are consistently less than the Ontario Drinking Water Quality Standard (ODWQS) values,

including aluminum, hardness, iron, manganese and turbidity. Trends of increasing concentrations that would exceed the ODWQS value within 50 years were not observed,

The rare presence of coliform bacteria in raw or treated water is not considered to represent a specific Drinking Water Issue as these parameters have only been rarely observed under circumstances that are not considered to be persistent.

10.3.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Buckingham Woods Water Supply was completed in accordance with the detailed methodology presented in Technical Memo – A5 (Appendix MO). A Drinking Water Threat is defined as "an Activity, or Condition that adversely affects or has the potential to adversely affect, the quality and quantity of any water that is or may be used as a source of drinking water, and includes any Activity or Condition that is prescribed by the regulations as a drinking water threat." An Activity is one or a series of related processes, natural or anthropogenic that occurs within a geographical area and may be related to a particular land use, whereas a Condition refers to the presence of a contaminant in the soil, sediment, or groundwater resulting from past activities. Therefore, it is not only presently existing Threats that must be regulated, but future ones as well.

The Drinking Water Threats Assessment for the Buckingham Woods Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes preparation of:

- A list of Drinking Water Threats for Activities,
- A list of Drinking Water Threats for Conditions,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Activities,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Conditions, and
- An enumeration of Drinking Water Threats.

10.3.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the Buckingham Woods Drinking Water Supply is provided in Chapter 5, section 5.5.1.

No additional Drinking Water Threats were identified for consideration. No local circumstances for prescribed Threats were identified.

10.3.3.2 List of Drinking Water Threats – Conditions

Methods used to assess Conditions are described in Technical Memorandum A5 (Appendix MO). The following information sources were consulted to identify existing Conditions that could affect the Buckingham Woods Water Supply system:

- Files provided by the Ministry of the Environment local offices pertaining to licenses, and records of spills in the area of the delineated WHPA.
- Records available from the Ministry of the Environment website containing registry of Brownfield Sites.
- Records from available technical studies and previous contaminant source inventories that identified situations that may qualify as conditions.
- Interviews of Township of Clearview staff to identify potential conditions within the identified WHPA for the drinking water supply.

No confirmed Conditions have been identified for the Buckingham Woods Water Supply. No potential Conditions have been identified for consideration at this time.

10.3.3.3 Identifying Areas of Significant/Moderate/Low Threats – Activities

The areas where Activities are or would be Drinking Water Threats are illustrated on a series of maps based on the Vulnerability Scores and Vulnerable Area delineations. The maps include references to a series of tables prepared by MOE to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php

10.3.3.3.1 Pathogen Parameters

The Key Table on Figure 10a-4 can be used in conjunction with the Vulnerability Scores to identify the areas where activities associated with pathogen Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Buckingham Woods Water Supply. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 10. Pathogens can also only be a Significant, Moderate or Low Threat within WHPA-A and WHPA-B.

10.3.3.3.2 Chemical Parameters

The Key Table on Figure 10a-5 can be used in conjunction with the Vulnerability Scores to identify the areas where activities associated with chemical Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Buckingham Woods Water Supply, Activities that are or would be Significant Drinking Water Threats for chemicals

can be observed within areas where the Vulnerability Score is equal to or greater than 8.

10.3.3.3.3 DNAPL Chemical Parameters

Figure 10a-6 illustrates the area of the 5-year time-of-travel zone (WHPA-C) and areas with a Vulnerability Score of 6, where activities associated with DNAPL parameters are considered to be a Significant Drinking Water Threat for the Buckingham Woods Water Supply. The Key Table on Figure 10a-6 can be used to can be used to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

10.3.3.4 Identifying Areas of Significant/Moderate/Low Threats – Conditions

Further to Section 10.3.3.2, no Conditions have been confirmed within the WHPA for the Buckingham Woods Water Supply.

A Condition or potential Condition that has not been identified would potentially be a Significant, Moderate, or Low Threat to Drinking Water based on the combination of Hazard Rating and Vulnerability Rating as described in Section 5.5.5 (Chapter 5: Methods Overview) and Technical Memorandum A5 (Appendix MO). The Hazard Rating is dependent on whether there is evidence the Condition is causing off-site contamination, and whether the Condition is located on the same property as the supply well.

A Condition would be a threat to municipal drinking water in the following situations:

- **Significant**: where the Vulnerability Score is ≥ 8 and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well.
- **Moderate**: (1) where the Vulnerability Score ≥ 6 and < 8, and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well; or (2) Where the Vulnerability Score is 10, and there is no evidence of off-site contamination.
- **Low**: Where the Vulnerability Score ≥ 8 and < 10 and there is no evidence of off-site contamination.

Figure 10a-3 illustrates the Vulnerability Score map for Buckingham Woods well supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

10.3.3.5 Enumerating Drinking Water Threats

The number of Significant Drinking Water Threats for the Buckingham Woods Water Supply has been determined using the methodology outlined in Technical Memorandum A5 (Appendix A). There are no Significant Threats associated with Conditions or Drinking Water Issues Table 10-2 documents the enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the WHPA for Well 1 and 2 for the Buckingham Woods Water Distribution System. There were no activities identified within the WHPA for Well 3 that would be considered to be potential Significant Drinking Water Threats. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is 10.

Six (6) activities that are considered to be potential Significant Drinking Water Threats were identified in association with six (6) land parcels in the WHPA for the Buckingham Woods Water Distribution System. Five (5) parcels are identified as having potential significant threat activities relating to residential land use via the use of private individual sewage disposal systems. One (1) threat activity and parcel has been included to represent the potential for subsurface storage of fuel for home heating purposes within the area where the Vulnerability Score is 10. There are five (5) residential parcels within this area.

Table 10-2: Number of Significant Drinking Water Threats for the Buckingham Woods Wells 1 and 2 Drinking Water Supply.

Enumeration of Significant Threats (Wellhead Protection Areas)					
Threat		Significant Threat Counts by Vulnerability Score			
		VS=10		WHPA B & C	
		# threats	# parcels	# threats	# parcels
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.				
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	5	5		
3	The application of agricultural source material to land.				
4	The storage of agricultural source material.				
5	The management of agricultural source material.				
6	The application of non-agricultural source material to land.				
7	The handling and storage of non-agricultural source material.				
8	The application of commercial fertilizer to land.				
9	The handling and storage of commercial fertilizer.				
10	The application of pesticide to land.				
11	The handling and storage of pesticide.				
12	The application of road salt.				
13	The handling and storage of road salt.				
14	The storage of snow.				
15	The handling and storage of fuel.	1	1		
16	The handling and storage of a dense non-aqueous phase liquid.				
17	The handling and storage of an organic solvent.				
18	The management of runoff that contains chemicals used in the de-icing of aircraft.				
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard.				
TOTAL		6	6	0	0
TOTAL NUMBER OF SIGNIFICANT THREATS:		**6**			
TOTAL PARCELS WITH SIGNIFICANT THREATS:		6			
Note: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel.					

10.3.3.5.1 Managed Lands

Technical Rule 16(9) (August 2009) requires the Assessment Report to include maps showing the location of Managed Lands and the percentage of Managed Lands within a Vulnerable Area, including WHPA-A, -B, -C, -D, and –E . This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

Managed Lands were identified and the Managed Lands proportions were determined for the WHPA of the Buckingham Woods Water Distribution System as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.3.3.5). The Managed Lands are used in the identification of threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material and commercial fertilizer

Figure 10a-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Buckingham Woods Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.3.3.5.2 Livestock Density

Technical Rule 16(10) (August 2009) requires the Assessment Report to include maps showing the livestock density within WHPA-A, -B, -C, -D, and –E. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The Livestock Density was determined for the delineated WHPA zones of the Buckingham Woods Water Distribution System as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.3.3.5). Nutrient Units per farm are used in the identification of Threat activities associated with the storage of Agricultural Source Material, and the grazing and/or confinement of livestock.

Figure 10a-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Buckingham Woods Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D. The Livestock Density figure reflects the distribution of Agricultural Managed Lands as determined in accordance with Technical Memorandum A5 (Appendix MO).

10.3.3.5.3 Impervious Surfaces

Technical Rule 16(11) (August 2009) requires the Assessment Report to include maps showing the percentage of surface area where road salt could be applied to Impervious Surfaces within WHPA-A, -B, -C, -D, and –E . This mapping is not required where the

Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The proportion of impervious surfaces within the delineated WHPA zones for the Buckingham Woods Water Distribution System was determined in accordance with the methodology in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.3.3.5). The Impervious Surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt).

Figure 10a-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Buckingham Woods Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.4 COLLING-WOODLANDS WELL SUPPLY

The Colling-woodlands Water Supply System is located on two wellfields (Lot 40, Concession 11 and Lot 40, Concession 12) in the Township of Clearview and services an estimated 70 houses in the Colling-woodlands Subdivision. The water supply consists of five wells: Well 1, Well 2, Well 3, Well 4, and Well 5.

The Colling-woodlands Water Supply System operate under Permit to Take Water 00-P-1069 issued on August 24, 2000. Wells 1, 2, 3, and 4 are permitted to pump at maximum rates of 45 L/min (65 m^3/day) and Well 5 is permitted to pump at a maximum rate of 68 L/min (98 m^3/day). The five wells can operate up to a maximum combined taking of 358 m^3/day.

Wells 1, 2, 3, 4, and 5 were constructed in 1981, 1980, 1986, 1986, and 1990, respectively. Well 1 was drilled to a depth of 8.2 m below ground level (bgl) and screened from 7.3 mbgl to 8.2 mbgl. Well 2 was drilled to a depth of 8.2 mbgl and screened from 7.3 mbgl to 8.2 mbgl. Well 3 was drilled to a depth of 8.5 mbgl and screened from 7.6 mbgl to 8.5 mbgl. Well 4 was drilled to a depth of 7.3 mbgl and screened from 6.4 mbgl to 7.3 mbgl. Well 5 was drilled to a depth of 11.3 mbgl and screened from 8.5 mbgl to 10.0 mbgl. Wells 1, 2, 4, and 5 were screened in a confined sand and gravel aquifer and Well 3 was screened in a confined sand aquifer.

At the Colling-woodlands Water Supply System, one aquifer was encountered. A stony clay aquitard extends from ground surface to approximately 7 mbgl. The aquitard confines an artesian sand aquifer, approximately 1.2 m thick at Wells 1 through 4 and 4 m thick at Well 5. The aquifer is underlain by 15 m thick layer of clay which overlies limestone bedrock, encountered at a depth of approximately 31 mbgl. Due to the flowing artesian conditions, the static water levels at Wells 1 through 5 were approximately at 0.2 m above ground level (agl) in 2004.

The screen intervals for Wells 1, 2, 4, and 5 have been assigned to the A4 Aquifer and the screen interval for Well 3 has been assigned to the A3 Aquifer in the draft regional hydrostratigraphic model prepared by Golder and Aquaresource (2009). The Groundwater Vulnerability rating will be determined for the A3 and A4 Aquifers.

Information presented for the Colling-woodlands section of this Chapter is based on Genivar 2010a report.

10.4.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, which current (or future) Threats at the surface present the greatest risk to contaminate the water supply. The Vulnerability Analysis considers the WHPA and the Groundwater Vulnerability, as well as the potential for the vulnerability to be increased by man-made (anthropogenic) structures, through Transport Pathways, by developing a “Vulnerability Score” within the WHPA. Conversion of Vulnerability categories (High, Medium and

Low) to Vulnerability Scores (10, 8, 6, 4 and 2) results in a new map for each WHPA that expresses the relative degree to which a Threat could affect the drinking water supply. A higher value Vulnerability Score will always be assigned to the immediate vicinity of the well and to any areas that are shown to be vulnerable.

The Groundwater Vulnerability for the Colling-woodlands Water Supply has been delineated following the process recommended in the Technical Rules (MOE, 2008a). The areas that determined to contribute groundwater to the wells within 25 years were delineated as WHPA. The Groundwater Vulnerability within the WHPA was assessed and included consideration for the effects of man-made structures that may increase the Vulnerability. The WHPA and the Vulnerability were considered together as per the Technical Rules to determine a Vulnerability Score for the Colling-woodlands WHPA. Details of the methods for the Vulnerability Analysis are provided in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO).

10.4.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for Well 1, Well 2, Well 3, Well 4 and Well 5 of the Colling-woodlands Water Supply System were delineated in 2005 by Golder using a 2-dimensional analytical groundwater flow model. An updated survey of well locations was commissioned by SGBLS in 2009 to provide improved accuracy for delineation of the WHPA. A minor translation was required to adjust the Colling-woodlands well locations and the WHPA. The updated well locations and the WHPA are shown in Figure 10b-1. WHPA delineation and adjustment details are documented in Genivar, 2010a.

WHPA-A has been added to include the 100 m radius from each municipal well. The Golder (2005) study delineated time-of-travel zones (TOT) for 50 days, 2 years, 10 years and 25 years. WHPA-C, representing the 5 year TOT zone, was estimated under this study as per Technical Memorandum A2 – 5 year Time-of-Travel Estimation Methods (Appendix MO). The 5 year TOT zone was estimated as the average velocity between the 2 year TOT zone and the extent of the delineated 10 year TOT zone. It is possible that the 10 year TOT zone may reflect steady-state capture in which case the length of the 5 year TOT zone may be underestimated.

The WHPA for Wells 1, 2, 3, 4 and 5 reflect groundwater flow from southwest to northeast. This is reasonable based on available data describing regional groundwater flow patterns.

10.4.1.2 Groundwater Vulnerability

The Colling-woodlands wells draw water from confined overburden aquifer layers (regional aquifer systems A3 and A4). The Groundwater Vulnerability for the municipal overburden aquifers in the area was determined using the regional Aquifer Vulnerability Index (AVI methods outlined in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO). The regional Groundwater Vulnerability is

illustrated in Technical Memorandum B1 – Regional Groundwater Vulnerability Mapping.

The Groundwater Vulnerability within the WHPA of the municipal wells in the Colling-woodlands Water Supply System is shown in Figure 10b-2. The Groundwater Vulnerability for the two municipal water supply aquifers within the WHPA is typically medium in the vicinity of the wells and varies between Low and Medium beneath WHPA-C and WHPA-D. The Groundwater Vulnerability at the outermost extent of WHPA-D was observed to be High. This would be consistent with the observation above that the WHPA may have achieved steady-state capture within this time interval.

10.4.1.3 Transport Pathway Increase

Technical Memorandum A3 (Appendix MO) documents the consideration of Transport Pathways to increase the Vulnerability Rating as per the Technical Rules. The Vulnerability Rating can be increased from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial Transport Pathways to increase the observed vulnerability.

Private wells, and particularly wells that either do not contain seals that will prevent water from moving down around the outside of the well pipe, and wells that are no longer used and/or that have not been sealed present the greatest potential for increasing the rated Vulnerability. The available data from the Provincial Water Well Information System (WWIS) database was screened to identify wells that penetrate to the water supply aquifers and have potential to increase the Vulnerability of the natural stratigraphic profile. There is potential that other wells may exist that are not included in the database, particularly in areas now serviced by municipal water that formerly obtained water supply from private wells.

No wells were identified within the Colling-woodlands WHPA that are considered to have the potential to be a Transport Pathway. The Groundwater Vulnerability map (Figure 10b-2) is therefore proposed to be used to generate the Vulnerability Scores.

10.4.1.4 WHPA-E / WHPA-F

None of the wells in this study have been identified as Groundwater Under the Direct Influence of surface water (GUDI), therefore delineation of a WHPA-E was not required. Since a WHPA-E was not required for any of the wells, the delineation of a WHPA-F was also not required.

10.4.1.5 Vulnerability Score

The WHPA zones for the Colling-woodlands Water Supply, as shown in Figure 10b-1, and the Groundwater Vulnerability, as shown in Figure 10b-2, were used to assign a Vulnerability Score by using the matrix from Table 5-3 (Chapter 5: Methods Overview,

Section 5.2.4). Figure 10b-3 illustrates the Vulnerability Scores for the Colling-woodlands WHPA. Figure 10b-3 will be used to assess Drinking Water Threats in Section 10.4.3. The observed pattern of Vulnerability Scores reflects that the increased Vulnerability at the maximum extent of the WHPA.

10.4.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating of either High or Low be assigned with each Vulnerable Area as outlined in Technical Rules 13-15 (Part I.4 – Uncertainty Analysis – Water Quality (MOE, 2008a)). A component of the Uncertainty Rating is to be provided for the WHPA delineation by the technical peer review consultant. A second component of the Uncertainty Rating is to be provided in association with the Vulnerability Assessment.

The uncertainty delineation of the Colling-woodlands WHPAs was determined by peer reviewers from Dillon Consulting using a standard scoring matrix (Table 1, Appendix MO). The Uncertainty Rating assigned for the Colling-woodlands WHPAs is High. The full results of the WHPA delineation Peer Review process, for Colling-woodlands is available in Appendix C and discussed in Chapter 5 (Methods Overview).

The assessment of the uncertainty for the Vulnerability Assessment considers the type, quantity and quality of available data, the methods used to determine the Groundwater Vulnerability, and the nature of the groundwater flow system.

The Uncertainty Rating assigned for the Vulnerability Assessment Component for the Colling-woodlands WHPA is High. The Vulnerability Rating for the Colling-woodlands Water Supply has been determined using decisions and assumptions that would err on the conservative side (higher Vulnerability Scores). In this case, the High Uncertainty Rating reflects that additional data to describe the continuity, thickness and types of soils within the delineated WHPA could potentially be used to improve the understanding of local hydrostratigraphy and to increase the confidence in the Vulnerability Analysis. For further information, refer to Technical Memorandum A1.

10.4.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify chemical or bacterial situations in the raw drinking water that will limit the ability of the water to serve as a drinking water source either now, or in the future. To be considered a Drinking Water Issue, a parameter needs to be at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water or if there is a trend of increasing concentrations of the parameter and a continuation of that trend that would result in the deterioration of the quality of the water as a source of drinking water (Technical Rule 114.(1)(a-b)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

Available data describing raw water quality and treated water quality for the Colling-woodlands Water Supply have been reviewed to identify Drinking Water Issues that are considered likely to result in a deterioration of the quality of water for use as a source of drinking water. Details of the Drinking Water Issues Evaluation for Colling-woodlands are provided in Technical Memorandum E1 – Drinking Water Issues Evaluation – Clearview (Appendix C).

No Drinking Water Issues were identified for the Colling-woodlands Water Supply.

Several parameters were observed on occasion or in low concentrations that are consistently less than the Ontario Drinking Water Quality Standard (ODWQS) values, including hardness, iron, methane and turbidity. Trends of increasing concentrations that would exceed the ODWQS value within 50 years were not observed,

Trihalomethanes are present in trace concentrations in the treated water as by-products of disinfection by chlorination. Trihalomethane concentrations are typically well below ODWQS values and do not display increasing trends.

Coliforms and *E. coli* have been detected in the raw water under conditions that are rare and not consistent. Treatment consisting of adequate filtration and disinfection is in place and maintained in accordance with Provincial standards set under the Safe Drinking Water Act. As this treatment is effective and detections are rare, the coliform bacteria are not considered to be Drinking Water Issues.

10.4.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Colling-woodlands Water Supply was completed in accordance with the detailed methodology presented in Technical Memo – A5 (Appendix MO). A Drinking Water Threat is defined as “an activity, or condition that adversely affects or has the potential to adversely affect, the quality and quantity of any water that is or may be used as a source of drinking water, and includes any activity or condition that is prescribed by the regulations as a drinking water threat.” An Activity is one or a series of related processes, natural or anthropogenic that occurs within a geographical area and may be related to a particular land use, whereas a Condition refers to the presence of a contaminant in the soil, sediment, or groundwater resulting from past activities. Therefore, it is not only presently existing Threats that must be regulated, but future ones as well.

The Drinking Water Threats Assessment for the Colling-woodlands Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes preparation of:

- A list of Drinking Water Threats for Activities,
- A list of Drinking Water Threats for Conditions,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Activities,

- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Conditions, and
- An enumeration of Drinking Water Threats.

10.4.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the Colling-woodlands Drinking Water Supply is provided in Chapter 5, section 5.5.1.

No additional Drinking Water Threats were identified for consideration. No local circumstances for prescribed Threats were identified.

10.4.3.2 List of Drinking Water Threats – Conditions

Methods used to assess Conditions are described in Technical Memorandum A5 (Appendix MO). The following information sources were consulted to identify existing Conditions that could affect the Colling-woodlands Water Supply system:

- Files provided by the Ministry of the Environment local offices pertaining to licenses, and records of spills in the area of the delineated WHPA.
- Records available from the Ministry of the Environment website containing registry of Brownfield Sites.
- Records from available technical studies and previous contaminant source inventories that identified situations that may qualify as conditions.
- Interviews of Township of Clearview staff to identify potential conditions within the identified WHPA for the drinking water supply.

No confirmed Conditions have been identified for the Colling-woodlands Water Supply. No potential Conditions have been identified for consideration at this time.

10.4.3.3 Identifying Areas of Significant/Moderate/Low Threats – Activities

The areas where Activities are or would be Drinking Water Threats are illustrated on a series of maps based on the Vulnerability Scores and Vulnerable Area delineations. The maps include references to a series of tables prepared by MOE to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php

10.4.3.3.1 Pathogen Parameters

The Key Table on Figure 10b-4 can be used in conjunction with the Vulnerability Scores to identify the areas where activities associated with pathogen Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Colling-woodlands Water Supply. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 10. Pathogens can also only be a Significant, Moderate or Low Threat within WHPA-A and WHPA-B.

10.4.3.3.2 Chemical Parameters

The Key Table on Figure 10b-5 can be used in conjunction with the Vulnerability Scores to identify the areas where activities associated with chemical Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Colling-woodlands Water Supply, Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is equal to or greater than 8.

10.4.3.3.3 DNAPL Chemical Parameters

Figure 10b-6 illustrates the area of the 5-year time-of-travel zone (WHPA-C) and areas with a Vulnerability Score of 6, where activities associated with DNAPL parameters are considered to be a Significant Drinking Water Threat for the Colling-woodlands Water Supply. The Key Table on Figure 10b-6 can be used to can be used to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

10.4.3.4 Identifying Areas of Significant/Moderate/Low Threats – Conditions

Further to Section 10.4.3.2, no Conditions have been confirmed within the WHPA for the Colling-woodlands Water Supply.

A Condition or potential Condition that has not been identified would potentially be a Significant, Moderate, or Low Threat to Drinking Water based on the combination of Hazard Rating and Vulnerability Rating as described in Section 5.5.5 (Chapter 5: Methods Overview) and Technical Memorandum A5 (Appendix MO). The Hazard Rating is dependent on whether there is evidence the Condition is causing off-site contamination, and whether the Condition is located on the same property as the supply well.

A Condition would be a threat to municipal drinking water in the following situations:

- **Significant**: where the Vulnerability Score is ≥ 8 and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well.
- **Moderate**: (1) where the Vulnerability Score ≥ 6 and < 8, and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well; or (2) Where the Vulnerability Score is 10, and there is no evidence of off-site contamination.
- **Low**: Where the Vulnerability Score ≥ 8 and < 10 and there is no evidence of off-site contamination.

Figure 10b-3 illustrates the Vulnerability Score map for Colling-woodlands well supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

10.4.3.5 Enumerating Drinking Water Threats

The number of Significant Drinking Water Threats for the Colling-woodlands Water Supply has been determined using the methodology outlined in Technical Memorandum A5 (Appendix MO). There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 10-3 documents the enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the WHPA for the Colling-woodlands Water Supply System. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is 10.

Fifteen (15) activities that are considered to be potential Significant Drinking Water Threats were identified in association with fifteen (15) land parcels in the WHPA for the Colling-woodlands Water Supply System. Fourteen (14) parcels were identified as having significant threat activities relating to residential landuse via the use of private individual sewage disposal systems. One (1) threat activity and parcel has been included to represent the potential for subsurface storage of fuel for home heating purposes within the area where the Vulnerability Score is 10. There are fourteen (14) residential parcels within this area.

Table 10-3: Number of Significant Drinking Water Threats for the Colling-woodlands Drinking Water Supply.

Enumeration of Significant Threats (Wellhead Protection Areas)					
Threat		Significant Threat Counts by Vulnerability Score			
		VS=10		WHPA B & C	
		# threats	# parcels	# threats	# parcels
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.				
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	14	14		
3	The application of agricultural source material to land.				
4	The storage of agricultural source material.				
5	The management of agricultural source material.				
6	The application of non-agricultural source material to land.				
7	The handling and storage of non-agricultural source material.				
8	The application of commercial fertilizer to land.				
9	The handling and storage of commercial fertilizer.				
10	The application of pesticide to land.				
11	The handling and storage of pesticide.				
12	The application of road salt.				
13	The handling and storage of road salt.				
14	The storage of snow.				
15	The handling and storage of fuel.	1	1		
16	The handling and storage of a dense non-aqueous phase liquid.				
17	The handling and storage of an organic solvent.				
18	The management of runoff that contains chemicals used in the de-icing of aircraft.				
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard.				
TOTAL		15	15	0	0
TOTAL NUMBER OF SIGNIFICANT THREATS:		**15**			
TOTAL PARCELS WITH SIGNIFICANT THREATS:		15			
Note: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel.					

10.4.3.5.1 Managed Lands

Technical Rule 16(9) (August 2009) requires the Assessment Report to include maps showing the location of Managed Lands and the percentage of Managed Lands within a Vulnerable Area, including WHPA-A, -B, -C, -D, and –E . This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

Managed Lands were identified and the Managed Lands proportions were determined for the WHPA of the Colling-woodlands Water Supply System as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.4.3.5). The Managed Lands is used in the identification of threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material and commercial fertilizer.

Figure 10b-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Colling-woodlands Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.4.3.5.2 Livestock Density

Technical Rule 16(10) (August 2009) requires the Assessment Report to include maps showing the livestock density within WHPA-A, -B, -C, -D, and –E. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The Livestock Density was determined for the delineated WHPA zones of the Colling-woodlands Water Supply System as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.4.3.5). Nutrient Units per farm are used in the identification of threat activities associated with the storage of Agricultural Source Material, and the grazing and/or confinement of livestock.

Figure 10b-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Colling-woodlands Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D. The Livestock Density figure reflects the distribution of Agricultural Managed Lands as determined in accordance with Technical Memorandum A5 (Appendix MO).

10.4.3.5.3 Impervious Surfaces

Technical Rule 16(11) (August 2009) requires the Assessment Report to include maps showing the percentage of surface area where road salt could be applied to Impervious Surfaces within WHPA-A, -B, -C, -D, and –E . This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The proportion of impervious surfaces within the delineated WHPA zones for the Colling-woodlands Water Supply System was determined in accordance with the methodology in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.4.3.5). The Impervious Surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt).

Figure 10b-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Colling-woodlands Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.5 CREEMORE WELL SUPPLY

The Creemore Water Distribution System is located on Mary Street in the Community of Creemore and services an estimated population of 13,000. The water supply consists of two wells: Well 1, and Well 2.

The Creemore Water Distribution System operates under Permit to Take Water 4101-6W6JVE issued on December 12, 2006 and expires on May 15, 2011. Wells 1 and 2 are permitted to pump at maximum rates of 1,023 L/min (1,473 m^3/day). The two wells can operate up to a maximum combined taking of 2,688 m^3/day.

Wells 1 and 2 were constructed in 1974 and 1995, respectively. Well 1 was screened from 42.6 mbgl to 45.6 mbgl. Well 2 was screened from 40.8 mbgl to 43.8 mbgl. The two wells were screened in the deeper aquifer of a combined aquifer unit.

At the Creemore Water Distribution System, two combined aquifers were encountered. An unconfined aquifer extends from ground surface do a depth of approximately 25 mbgl. This aquifer is underlain by another aquifer to form a combined, unconfined aquifer unit. The combined aquifers are underlain by shale bedrock, encountered at a depth of approximately 48 mbgl. Further from the site, the two aquifers are separated by a clay aquitard which bounds the upper aquifer and confines the deeper, regionally extensive aquifer. Further from Creemore, the confining clay aquitard extends from ground surface to approximately 20 mbgl. The static water levels at Wells 1 and 2 were approximately 3.4 m below top of casing (btoc) (2000) and 3.4 mbtoc (1995), respectively.

The screen intervals for Wells 1 and 2 have been assigned to the A4 Aquifer in the draft regional hydrostratigraphic model prepared by Golder and Aquaresource (2009). The Groundwater Vulnerability rating will be determined for the A4 Aquifer.

Information presented for the Creemore section of this Chapter is based on Genivar 2010a report.

10.5.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, which current (or future) Threats at the surface present the greatest risk to contaminate the water supply. The Vulnerability Analysis considers the WHPA and the Groundwater Vulnerability, as well as the potential for the vulnerability to be increased by man-made (anthropogenic) structures, through Transport Pathways, by developing a “Vulnerability Score” within the WHPA. Conversion of Vulnerability categories (High, Medium and Low) to Vulnerability Scores (10, 8, 6, 4 and 2) results in a new map for each WHPA that expresses the relative degree to which a Threat could affect the drinking water supply. A higher value Vulnerability Score will always be assigned to the immediate vicinity of the well and to any areas that are shown to be vulnerable.

The Groundwater Vulnerability for the Creemore Water Supply has been delineated following the process recommended in the Technical Rules (MOE, 2008a). The areas that determined to contribute groundwater to the wells within 25 years were delineated as WHPA. The Groundwater Vulnerability within the WHPA was assessed and included consideration for the effects of man-made structures that may increase the Vulnerability. The WHPA and the Vulnerability were considered together as per the Technical Rules to determine a Vulnerability Score for the Creemore WHPA. Details of the methods for the Vulnerability Analysis are provided in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO).

10.5.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for Well 1 and Well 2 in the Creemore Water Distribution System were delineated in 2005 by Golder using a 3-dimensional numerical groundwater flow model. An updated survey of well locations was commissioned by SGBLS in 2009 to provide improved accuracy for delineation of the WHPA. A minor translation was required to adjust the Creemore well locations and the WHPA. The updated well locations and the WHPA are shown in Figure 10c-1. WHPA delineation and adjustment details are documented in Genivar. 2010a.

WHPA-A has been added to include the 100 m radius from each municipal well. The Golder (2005) study delineated time-of-travel zones (TOT) for 50 days, 2 years, 10 years and 25 years. The 10 year TOT zone was used as WHPA-C1 for determination of Vulnerability Scores.

The WHPA for Wells 1 and 2 reflect groundwater flow from west to east. This is reasonable based on available data describing regional groundwater flow patterns.

10.5.1.2 Groundwater Vulnerability

The Creemore Water Distribution System draws water from unconfined overburden aquifer layers (regional aquifer systems A4). The Groundwater Vulnerability for the municipal overburden aquifers in the area was determined using the regional Aquifer Vulnerability Index (AVI methods outlined in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO). The regional Groundwater Vulnerability is illustrated in Technical Memorandum B1 – Regional Groundwater Vulnerability Mapping.

The Groundwater Vulnerability within the WHPA of the municipal wells in the Creemore Water Distribution System is shown in Figure 10c-2. The Groundwater Vulnerability for the two municipal water supply aquifers within the WHPA is considered to be Medium near the wells and much of WHPA-B. The Groundwater Vulnerability is High beneath much of the WHPA-C1 and WHPA-D.

10.5.1.3 Transport Pathway Increase

Technical Memorandum A3 (Appendix MO) documents the consideration of Transport Pathways to increase the Vulnerability Rating as per the Technical Rules. The Vulnerability Rating can be increased from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial Transport Pathways to increase the observed vulnerability.

Private wells, and particularly wells that either do not contain seals that will prevent water from moving down around the outside of the well pipe, and wells that are no longer used and/or that have not been sealed present the greatest potential for increasing the rated Vulnerability. The available data from the Provincial Water Well Information System (WWIS) database was screened to identify wells that penetrate to the water supply aquifers and have potential to increase the Vulnerability of the natural stratigraphic profile. There is potential that other wells may exist that are not included in the database, particularly in areas now serviced by municipal water that formerly obtained water supply from private wells.

No wells were identified within the Creemore WHPA are considered to have the potential to be a Transport Pathway. The Groundwater Vulnerability cannot be increased in areas where it has been assigned a value of High. The Groundwater Vulnerability map (Figure 10c-2) is therefore proposed to be used to generate the Vulnerability Scores.

10.5.1.4 WHPA-E / WHPA-F

None of the wells in this study have been identified as Groundwater Under the Direct Influence of surface water (GUDI), therefore delineation of a WHPA-E was not required. Since a WHPA-E was not required for any of the wells, the delineation of a WHPA-F was also not required.

10.5.1.5 Vulnerability Score

The WHPA zones for the Creemore Water Supply, as shown in Figure 10c-1, and the Groundwater Vulnerability, as shown in Figure 10c-2, were used to assign a Vulnerability Score by using the matrix from Table 5.3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 10c-3 illustrates the Vulnerability Scores for the Creemore WHPA. Figure 10c-3 will be used to assess Drinking Water Threats in Section 10.5.3.

10.5.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating of either High or Low be assigned with each Vulnerable Area as outlined in Technical Rules 13-15 (Part I.4 – Uncertainty Analysis – Water Quality (MOE, 2008a)). A component of the Uncertainty Rating is to be provided for the WHPA delineation by the technical peer review

consultant. A second component of the Uncertainty Rating is to be provided in association with the Vulnerability Assessment.

The uncertainty delineation of the Creemore WHPAs was determined by peer reviewers from Dillon Consulting using a standard scoring matrix (Table 1, Appendix MO). The Uncertainty Rating assigned for the Creemore WHPAs is High. The full results of the WHPA delineation Peer Review process, for Creemore is available in Appendix C and discussed in Chapter 5 (Methods Overview).

The assessment of the uncertainty for the Vulnerability Assessment considers the type, quantity and quality of available data, the methods used to determine the Groundwater Vulnerability, and the nature of the groundwater flow system.

The Uncertainty Rating assigned for the Vulnerability Assessment Component for the Creemore WHPA is High. The Vulnerability Rating for the Creemore Water Supply has been determined using decisions and assumptions that would err on the conservative side (higher Vulnerability Scores). In this case, the High Uncertainty Rating reflects that additional data to describe the continuity, thickness and types of soils within the delineated WHPA could potentially be used to improve the understanding of local hydrostratigraphy and to increase the confidence in the Vulnerability Analysis. For further information, refer to Technical Memorandum A1 (Appendix MO).

10.5.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals or pathogen) in the raw drinking water that will limit the ability of the water to serve as a drinking water source either now, or in the future. To be considered a Drinking Water Issue, a parameter needs to be at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water or if there is a trend of increasing concentrations of the parameter and a continuation of that trend that would result in the deterioration of the quality of the water as a source of drinking water (Technical Rule 114.(1)(a-b)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

Available data describing raw water quality and treated water quality for the Creemore Water Supply have been reviewed to identify Drinking Water Issues that are considered likely to result in a deterioration of the quality of water for use as a source of drinking water. Details of the Drinking Water Issues Evaluation for Creemore are provided in Technical Memorandum E1 – Drinking Water Issues Evaluation – Clearview (Appendix C).

No Drinking Water Issues were identified for the Creemore Water Supply.

Several parameters were observed on occasion or in low concentrations that are consistently less than the Ontario Drinking Water Quality Standard (ODWQS) values, including hardness. Trends of increasing concentrations that would exceed the ODWQS value within 50 years were not observed,

Sodium concentrations have exceeded the guideline of 20 mg/L used by the Medical Officer of Health for sodium restricted diets but are not projected to exceed the ODWQS objective of 200 mg/L within 50 years.

Trihalomethanes are present in trace concentrations in the treated water as by-products of disinfection by chlorination. Trihalomethane concentrations are typically well below ODWQS values and do not display increasing trends.

Coliforms have been detected in the raw water under conditions that are rare and not consistent. Treatment consisting of adequate filtration and disinfection is in place and maintained in accordance with Provincial standards set under the Safe Drinking Water Act. As this treatment is effective and detections are rare, the coliform bacteria are not considered to be Drinking Water Issues.

10.5.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Creemore Water Supply was completed in accordance with the detailed methodology presented in Technical Memo – A5 (Appendix MO). A Drinking Water Threat is defined as “an Activity, or Condition that adversely affects or has the potential to adversely affect, the quality and quantity of any water that is or may be used as a source of drinking water, and includes any Activity or Condition that is prescribed by the regulations as a drinking water threat.” An Activity is one or a series of related processes, natural or anthropogenic that occurs within a geographical area and may be related to a particular land use, whereas a Condition refers to the presence of a contaminant in the soil, sediment, or groundwater resulting from past activities. Therefore, it is not only presently existing Threats that must be regulated, but future ones as well.

The Drinking Water Threats Assessment for the Creemore Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes preparation of:

- A list of Drinking Water Threats for Activities,
- A list of Drinking Water Threats for Conditions,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Activities,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Conditions, and
- An enumeration of Drinking Water Threats.

10.5.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the Creemore Drinking Water Supply is provided in Chapter 5, section 5.5.1.

No additional Drinking Water Threats were identified for consideration. No local circumstances for prescribed Threats were identified.

10.5.3.2 List of Drinking Water Threats – Conditions

Methods used to assess Conditions are described in Technical Memorandum A5 (Appendix MO). The following information sources were consulted to identify existing Conditions that could affect the Creemore Water Supply system:

- Files provided by the Ministry of the Environment local offices pertaining to licenses, and records of spills in the area of the delineated WHPA.
- Records available from the Ministry of the Environment website containing registry of Brownfield Sites.
- Records from available technical studies and previous contaminant source inventories that identified situations that may qualify as conditions.
- Interviews of Township of Clearview staff to identify potential conditions within the identified WHPA for the drinking water supply.

No confirmed Conditions have been identified for the Creemore Water Supply. No potential Conditions have been identified for consideration at this time.

10.5.3.3 Identifying Areas of Significant/Moderate/Low Threats – Activities

The areas where Activities are or would be Drinking Water Threats are illustrated on a series of maps based on the Vulnerability Scores and Vulnerable Area delineations. The maps include references to a series of tables prepared by MOE to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php

10.5.3.3.1 Pathogen Parameters

The Key Table on Figure 10c-4 can be used in conjunction with the Vulnerability Scores to identify the areas where activities associated with pathogen Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Creemore Water Supply. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 10. Pathogens can also only be a Significant, Moderate or Low Threat within WHPA-A and WHPA-B.

10.5.3.3.2 Chemical Parameters

The Key Table on Figure 10c-5 can be used in conjunction with the Vulnerability Scores to identify the areas where activities associated with chemical Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Creemore Water Supply,

Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is equal to or greater than 8.

10.5.3.3.3 DNAPL Chemical Parameters

Figure 10c-6 illustrates the area of the 5-year time-of-travel zone (WHPA-C) and areas with a Vulnerability Score of 6, where activities associated with DNAPL parameters are considered to be a Significant Drinking Water Threat for the Creemore Water Supply. The Key Table on Figure 10c-6 can be used to can be used to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

10.5.3.4 Identifying Areas of Significant/Moderate/Low Threats – Conditions

Further to Section 10.5.3.2, no Conditions have been confirmed within the WHPA for the Creemore Water Supply.

A Condition or potential Condition that has not been identified would potentially be a Significant, Moderate, or Low Threat to Drinking Water based on the combination of Hazard Rating and Vulnerability Rating as described in Section 5.5.5 (Chapter 5: Methods Overview) and Technical Memorandum A5 (Appendix MO). The Hazard Rating is dependent on whether there is evidence the Condition is causing off-site contamination, and whether the Condition is located on the same property as the supply well.

A Condition would be a threat to municipal drinking water in the following situations:

- **Significant**: where the Vulnerability Score is ≥ 8 and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well.
- **Moderate**: (1) where the Vulnerability Score ≥ 6 and < 8, and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well; or (2) Where the Vulnerability Score is 10, and there is no evidence of off-site contamination.
- **Low**: Where the Vulnerability Score ≥ 8 and < 10 and there is no evidence of off-site contamination.

Figure 10c-3 illustrates the Vulnerability Score map for Creemore Water Supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

10.5.3.5 Enumerating Drinking Water Threats

The number of Significant Drinking Water Threats for the Creemore Water Supply has been determined using the methodology outlined in Technical Memorandum A5 (Appendix A). There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 10-4 documents the enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the WHPA for the Creemore Water Distribution System. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is 10 and for parcels within WHPA B & C that are identified as potentially having a threat related to Dense Non-Aqueous Phase Liquids (DNAPL).

Twenty-four (24) activities that are considered to be potential Significant Drinking Water Threats were identified in association with thirteen (13) land parcels in the WHPA for the Creemore Water Distribution System. Nine (9) parcels were identified as having potential significant threat activities relating to residential landuse via the use of private individual sewage disposal systems. One (1) threat activity and parcel has been included to represent the potential for subsurface storage of fuel for home heating purposes within the area where the Vulnerability Score is 10. There are nine (9) residential parcels within this area. One (1) parcel was identified for the potential application of agricultural source material and pesticide to land. Ten (10) parcels were identified for the potential application of commercial fertilizer to land as a result of the delineated managed land proportion for WHPA-A. Two (2) parcels within WHPA-C1 were identified as significant threat activities due to potential for handling/storage of DNAPL.

Table 10-4: Number of Significant Drinking Water Threats for the Creemore Drinking Water Supply.

Enumeration of Significant Threats (Wellhead Protection Areas)						
Threat		Significant Threat Counts by Vulnerability Score				
		VS=10		WHPA B & C		
		# threats	# parcels	# threats	# parcels	
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.					
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	9	9			
3	The application of agricultural source material to land.	1	1			
4	The storage of agricultural source material.					
5	The management of agricultural source material.					
6	The application of non-agricultural source material to land.					
7	The handling and storage of non-agricultural source material.					
8	The application of commercial fertilizer to land.	10	10			
9	The handling and storage of commercial fertilizer.					
10	The application of pesticide to land.	1	1			
11	The handling and storage of pesticide.					
12	The application of road salt.					
13	The handling and storage of road salt.					
14	The storage of snow.					
15	The handling and storage of fuel.	1	1			
16	The handling and storage of a dense non-aqueous phase liquid.			2	2	
17	The handling and storage of an organic solvent.					
18	The management of runoff that contains chemicals used in the de-icing of aircraft.					
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard.					
TOTAL		22	11	2	2	
TOTAL NUMBER OF SIGNIFICANT THREATS:		**24**				
TOTAL PARCELS WITH SIGNIFICANT THREATS:		13				
Note: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel.						

10.5.3.5.1 Managed Lands

Technical Rule 16(9) (August 2009) requires the Assessment Report to include maps showing the location of Managed Lands and the percentage of Managed Lands within a Vulnerable Area, including WHPA-A, -B, -C, -D, and –E . This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

Managed Lands were identified and the Managed Lands proportions were determined for the WHPA of the Creemore Water Distribution System as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.5.3.5). The Managed Lands are used in the identification of threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material and commercial fertilizer.

Figure 10c-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Creemore Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.5.3.5.2 Livestock Density

Technical Rule 16(10) (August 2009) requires the Assessment Report to include maps showing the livestock density within WHPA-A, -B, -C, -D, and –E. This mapping is not required where the vulnerability scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The Livestock Density was determined for the delineated WHPA zones of the Creemore Water Distribution System as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.5.3.5). Nutrient Units per farm are used in the identification of Threat activities associated with the storage of Agricultural Source Material, and the grazing and/or confinement of livestock.

Figure 10c-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Creemore Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D. The Livestock Density figure reflects the distribution of Agricultural Managed Lands as determined in accordance with Technical Memorandum A5 (Appendix MO).

10.5.3.5.3 Impervious Surfaces

Technical Rule 16(11) (August 2009) requires the Assessment Report to include maps showing the percentage of surface area where road salt could be applied to Impervious Surfaces within WHPA-A, -B, -C, -D, and –E . This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The proportion of Impervious Surfaces within the delineated WHPA zones for the Creemore Water Distribution System was determined in accordance with the methodology in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.5.3.5). The Impervious Surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt).

Figure 10c-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Creemore Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.6 NEW LOWELL WELL SUPPLY

The New Lowell Water Distribution System is located on two wellfields in the Community of New Lowell. The water supply consists of three wells: Well 1, Well 2 and Well 6. Two former wells, Well 3 and Well 4 were removed from the water supply system since the previous study by Golder Associates (2005).

The New Lowell Water Distribution System operates under a Permit to Take Water issued on February 6, 2001 that expires on March 31, 2011. Well 1 is permitted to pump at a maximum rate of 250 L/min (360 m^3/day), Well 2 is permitted to pump at a maximum rate of 150 L/min (216 m^3/day). Well 6 is permitted to pump at a maximum rate of 174 L/min (251 m^3/day). The wells can operate up to a maximum combined taking of 1,035 m^3/day. Wells 3 and 4 were abandoned in mid-2009.

Wells 1, 2, and 6 were constructed in 1978, 1978 and 1995, respectively. Well 1 was screened from 54.2 mbgl to 57.3 mbgl. Well 2 was screened from 58.5 mbgl to 60.1 mbgl. Well 6 was screened from 51.8 mbgl to 54.6 mbgl. The three wells were screened in a confined sand to gravelly sand aquifer.

At the New Lowell Water Distribution System, two aquifers were encountered. A localized confined sand to gravelly sand aquifer exists from approximately 50 mbgl to 65 mbgl. The aquifer is confined by a regionally extensive layer of clay and/or till and is underlain by a bedrock aquifer. The static water levels at Wells, 1, 2 and 6 were reported as 9.5 mbgl (1978), 12.1 mbgl (1978) and 13.9 mbgl (1995), respectively.

The screen intervals for Wells 1, 2 and 6 have been assigned to the A4 Aquifer in the draft regional hydrostratigraphic model prepared by Golder and Aquaresource (2009). The groundwater vulnerability rating has been determined for the A4 Aquifer.

Information presented for the New Lowell section of this Chapter is based on Genivar 2010a report.

10.6.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, which current (or future) Threats at the surface present the greatest risk to contaminate the water supply. The Vulnerability Analysis considers the WHPA and the Groundwater Vulnerability, as well as the potential for the vulnerability to be increased by man-made (anthropogenic) structures, through Transport Pathways, by developing a “Vulnerability Score” within the WHPA. Conversion of Vulnerability categories (High, Medium and Low) to Vulnerability Scores (10, 8, 6, 4 and 2) results in a new map for each WHPA that expresses the relative degree to which a Threat could affect the drinking water supply. A higher value Vulnerability Score will always be assigned to the immediate vicinity of the well and to any areas that are shown to be vulnerable.

The Groundwater Vulnerability for the New Lowell Water Supply has been delineated following the process recommended in the Technical Rules (MOE, 2008a). The areas that determined to contribute groundwater to the wells within 25 years were delineated

as WHPA. The Groundwater Vulnerability within the WHPA was assessed and included consideration for the effects of man-made structures that may increase the Vulnerability. The WHPA and the Vulnerability were considered together as per the Technical Rules to determine a Vulnerability Score for the New Lowell WHPA. Details of the methods for the Vulnerability Analysis are provided in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO).

10.6.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for Well 1, Well 2 and Well 6 in the New Lowell Water Distribution System were delineated in 2005 by Golder using a 2-dimensional analytical groundwater flow model. The delineated WHPA also considered the operation of Well 3 and Well 4 within the WHPA for Well1 and Well 2. Removal of Well 3 and Well 4 will result in the combined WHPA as determined in 2005 providing a more conservative estimate of the capture zone. Future work in this area should include a re-evaluation of the WHPA utilizing only the wells currently in operation. An updated survey of well locations was commissioned by SGBLS in 2009 to provide improved accuracy for delineation of the WHPA. A minor translation was required to adjust the New Lowell well locations and the WHPA. The updated well locations and the WHPA are shown in Figure 10d-1. WHPA delineation and adjustment details are documented in Genivar, 2010a.

WHPA-A has been added to include the 100 m radius from each municipal well. The Golder (2005) study delineated time-of-travel zones (TOT) for 50 days, 2 years, 10 years and 25 years. WHPA-C, representing the 5 year TOT zone, was estimated under this study as per Technical Memorandum A2 – 5 year Time-of-Travel Estimation Methods (Appendix MO).

The WHPA for Wells 1, 2 and 6 reflect groundwater flow from southwest to northeast. This is reasonable based on available data describing regional groundwater flow patterns.

10.6.1.2 Groundwater Vulnerability

The New Lowell Water Distribution System draws water from confined overburden aquifer layers (regional aquifer system A4). The Groundwater Vulnerability for the municipal overburden aquifers in the area was determined using the regional Aquifer Vulnerability Index (AVI methods outlined in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO). The regional Groundwater Vulnerability is illustrated in Technical Memorandum B1 – Regional Groundwater Vulnerability Mapping.

The Groundwater Vulnerability within the WHPA of the municipal wells in the New Lowell Water Distribution System is shown in Figure 10d-2. The Groundwater Vulnerability for the two municipal water supply aquifers within the WHPA is considered to be Low.

10.6.1.3 Transport Pathway Increase

Technical Memorandum A3 (Appendix MO) documents the consideration of Transport Pathways to increase the Vulnerability Rating as per the Technical Rules. The Vulnerability Rating can be increased from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial Transport Pathways to increase the observed vulnerability.

Private wells, and particularly wells that either do not contain seals that will prevent water from moving down around the outside of the well pipe, and wells that are no longer used and/or that have not been sealed present the greatest potential for increasing the rated Vulnerability. The available data from the Provincial Water Well Information System (WWIS) database was screened to identify wells that penetrate to the water supply aquifers and have potential to increase the Vulnerability of the natural stratigraphic profile. There is potential that other wells may exist that are not included in the database, particularly in areas now serviced by municipal water that formerly obtained water supply from private wells.

Four (4) wells were identified within the New Lowell WHPA that are considered to have the potential to be a transport pathway. The wells are located within areas of Low Vulnerability Rating. The Vulnerability Rating of the 30 m radius around each well has been increased from Low to Medium. One of the identified wells is within WHPA-A (the 100m radius) – the change in Vulnerability Rating will not influence the Vulnerability Score in this area. Mapping of the transport pathways and increased vulnerability were presented in the technical study completed by GENIVAR (2010). Ultimately the locations of transport pathways and increased vulnerability are reflected in the maps of Vulnerability Scores (See Section 10.6.1.5).

10.6.1.4 WHPA-E / WHPA-F

None of the wells in this study have been identified as Groundwater Under the Direct Influence of surface water (GUDI), therefore delineation of a WHPA-E was not required. Since a WHPA-E was not required for any of the wells, the delineation of a WHPA-F was also not required.

10.6.1.5 Vulnerability Score

The WHPA zones for the New Lowell Water Supply, as shown in Figure 10d-1, the Groundwater Vulnerability, as shown in Figure 10d-2, and the increased vulnerability discussed in Section 10.6.1.3, were used to assign a Vulnerability Score by using the matrix from Table 5-3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 10d-3 illustrates the Vulnerability Scores for the New Lowell WHPA. Figure 10d-3 will be used to assess Drinking Water Threats in Section 10.6.3. The Transport Pathways are illustrated as circles with 30 m radius in the WHPA.

10.6.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating of either High or Low be assigned with each Vulnerable Area as outlined in Technical Rules 13-15 (Part I.4 – Uncertainty Analysis – Water Quality (MOE, 2008a)). A component of the Uncertainty Rating is to be provided for the WHPA delineation by the technical peer review consultant. A second component of the Uncertainty Rating is to be provided in association with the Vulnerability Assessment.

The uncertainty delineation of the New Lowell WHPAs was determined by peer reviewers from Dillon Consulting using a standard scoring matrix (Table 1, Appendix MO). The Uncertainty Rating assigned for the New Lowell WHPAs is High. The full results of the WHPA delineation Peer Review process, for New Lowell is available in Appendix C and discussed in Chapter 5 (Methods Overview).

The assessment of the uncertainty for the Vulnerability Assessment considers the type, quantity and quality of available data, the methods used to determine the Groundwater Vulnerability, and the nature of the groundwater flow system.

The Uncertainty Rating assigned for the Vulnerability Assessment Component for the New Lowell WHPA is High. The Vulnerability Rating for the New Lowell Water Supply has been determined using decisions and assumptions that would err on the conservative side (higher Vulnerability Scores). In this case, the High Uncertainty Rating reflects that additional data to describe the continuity, thickness and types of soils within the delineated WHPA could potentially be used to improve the understanding of local hydrostratigraphy and to increase the confidence in the Vulnerability Analysis. For further information, refer to Technical Memorandum A1.

10.6.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify chemical or bacterial situations in the raw drinking water that will limit the ability of the water to serve as a drinking water source either now, or in the future. To be considered a Drinking Water Issue, a parameter needs to be at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water or if there is a trend of increasing concentrations of the parameter and a continuation of that trend that would result in the deterioration of the quality of the water as a source of drinking water (Technical Rule 114.(1)(a-b)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

Available data describing raw water quality and treated water quality for the New Lowell Water Supply have been reviewed to identify Drinking Water Issues that are considered likely to result in a deterioration of the quality of water for use as a source of drinking water. Details of the Drinking Water Issues Evaluation for New Lowell are provided in Technical Memorandum E1 – Drinking Water Issues Evaluation – Clearview (Appendix C).

No Drinking Water Issues were identified for the New Lowell Water Supply.

Several parameters were observed on occasion or in low concentrations that are consistently less than the Ontario Drinking Water Quality Standard (ODWQS) values, including ammonia, hardness, methane, organic nitrogen and sulphide. Trends of increasing concentrations that would exceed the ODWQS value within 50 years were not observed.

Sodium concentrations have exceeded the guideline of 20 mg/L used by the Medical Officer of Health for sodium restricted diets but are not projected to exceed the ODWQS objective of 200 mg/L within 50 years.

Trihalomethanes are present in trace concentrations in the treated water as by-products of disinfection by chlorination. Trihalomethane concentrations are typically well below ODWQS values and do not display increasing trends.

Coliforms have been detected in the raw water under conditions that are rare and not consistent. Treatment consisting of adequate filtration and disinfection is in place and maintained in accordance with Provincial standards set under the Safe Drinking Water Act. As this treatment is effective and detections are rare, the coliform bacteria are not considered to be Drinking Water Issues.

10.6.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the New Lowell Water Supply was completed in accordance with the detailed methodology presented in Technical Memo – A5 (Appendix MO). A Drinking Water Threat is defined as “an activity, or condition that adversely affects or has the potential to adversely affect, the quality and quantity of any water that is or may be used as a source of drinking water, and includes any activity or condition that is prescribed by the regulations as a drinking water threat.” An Activity is one or a series of related processes, natural or anthropogenic that occurs within a geographical area and may be related to a particular land use, whereas a Condition refers to the presence of a contaminant in the soil, sediment, or groundwater resulting from past activities. Therefore, it is not only presently existing Threats that must be regulated, but future ones as well.

The Drinking Water Threats Assessment for the New Lowell Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes preparation of:

- A list of Drinking Water Threats for Activities,
- A list of Drinking Water Threats for Conditions,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Activities,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Conditions, and
- An enumeration of Drinking Water Threats.

10.6.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the New Lowell Drinking Water Supply is provided in Chapter 5, section 5.5.1.

No additional Drinking Water Threats were identified for consideration. No local circumstances for prescribed Threats were identified.

10.6.3.2 List of Drinking Water Threats – Conditions

Methods used to assess Conditions are described in Technical Memorandum A5 (Appendix MO). The following information sources were consulted to identify existing Conditions that could affect the New Lowell Water Supply system:

- Files provided by the Ministry of the Environment local offices pertaining to licenses, and records of spills in the area of the delineated WHPA.
- Records available from the Ministry of the Environment website containing registry of Brownfield Sites.
- Records from available technical studies and previous contaminant source inventories that identified situations that may qualify as conditions.
- Interviews of Township of Clearview staff to identify potential conditions within the identified WHPA for the drinking water supply.

No confirmed Conditions have been identified for the New Lowell Water Supply. No potential Conditions have been identified for consideration at this time.

10.6.3.3 Identifying Areas of Significant/Moderate/Low Threats – Activities

The areas where Activities are or would be Drinking Water Threats are illustrated on a series of maps based on the Vulnerability Scores and Vulnerable Area delineations. The maps include references to a series of tables prepared by MOE to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php

10.6.3.3.1 Pathogen Parameters

The Key Table on Figure 10d-4 can be used in conjunction with the Vulnerability Scores to identify the areas where activities associated with pathogen Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the New Lowell Water Supply. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 10. Pathogens can also only be a Significant, Moderate or Low Threat within WHPA-A and WHPA-B.

10.6.3.3.2 Chemical Parameters

The Key Table on Figure 10d-5 can be used in conjunction with the Vulnerability Scores to identify the areas where activities associated with chemical Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the New Lowell Water Supply, Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is equal to or greater than 8.

10.6.3.3.3 DNAPL Chemical Parameters

Figure 10d-6 illustrates the area of the 5-year time-of-travel zone (WHPA-C) and areas with a Vulnerability Score of 6, where activities associated with DNAPL parameters are considered to be a Significant Drinking Water Threat for the New Lowell Water Supply. The Key Table on Figure 10d-6 can be used to can be used to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

10.6.3.4 Identifying Areas of Significant/Moderate/Low Threats – Conditions

Further to Section 10.6.3.2, no Conditions have been confirmed within the WHPA for the New Lowell Water Supply.

A Condition or potential Condition that has not been identified would potentially be a Significant, Moderate, or Low Threat to Drinking Water based on the combination of Hazard Rating and Vulnerability Rating as described in Section 5.5.5 (Chapter 5: Methods Overview) and Technical Memorandum A5 (Appendix MO). The Hazard Rating is dependent on whether there is evidence the Condition is causing off-site contamination, and whether the Condition is located on the same property as the supply well.

A Condition would be a threat to municipal drinking water in the following situations:

- **Significant**: where the Vulnerability Score is ≥ 8 and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well.
- **Moderate**: (1) where the Vulnerability Score ≥ 6 and < 8, and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well; or (2) Where the Vulnerability Score is 10, and there is no evidence of off-site contamination.
- **Low**: Where the Vulnerability Score ≥ 8 and < 10 and there is no evidence of off-site contamination.

Figure 10d-3 illustrates the Vulnerability Score map for New Lowell well supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

10.6.3.5 Enumerating Drinking Water Threats

The number of Significant Drinking Water Threats for the New Lowell Water Supply has been determined using the methodology outlined in Technical Memorandum A5 (Appendix MO). There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 10-5 and Table 10-6 document the enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the WHPA for the New Lowell Water Distribution System. Table 10-5 documents the enumeration for the WHPA at Wells 1 and 2, while Table 10-6 documents the enumeration for the WHPA at Well 6. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is 10.

Twenty-two (22) activities that are considered to be potential Significant Drinking Water Threats were identified in association with eleven (11) land parcels in the WHPA for Well 1 and 2 for the New Lowell Water Distribution System. Nine (9) parcels were identified as having potential significant threat activities relating to residential land use via the use of private individual sewage disposal systems. One (1) threat activity and parcel has been included to represent the potential for subsurface storage of fuel for home heating purposes within the area where the Vulnerability Score is 10. There are nine (9) residential parcels within this area. One (1) parcel was identified for the potential application of agricultural source material and pesticide to land. Ten (10) parcels were identified for the potential application of commercial fertilizer to land due to the identified managed lands proportion.

Twenty-six (26) activities that are considered to be potential Significant Drinking Water Threats were identified in association with twenty-six (26) land parcels in the WHPA for Well 6 of the New Lowell Water Distribution System. Twenty-five (25) parcels were identified as having potential significant threat activities relating to residential land use via the use of private individual sewage disposal systems. One (1) threat activity and parcel has been included to represent the potential for subsurface storage of fuel for home heating purposes within the area where the Vulnerability Score is 10. There are 25 residential parcels within this area.

Table 10-5: Number of Significant Drinking Water Threats for the New Lowell Wells 1 and 2 Drinking Water Supply.

Enumeration of Significant Threats (Wellhead Protection Areas)						
Threat		Significant Threat Counts by Vulnerability Score				
		VS=10		WHPA B & C		
		# threats	# parcels	# threats	# parcels	
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.					
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	9	9			
3	The application of agricultural source material to land.	1	1			
4	The storage of agricultural source material.					
5	The management of agricultural source material.					
6	The application of non-agricultural source material to land.					
7	The handling and storage of non-agricultural source material.					
8	The application of commercial fertilizer to land.	10	10			
9	The handling and storage of commercial fertilizer.					
10	The application of pesticide to land.	1	1			
11	The handling and storage of pesticide.					
12	The application of road salt.					
13	The handling and storage of road salt.					
14	The storage of snow.					
15	The handling and storage of fuel.	1	1			
16	The handling and storage of a dense non-aqueous phase liquid.					
17	The handling and storage of an organic solvent.					
18	The management of runoff that contains chemicals used in the de-icing of aircraft.					
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard.					
TOTAL		22	11	0	0	
TOTAL NUMBER OF SIGNIFICANT THREATS:		**22**				
TOTAL PARCELS WITH SIGNIFICANT THREATS:		11				
Note: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel.						

Table 10-6: Number of Significant Drinking Water Threats for the New Lowell Well 6 Drinking Water Supply.

Enumeration of Significant Threats (Wellhead Protection Areas)						
Threat		Significant Threat Counts by Vulnerability Score				
		VS=10		WHPA B & C		
		# threats	# parcels	# threats	# parcels	
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.					
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	25	25			
3	The application of agricultural source material to land.					
4	The storage of agricultural source material.					
5	The management of agricultural source material.					
6	The application of non-agricultural source material to land.					
7	The handling and storage of non-agricultural source material.					
8	The application of commercial fertilizer to land.					
9	The handling and storage of commercial fertilizer.					
10	The application of pesticide to land.					
11	The handling and storage of pesticide.					
12	The application of road salt.					
13	The handling and storage of road salt.					
14	The storage of snow.					
15	The handling and storage of fuel.	1	1			
16	The handling and storage of a dense non-aqueous phase liquid.					
17	The handling and storage of an organic solvent.					
18	The management of runoff that contains chemicals used in the de-icing of aircraft.					
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard.					
TOTAL		26	26	0	0	
TOTAL NUMBER OF SIGNIFICANT THREATS:		**26**				
TOTAL PARCELS WITH SIGNIFICANT THREATS:		26				
Note: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel.						

10.6.3.5.1 Managed Lands

Technical Rule 16(9) (August 2009) requires the Assessment Report to include maps showing the location of Managed Lands and the percentage of Managed Lands within a Vulnerable Area, including WHPA-A, -B, -C, -D, and –E . This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

Managed Lands were identified and the Managed Lands proportions were determined for the WHPA of the New Lowell Water Distribution System as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.6.3.5). The Managed Lands is used in the identification of threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material and commercial fertilizer.

Figure 10d-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the New Lowell Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.6.3.5.2 Livestock Density

Technical Rule 16(10) (August 2009) requires the Assessment Report to include maps showing the livestock density within WHPA-A, -B, -C, -D, and –E. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The Livestock Density was determined for the delineated WHPA zones of the New Lowell Water Distribution System as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.6.3.5). Nutrient Units per farm are used in the identification of threat activities associated with the storage of Agricultural Source Material, and the grazing and/or confinement of livestock.

Figure 10d-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the New Lowell Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D. The Livestock Density figure reflects the distribution of Agricultural Managed Lands as determined in accordance with Technical Memorandum A5 (Appendix MO).

10.6.3.5.3 Impervious Surfaces

Technical Rule 16(11) (August 2009) requires the Assessment Report to include maps showing the percentage of surface area where road salt could be applied to Impervious Surfaces within WHPA-A, -B, -C, -D, and –E . This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The proportion of Impervious Surfaces within the delineated WHPA zones for the New Lowell Water Distribution System was determined in accordance with the methodology in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.6.3.5). The Impervious Surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt).

Figure 10d-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the New Lowell Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.7 McKEAN SUBDIVISION WELL SUPPLY

The McKean Subdivision Water Distribution System is located on a single wellfield (Lot 35, Concession 8) in the Township of Clearview and services an estimated population of 500 (137 lots) in the McKean Subdivision. The water supply consists of three wells: Well 1, Well 2, and Well 3.

The McKean Subdivision Water Distribution System operates under Permit to Take Water 3237-6CQPT8 issued on May 27, 2005 and expires on May 31, 2010. Well 1 is permitted to pump at a maximum rate of 163 L/min (235 m^3/day), Well 2 is permitted to pump at a maximum rate of 114 L/min (164 m^3/day), and Well 3 is permitted to pump at a maximum rate of 456 L/min (657 m^3/day). The wells can operate up to a maximum combined taking of 1,055 m^3/day.

Wells 1, 2, and 3 were constructed in 1986, 1986, and 1989, respectively. Well 1 was screened from 12.8 mbgl to 16.8 mbgl. Well 2 was screened from 11.3 mbgl to 15.2 mbgl. Well 3 was screened from 8.6 mbgl to 13.2 mbgl. The three wells were screened in a confined aquifer.

At the McKean Subdivision Water Distribution System, two aquifers were encountered. An unconfined aquifer extends to a depth of approximately 2.0 mbgl to 4.0 mbgl. The unconfined aquifer extends to the north and west and pinches out to the south and east. A clayey-sand till aquitard underlies the aquifer and is approximately 0.6 m to 2.4 m thick. This aquitard increases to thicknesses of 10 m further from the wellfield. At the wellfield, the aquitard confines a localized artesian aquifer approximately 2 m to 10 m thick. Limestone and shale bedrock was encountered at a depth of approximately 50 m. The static water levels at Wells, 1, 2, and 3 were reported as approximately 1.0 mbgl (2004).

The screen intervals for Wells 1, 2, and 3 have been assigned to the A4 Aquifer in the draft regional hydrostratigraphic model prepared by Golder and Aquaresource (2009). The Groundwater Vulnerability rating will be determined for the A4 Aquifer.

Information presented for the McKean Subdivision section of this Chapter is based on Genivar 2010a report.

10.7.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, which current (or future) Threats at the surface present the greatest risk to contaminate the water supply. The Vulnerability Analysis considers the WHPA and the Groundwater Vulnerability, as well as the potential for the vulnerability to be increased by man-made (anthropogenic) structures, through Transport Pathways, by developing a “Vulnerability Score” within the WHPA. Conversion of Vulnerability categories (High, Medium and Low) to Vulnerability Scores (10, 8, 6, 4 and 2) results in a new map for each WHPA that expresses the relative degree to which a Threat could affect the drinking water

supply. A higher value Vulnerability Score will always be assigned to the immediate vicinity of the well and to any areas that are shown to be vulnerable.

The Groundwater Vulnerability for the McKean Water Supply has been delineated following the process recommended in the Technical Rules (MOE, 2008a). The areas that determined to contribute groundwater to the wells within 25 years were delineated as WHPA. The Groundwater Vulnerability within the WHPA was assessed and included consideration for the effects of man-made structures that may increase the Vulnerability. The WHPA and the Vulnerability were considered together as per the Technical Rules to determine a Vulnerability Score for the McKean WHPA. Details of the methods for the Vulnerability Analysis are provided in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO).

10.7.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for Well 1, Well 2 and Well 3 in the McKean Subdivision Water Distribution System were delineated in 2005 by Golder using a 2-dimensional analytical groundwater flow model. An updated survey of well locations was commissioned by SGBLS in 2009 to provide improved accuracy for delineation of the WHPA. A minor translation was required to adjust the McKean well locations and the WHPA. The updated well locations and the WHPA are shown in Figure 10e-1. WHPA delineation and adjustment details are documented in Genivar, 2010a.

WHPA-A has been added to include the 100 m radius from each municipal well. The Golder (2005) study delineated time-of-travel zones (TOT) for 50 days, 2 years, 10 years and 25 years. WHPA-C, representing the 5 year TOT zone, was estimated under this study as per Technical Memorandum A2 – 5 year Time-of-Travel Estimation Methods (Appendix MO).

The WHPA for Wells 1, 2 and 3 reflect groundwater flow from southwest to northeast. This is reasonable based on available data describing regional groundwater flow patterns.

10.7.1.2 Groundwater Vulnerability

The McKean Subdivision Water Distribution System draws water from overburden aquifer layers (regional aquifer system A4). The Groundwater Vulnerability for the municipal overburden aquifers in the area was determined using the regional Aquifer Vulnerability Index (AVI methods outlined in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO). The regional Groundwater Vulnerability is illustrated in Technical Memorandum B1 – Regional Groundwater Vulnerability Mapping.

The Groundwater Vulnerability within the WHPA of the municipal wells in the McKean Subdivision Water Distribution System is shown in Figure 10e-2. The Groundwater Vulnerability for the municipal water supply aquifer is considered to be High near the

municipal wells and much of WHPA-A and WHPA-B and Medium beneath WHPA-C and WHPA-D.

10.7.1.3 Transport Pathway Increase

Technical Memorandum A3 (Appendix MO) documents the consideration of Transport Pathways to increase the Vulnerability Rating as per the Technical Rules. The Vulnerability Rating can be increased from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial Transport Pathways to increase the observed vulnerability.

Private wells, and particularly wells that either do not contain seals that will prevent water from moving down around the outside of the well pipe, and wells that are no longer used and/or that have not been sealed present the greatest potential for increasing the rated Vulnerability. The available data from the Provincial Water Well Information System (WWIS) database was screened to identify wells that penetrate to the water supply aquifers and have potential to increase the Vulnerability of the natural stratigraphic profile. There is potential that other wells may exist that are not included in the database, particularly in areas now serviced by municipal water that formerly obtained water supply from private wells.

Approximately five wells were identified within the McKean WHPA that are considered to have the potential to be a Transport Pathway. The wells are located within areas of Medium or High Vulnerability Rating. The Vulnerability Rating of the 30 m radius around each well within the Medium Vulnerability can therefore be increased from Medium to High. The Vulnerability Rating where the Transport Pathways are located within the area of High Vulnerability cannot be increased further. Mapping of the transport pathways and increased vulnerability were presented in the technical study completed by GENIVAR (2010). Ultimately the locations of transport pathways and increased vulnerability are reflected in the maps of Vulnerability Scores (See Section 10.7.1.5).

10.7.1.4 WHPA-E / WHPA-F

None of the wells in this study have been identified as Groundwater Under the Direct Influence (GUDI), therefore delineation of a WHPA-E was not required. Since a WHPA-E was not required for any of the wells, the delineation of a WHPA-F was also not required.

10.7.1.5 Vulnerability Score

The WHPA zones for the McKean Water Supply, as shown in Figure 10e-1, the Groundwater Vulnerability, as shown in Figure 10e-2, and the increased vulnerability discussed in Section 10.7.1.3 were used to assign a Vulnerability Score by using the matrix from Table 5-3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 10e-3 illustrates the Vulnerability Scores for the McKean WHPA. Figure 10e-3 will be used to

assess Drinking Water Threats in Section 10.7.3. The Transport Pathways are illustrated as circles with 30 m radius in the WHPA.

10.7.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating of either High or Low be assigned with each Vulnerable Area as outlined in Technical Rules 13-15 (Part I.4 – Uncertainty Analysis – Water Quality (MOE, 2008a)). A component of the Uncertainty Rating is to be provided for the WHPA delineation by the technical peer review consultant. A second component of the Uncertainty Rating is to be provided in association with the Vulnerability Assessment.

The uncertainty delineation of the McKean WHPAs was determined by peer reviewers from Dillon Consulting using a standard scoring matrix (Table 1, Appendix MO). The Uncertainty Rating assigned for the McKean WHPAs is High. The full results of the WHPA delineation Peer Review process, for McKean is available in Appendix C and discussed in Chapter 5 (Methods Overview).

The assessment of the uncertainty for the Vulnerability Assessment considers the type, quantity and quality of available data, the methods used to determine the Groundwater Vulnerability, and the nature of the groundwater flow system.

The Uncertainty Rating assigned for the Vulnerability Assessment Component for the McKean WHPA is High. The Vulnerability Rating for the McKean Water Supply has been determined using decisions and assumptions that would err on the conservative side (higher Vulnerability Scores). In this case, the High Uncertainty Rating reflects that additional data to describe the continuity, thickness and types of soils within the delineated WHPA could potentially be used to improve the understanding of local hydrostratigraphy and to increase the confidence in the Vulnerability Analysis. For further information, refer to Technical Memorandum A1 (Appendix MO).

10.7.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals or pathogen) in the raw drinking water that will limit the ability of the water to serve as a drinking water source either now, or in the future. To be considered a Drinking Water Issue, a parameter needs to be at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water or if there is a trend of increasing concentrations of the parameter and a continuation of that trend that would result in the deterioration of the quality of the water as a source of drinking water (Technical Rule 114.(1)(a-b)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

Available data describing raw water quality and treated water quality for the McKean Water Supply have been reviewed to identify Drinking Water Issues that are considered likely to result in a deterioration of the quality of water for use as a source of drinking water. Details of the Drinking Water Issues Evaluation for McKean are provided in

Technical Memorandum E1 – Drinking Water Issues Evaluation – Clearview (Appendix C).

No Drinking Water Issues were identified for the McKean Water Supply.

Several parameters were observed on occasion or in low concentrations that are consistently less than the Ontario Drinking Water Quality Standard (ODWQS) values, including ammonia, hardness, iron, manganese, organic nitrogen and turbidity. Trends of increasing concentrations that would exceed the ODWQS value within 50 years were not observed,

Sodium concentrations have exceeded the guideline of 20 mg/L used by the Medical Officer of Health for sodium restricted diets but are not projected to exceed the ODWQS objective of 200 mg/L within 50 years.

Trihalomethanes are present in trace concentrations in the treated water as by-products of disinfection by chlorination. Trihalomethane concentrations are typically well below ODWQS values and do not display increasing trends.

Coliforms have been detected in the raw water under conditions that are rare and not consistent. Treatment consisting of adequate filtration and disinfection is in place and maintained in accordance with Provincial standards set under the Safe Drinking Water Act. As this treatment is effective and detections are rare, the coliform bacteria are not considered to be Drinking Water Issues.

10.7.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the McKean Water Supply was completed in accordance with the detailed methodology presented in Technical Memo – A5 (Appendix MO). A Drinking Water Threat is defined as “an Activity, or Condition that adversely affects or has the potential to adversely affect, the quality and quantity of any water that is or may be used as a source of drinking water, and includes any Activity or Condition that is prescribed by the regulations as a drinking water threat.” An Activity is one or a series of related processes, natural or anthropogenic that occurs within a geographical area and may be related to a particular land use, whereas a Condition refers to the presence of a contaminant in the soil, sediment, or groundwater resulting from past activities. Therefore, it is not only presently existing Threats that must be regulated, but future ones as well.

The Drinking Water Threats Assessment for the McKean Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes preparation of:

- A list of Drinking Water Threats for Activities,
- A list of Drinking Water Threats for Conditions,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Activities,

- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Conditions, and
- An enumeration of Drinking Water Threats.

10.7.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the McKean Drinking Water Supply is provided in Chapter 5, section 5.5.1.

No additional Drinking Water Threats were identified for consideration. No local circumstances for prescribed Threats were identified.

10.7.3.2 List of Drinking Water Threats – Conditions

Methods used to assess Conditions are described in Technical Memorandum A5 (Appendix MO). The following information sources were consulted to identify existing Conditions that could affect the McKean Water Supply system:

- Files provided by the Ministry of the Environment local offices pertaining to licenses, and records of spills in the area of the delineated WHPA.
- Records available from the Ministry of the Environment website containing registry of Brownfield Sites.
- Records from available technical studies and previous contaminant source inventories that identified situations that may qualify as conditions.
- Interviews of Township of Clearview staff to identify potential conditions within the identified WHPA for the drinking water supply.

No confirmed Conditions have been identified for the McKean Water Supply. No potential Conditions have been identified for consideration at this time.

10.7.3.3 Identifying Areas of Significant/Moderate/Low Threats – Activities

The areas where Activities are or would be Drinking Water Threats are illustrated on a series of maps based on the Vulnerability Scores and Vulnerable Area delineations. The maps include references to a series of tables prepared by MOE to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php

10.7.3.3.1 Pathogen Parameters

The Key Table on Figure 10e-4 can be used in conjunction with the Vulnerability Scores to identify the areas where activities associated with pathogen Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the McKean Water Supply.

Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 10. Pathogens can also only be a Significant, Moderate or Low Threat within WHPA-A and WHPA-B.

10.7.3.3.2 Chemical Parameters

The Key Table on Figure 10e-5 can be used in conjunction with the Vulnerability Scores to identify the areas where activities associated with chemical Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the McKean Water Supply, Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is equal to or greater than 8.

10.7.3.3.3 DNAPL Chemical Parameters

Figure 10e-6 illustrates the area of the 5-year time-of-travel zone (WHPA-C) and areas with a Vulnerability Score of 6, where activities associated with DNAPL parameters are considered to be a Significant Drinking Water Threat for the McKean Water Supply. The Key Table on Figure 10e-6 can be used to can be used to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

10.7.3.4 Identifying Areas of Significant/Moderate/Low Threats – Conditions

Further to Section 10.7.3.2, no Conditions have been confirmed within the WHPA for the McKean Water Supply.

A Condition or potential Condition that has not been identified would potentially be a Significant, Moderate, or Low Threat to Drinking Water based on the combination of Hazard Rating and Vulnerability Rating as described in Section 5.5.5 (Chapter 5: Methods Overview) and Technical Memorandum A5 (Appendix MO). The Hazard Rating is dependent on whether there is evidence the Condition is causing off-site contamination, and whether the Condition is located on the same property as the supply well.

A Condition would be a threat to municipal drinking water in the following situations:

- **Significant**: where the Vulnerability Score is ≥ 8 and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well.
- **Moderate**: (1) where the Vulnerability Score ≥ 6 and < 8, and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well; or (2) Where the Vulnerability Score is 10, and there is no evidence of off-site contamination.

- **Low**: Where the Vulnerability Score ≥ 8 and < 10 and there is no evidence of off-site contamination.

Figure 10e-3 illustrates the Vulnerability Score map for McKean well supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

10.7.3.5 Enumerating Drinking Water Threats

The number of Significant Drinking Water Threats for the McKean Water Supply has been determined using the methodology outlined in Technical Memorandum A5 (Appendix MO). There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 10-7 documents the enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the WHPA for the McKean Subdivision Water Distribution System. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is 10.

Forty-two (42) activities that are considered to be potential Significant Drinking Water Threats were identified in association with thirty-one (31) land parcels in the WHPA for the McKean Subdivision Water Distribution System. Twenty-nine (29) parcels were identified as having potential significant threat activities relating to residential landuse via the use of private individual sewage disposal systems. One (1) threat activity and parcel has been included to represent the potential for subsurface storage of fuel for home heating purposes within the area where the Vulnerability Score is 10. There are 29 residential parcels within this area. Nine (9) of the parcels that are intersected by WHPA-B were also identified for the potential application of commercial fertilizer to land as a result of the managed land proportion. One (1) parcel was identified for the potential application of agricultural source material, commercial fertilizer, and pesticide to land.

Table 10-7: Number of Significant Drinking Water Threats for the McKean Drinking Water Supply.

Enumeration of Significant Threats (Wellhead Protection Areas)					
Threat		Significant Threat Counts by Vulnerability Score			
		VS=10		WHPA B & C	
		# threats	# parcels	# threats	# parcels
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.				
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	29	29		
3	The application of agricultural source material to land.	1	1		
4	The storage of agricultural source material.				
5	The management of agricultural source material.				
6	The application of non-agricultural source material to land.				
7	The handling and storage of non-agricultural source material.				
8	The application of commercial fertilizer to land.	10	10		
9	The handling and storage of commercial fertilizer.				
10	The application of pesticide to land.	1	1		
11	The handling and storage of pesticide.				
12	The application of road salt.				
13	The handling and storage of road salt.				
14	The storage of snow.				
15	The handling and storage of fuel.	1	1		
16	The handling and storage of a dense non-aqueous phase liquid.				
17	The handling and storage of an organic solvent.				
18	The management of runoff that contains chemicals used in the de-icing of aircraft.				
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard.				
TOTAL		42	31	0	0
TOTAL NUMBER OF SIGNIFICANT THREATS:		**42**			
TOTAL PARCELS WITH SIGNIFICANT THREATS:		31			
Note: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel.					

10.7.3.5.1 Managed Lands

Technical Rule 16(9) (August 2009) requires the Assessment Report to include maps showing the location of Managed Lands and the percentage of Managed Lands within a Vulnerable Area, including WHPA-A, -B, -C, -D, and –E . This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

Managed Lands were identified and the Managed Lands proportions were determined for the WHPA of the McKean Subdivision Water Distribution System as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.7.3.5). The Managed Lands are used in the identification of threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material and commercial fertilizer.

Figure 10e-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the McKean Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.7.3.5.2 Livestock Density

Technical Rule 16(10) (August 2009) requires the Assessment Report to include maps showing the livestock density within WHPA-A, -B, -C, -D, and –E. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The Livestock Density was determined for the delineated WHPA zones of the McKean Subdivision Water Distribution System as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.7.3.5). Nutrient Units per farm are used in the identification of Threat activities associated with the storage of Agricultural Source Material, and the grazing and/or confinement of livestock.

Figure 10e-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the McKean Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D. The Livestock Density figure reflects the distribution of Agricultural Managed Lands as determined in accordance with Technical Memorandum A5 (Appendix MO).

10.7.3.5.3 Impervious Surfaces

Technical Rule 16(11) (August 2009) requires the Assessment Report to include maps showing the percentage of surface area where road salt could be applied to Impervious Surfaces within WHPA-A, -B, -C, -D, and –E . This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The proportion of impervious surfaces within the delineated WHPA zones for the McKean Subdivision Water Distribution System was determined in accordance with the methodology in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.7.3.5). The Impervious Surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt).

Figure 10e-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the McKean Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.8 STAYNER WELL SUPPLY

The Stayner Water Distribution System is located on two wellfields (Lot 24, Concession 1 and Lot 20, Concession 11) in the Township of Clearview and services an estimated population of 3,600 (1,575 units) in the Community of Stayner. The water supply consists of three wells: Well 1, Well 2, and Well 3. Well 3 is located beside Well 1 as shown in Figure 10f-1.

The Stayner Water Distribution System operates under Permit to Take Water 92-P-3011 issued on July 12, 2002 and expires on July 15, 2012. Well 1 is permitted to pump at a maximum rate of 909 L/min (1,309 m^3/day), and Wells 2 and 3 are permitted to pump at maximum rates of 1,818 L/min (2,618 m^3/day). The three wells can operate up to a maximum combined taking of 6,545 m^3/day.

Wells 1, 2, and 3 were constructed in 1967, 1968, and 1989, respectively. Well 1 was drilled to a depth of 28.0 m below ground level (bgl) and screened from 23.0 mbgl to 27.8 mbgl. Well 2 was drilled to a depth of 61.7 mbgl and screened from 25.7 mbgl to 31.3 mbgl. Well 3 was drilled to a depth of 39.0 mbgl and screened from 26.5 mbgl to 31.1 mbgl. Wells 1 and 2 are screened in a middle aquifer and Well 3 is screened in a lower aquifer.

At the Stayner Water Distribution System, three separate aquifers were observed, At the Well 2 location, a sandy clay with gravel aquitard, approximately 6 m thick, confines an upper aquifer (A4), approximately 18 m thick. This sand and gravel aquifer is under flowing artesian conditions and pinches out further from Well 2. A second aquitard consisting of stratified clay and sand and gravel extends approximately 8 m below the upper aquifer. The middle sand and gravel aquifer exists below this aquitard and is approximately 6 m at Well 2.

At Wells 1 and 3, a clay aquitard extends from ground level to approximately 6 m to 9 mbgl. This clay aquitard confines the middle sand and gravel aquifer (A2-A3), approximately 12 m thick at Wells 1 and 3.

This aquifer is underlain by a clay and till aquitard, approximately 5 m to 8 m thick. The clay and till aquitard confines the lower sand and gravel aquifer which is approximately 15 m thick. The upper aquifer is localized at Well 2 and the middle and lower aquifers are regionally extensive and vary in thicknesses. The static water levels at Well 3 was reported as approximately 17.7 m below top of casing (btoc) (2000).

The screen intervals for Wells 1, 2 and 3 have assigned to the A2, A4 and A3 Aquifers, respectively, in the draft regional hydrostratigraphic model prepared by Golder and Aquaresource (2009). The groundwater vulnerability rating will be determined for the A2, A3 and A4 Aquifers.

Information presented for the Stayner section of this Chapter is based on Genivar 2010a report.

10.8.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, which current (or future) Threats at the surface present the greatest risk to contaminate the water supply. The Vulnerability Analysis considers the WHPA and the Groundwater Vulnerability, as well as the potential for the vulnerability to be increased by man-made (anthropogenic) structures, through Transport Pathways, by developing a "Vulnerability Score" within the WHPA. Conversion of Vulnerability categories (High, Medium and Low) to Vulnerability Scores (10, 8, 6, 4 and 2) results in a new map for each WHPA that expresses the relative degree to which a Threat could affect the drinking water supply. A higher value Vulnerability Score will always be assigned to the immediate vicinity of the well and to any areas that are shown to be vulnerable.

The Groundwater Vulnerability for the Stayner Water Supply has been delineated following the process recommended in the Technical Rules (MOE, 2008a). The areas that determined to contribute groundwater to the wells within 25 years were delineated as WHPA. The Groundwater Vulnerability within the WHPA was assessed and included consideration for the effects of man-made structures that may increase the vulnerability. The WHPA and the Vulnerability were considered together as per the Technical Rules to determine a Vulnerability Score for the Stayner WHPA. Details of the methods for the Vulnerability Analysis are provided in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO).

10.8.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for Well 1, Well 2 and Well 3 in the Stayner Water Distribution System were delineated in 2005 by Golder using a 3-dimensional numerical groundwater flow model. An updated survey of well locations was commissioned by SGBLS in 2009 to provide improved accuracy for delineation of the WHPA. The updated well locations and the WHPA are shown in Figure 10f-1. WHPA delineation and adjustment details are documented in Genivar, 2010a.

WHPA-A has been added to include the 100 m radius from each municipal well. The Golder (2005) study delineated time-of-travel zones (TOT) for 50 days, 2 years, 10 years and 25 years. The 10 year TOT zone was used as WHPA-C1 for the determination of Vulnerability Scores.

The WHPA for Wells 1 and 3 reflect groundwater flow from southwest to northeast. The WHPA for Well 2 reflects groundwater flow from west to east. The groundwater flow patterns are reasonable based on available data describing regional groundwater flow patterns.

10.8.1.2 Groundwater Vulnerability

The Stayner Water Distribution System draws water from overburden aquifer layers (regional aquifer systems A2, A3 and A4). The Groundwater Vulnerability for the municipal overburden aquifers in the area was determined using the regional Aquifer Vulnerability Index (AVI methods outlined in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO). The regional Groundwater Vulnerability is illustrated in Technical Memorandum B1 – Regional Groundwater Vulnerability Mapping.

The Groundwater Vulnerability within the WHPA of the municipal wells in the Stayner Water Distribution System is shown in Figure 10f-2. The Groundwater Vulnerability for the municipal water supply aquifers within the WHPA was observed to vary from low to high. The Groundwater Vulnerability is typically Medium in the immediate vicinity of the wells and High beneath WHPA-D.

The AVI determined for Regional Aquifer A2 is used for the WHPA for Wells 1 and 3, and the AVI for Regional Aquifer A4 is used for the WHPA for Well 2. This results in a contrast in the vicinity of Well 2 between the relatively shallow aquifer that supplies water to Well 1 and the deeper aquifer that supplies water to Well 2. As only one WHPA is distinguished for the Well 1 and Well 3 well pair, the most conservative (highest) Vulnerability was associated with the aquifer that supplies Well 1 was used.

10.8.1.3 Transport Pathway Increase

Technical Memorandum A3 (Appendix MO) documents the consideration of Transport Pathways to increase the Vulnerability Rating as per the Technical Rules. The Vulnerability Rating can be increased from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial Transport Pathways to increase the observed vulnerability.

Private wells, and particularly wells that either do not contain seals that will prevent water from moving down around the outside of the well pipe, and wells that are no longer used and/or that have not been sealed present the greatest potential for increasing the rated Vulnerability. The available data from the Provincial Water Well Information System (WWIS) database was screened to identify wells that penetrate to the water supply aquifers and have potential to increase the Vulnerability of the natural stratigraphic profile. There is potential that other wells may exist that are not included in the database, particularly in areas now serviced by municipal water that formerly obtained water supply from private wells.

Three (3) wells were identified within the Stayner WHPA that are considered to have the potential to be a Transport Pathway. The wells are located within areas of Low and Medium Vulnerability Rating. The Vulnerability Rating of the 30 m radius around each well has been increased from Low to Medium or from Medium to High. Mapping of the transport pathways and increased vulnerability were presented in the technical study completed by GENIVAR (2010). Ultimately the locations of transport pathways and

increased vulnerability are reflected in the maps of Vulnerability Scores (See Section 10.8.1.5).

10.8.1.4 WHPA-E / WHPA-F

None of the wells in this study have been identified as Groundwater Under the Direct Influence (GUDI), therefore delineation of a WHPA-E was not required. Since a WHPA-E was not required for any of the wells, the delineation of a WHPA-F was also not required.

10.8.1.5 Vulnerability Score

The WHPA zones for the Stayner Water Supply, as shown in Figure 10f-1, the Groundwater Vulnerability, as shown in Figure 10f-2, and the increased vulnerability discussed in Section 10.8.1.3 were used to assign a Vulnerability Score by using the matrix from Table 5.3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 10f-3 illustrates the Vulnerability Scores for the Stayner WHPA. Figure 10f-3 will be used to assess Drinking Water Threats in Section 10.8.3. The Transport Pathways are illustrated as circles with 30 m radius in the WHPA.

10.8.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating of either High or Low be assigned with each Vulnerable Area as outlined in Technical Rules 13-15 (Part I.4 – Uncertainty Analysis – Water Quality (MOE, 2008a)). A component of the Uncertainty Rating is to be provided for the WHPA delineation by the technical peer review consultant. A second component of the Uncertainty Rating is to be provided in association with the Vulnerability Assessment.

The uncertainty delineation of the Stayner WHPAs was determined by peer reviewers from Dillon Consulting using a standard scoring matrix (Table 1, Appendix MO). The Uncertainty Rating assigned for the Stayner WHPAs is High. The full results of the WHPA delineation Peer Review process, for Stayner is available in Appendix C and discussed in Chapter 5 (Methods Overview).

The assessment of the uncertainty for the Vulnerability Assessment considers the type, quantity and quality of available data, the methods used to determine the Groundwater Vulnerability, and the nature of the groundwater flow system.

The Uncertainty Rating assigned for the Vulnerability Assessment Component for the Stayner WHPA is High. The Vulnerability Rating for the Stayner Water Supply has been determined using decisions and assumptions that would err on the conservative side (higher Vulnerability Scores). In this case, the High Uncertainty Rating reflects that additional data to describe the continuity, thickness and types of soils within the delineated WHPA could potentially be used to improve the understanding of local

hydrostratigraphy and to increase the confidence in the Vulnerability Analysis. For further information, refer to Technical Memorandum A1.

10.8.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify chemical or bacterial situations in the raw drinking water that will limit the ability of the water to serve as a drinking water source either now, or in the future. To be considered a Drinking Water Issue, a parameter needs to be at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water or if there is a trend of increasing concentrations of the parameter and a continuation of that trend that would result in the deterioration of the quality of the water as a source of drinking water (Technical Rule 114.(1)(a-b)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

Available data describing raw water quality and treated water quality for the Stayner Water Supply have been reviewed to identify Drinking Water Issues that are considered likely to result in a deterioration of the quality of water for use as a source of drinking water. Details of the Drinking Water Issues Evaluation for Stayner are provided in Technical Memorandum E1 – Drinking Water Issues Evaluation – Clearview (Appendix C).

No Drinking Water Issues were identified for the Stayner Water Supply.

Several parameters were observed on occasion or in low concentrations that are consistently less than the Ontario Drinking Water Quality Standard (ODWQS) values, including ammonia, hardness, iron and turbidity. Trends of increasing concentrations that would exceed the ODWQS value within 50 years were not observed,

The organic parameter *N*-Nitrosodimethylamine (NDMA) has been detected on rare occasions, and in trace concentrations, in the Well 2 raw water. Concentrations are well below ODWQS values and detections are not consistent.

Trihalomethanes are present in trace concentrations in the treated water as by-products of disinfection by chlorination. Trihalomethane concentrations are typically well below ODWQS values and do not display increasing trends.

Coliforms and *E. coli* have been detected in the raw water under conditions that are rare and not consistent. Treatment consisting of adequate filtration and disinfection is in place and maintained in accordance with Provincial standards set under the Safe Drinking Water Act. As this treatment is effective and detections are rare, the coliform and *E. coli* bacteria are not considered to be Drinking Water Issues.

10.8.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Stayner Water Supply was completed in accordance with the detailed methodology presented in Technical Memo – A5 (Appendix MO). A Drinking Water Threat is defined as “an activity, or condition that

adversely affects or has the potential to adversely affect, the quality and quantity of any water that is or may be used as a source of drinking water, and includes any activity or condition that is prescribed by the regulations as a drinking water threat." An Activity is one or a series of related processes, natural or anthropogenic that occurs within a geographical area and may be related to a particular land use, whereas a Condition refers to the presence of a contaminant in the soil, sediment, or groundwater resulting from past activities. Therefore, it is not only presently existing Threats that must be regulated, but future ones as well.

The Drinking Water Threats Assessment for the Stayner Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes preparation of:

- A list of Drinking Water Threats for Activities,
- A list of Drinking Water Threats for Conditions,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Activities,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Conditions, and
- An enumeration of Drinking Water Threats.

10.8.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the Stayner Drinking Water Supply is provided in Chapter 5, section 5.5.1.

No additional Drinking Water Threats were identified for consideration. No local circumstances for prescribed Threats were identified.

10.8.3.2 List of Drinking Water Threats – Conditions

Methods used to assess Conditions are described in Technical Memorandum A5 (Appendix MO). The following information sources were consulted to identify existing Conditions that could affect the Stayner Water Supply system:

- Files provided by the Ministry of the Environment local offices pertaining to licenses, and records of spills in the area of the delineated WHPA.
- Records available from the Ministry of the Environment website containing registry of Brownfield Sites.
- Records from available technical studies and previous contaminant source inventories that identified situations that may qualify as conditions.
- Interviews of Township of Clearview staff to identify potential conditions within the identified WHPA for the drinking water supply.

No confirmed Conditions have been identified for the Stayner Water Supply. No potential Conditions have been identified for consideration at this time.

10.8.3.3 Identifying Areas of Significant/Moderate/Low Threats – Activities

The areas where Activities are or would be Drinking Water Threats are illustrated on a series of maps based on the Vulnerability Scores and Vulnerable Area delineations. The maps include references to a series of tables prepared by MOE to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php

10.8.3.3.1 Pathogen Parameters

The Key Table on Figure 10f-4 can be used in conjunction with the Vulnerability Scores to identify the areas where activities associated with pathogen Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Stayner Water Supply. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 10. Pathogens can also only be a Significant, Moderate or Low Threat within WHPA-A and WHPA-B.

10.8.3.3.2 Chemical Parameters

The Key Table on Figure 10f-5 can be used in conjunction with the Vulnerability Scores to identify the areas where activities associated with chemical Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Stayner Water Supply, Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is equal to or greater than 8.

10.8.3.3.3 DNAPL Chemical Parameters

Figure 10f-6 illustrates the area of the 5-year time-of-travel zone (WHPA-C) and areas with a Vulnerability Score of 6, where activities associated with DNAPL parameters are considered to be a Significant Drinking Water Threat for the Stayner Water Supply. The Key Table on Figure 10f-6 can be used to can be used to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

10.8.3.4 Identifying Areas of Significant/Moderate/Low Threats – Conditions

Further to Section 10.8.3.2, no Conditions have been confirmed within the WHPA for the Stayner Water Supply.

A Condition or potential Condition that has not been identified would potentially be a Significant, Moderate, or Low Threat to Drinking Water based on the combination of Hazard Rating and Vulnerability Rating as described in Section 5.5.5 (Chapter 5: Methods Overview) and Technical Memorandum A5 (Appendix MO). The Hazard Rating is dependent on whether there is evidence the Condition is causing off-site contamination, and whether the Condition is located on the same property as the supply well.

A Condition would be a threat to municipal drinking water in the following situations:

- **Significant**: where the Vulnerability Score is ≥ 8 and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well.
- **Moderate**: (1) where the Vulnerability Score ≥ 6 and < 8, and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well; or (2) Where the Vulnerability Score is 10, and there is no evidence of off-site contamination.
- **Low**: Where the Vulnerability Score ≥ 8 and < 10 and there is no evidence of off-site contamination.

Figure 10f-3 illustrates the Vulnerability Score map for Stayner well supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

10.8.3.5 Enumerating Drinking Water Threats

The number of Significant Drinking Water Threats for the Stayner Water Supply has been determined using the methodology outlined in Technical Memorandum A5 (Appendix MO). There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 10-8 and Table 10-9 document the enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the WHPA for the Stayner Water Distribution System. Table 10-8 documents the enumeration for the WHPA for Wells 1 and 3. Table 10-9 documents the enumeration for the WHPA for Well 2. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is 10 and for parcels within WHPA B & C that are identified as potentially having a threat related to DNAPL.

Eleven (11) activities that are considered to be potential Significant Drinking Water Threats were identified in association with eleven (11) land parcels in the WHPA for Well 1 and 3 for the Stayner Water Distribution System. Eight (8) parcels were identified as having significant threat activities relating to residential land use via the use of private individual sewage disposal systems. Natural gas is available for use as a residential heating fuel in the Stayner community. In order to address the potential that some residents may not be connected to the natural gas system, one threat activity has

been considered within WHPA-A to reflect potential storage of fuel for home heating purposes on eight (8) residential parcels. One additional parcel was identified with potential for fuel storage relating to the observed land use. One parcel was also identified for potential handling/storage of DNAPL.

Six (6) activities that are considered to be potential Significant Drinking Water Threats were identified in association with three (3) land parcels in the WHPA for Well 2 of the Stayner Water Distribution System. One (1) parcel was identified as having significant threat activities relating to residential land use via the use of private individual sewage disposal systems and the potential storage of fuel for home heating purposes. Two (2) parcels were identified for the application of agricultural source material and pesticide to land.

Table 10-8: Number of Significant Drinking Water Threats for the Stayner Wells 1 and 3 Drinking Water Supply.

Enumeration of Significant Threats (Wellhead Protection Areas)					
Threat		Significant Threat Counts by Vulnerability Score			
		VS=10		WHPA B & C	
		# threats	# parcels	# threats	# parcels
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.				
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	8	8		
3	The application of agricultural source material to land.				
4	The storage of agricultural source material.				
5	The management of agricultural source material.				
6	The application of non-agricultural source material to land.				
7	The handling and storage of non-agricultural source material.				
8	The application of commercial fertilizer to land.				
9	The handling and storage of commercial fertilizer.				
10	The application of pesticide to land.				
11	The handling and storage of pesticide.				
12	The application of road salt.				
13	The handling and storage of road salt.				
14	The storage of snow.				
15	The handling and storage of fuel.	2	2		
16	The handling and storage of a dense non-aqueous phase liquid.			1	1
17	The handling and storage of an organic solvent.				
18	The management of runoff that contains chemicals used in the de-icing of aircraft.				
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard.				
TOTAL		10	10	1	1
TOTAL NUMBER OF SIGNIFICANT THREATS:		**11**			
TOTAL PARCELS WITH SIGNIFICANT THREATS:		11			
Note: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel.					

Table 10-9: Number of Significant Drinking Water Threats for the Stayner Well 2 Drinking Water Supply.

Enumeration of Significant Threats (Wellhead Protection Areas)					
Threat		Significant Threat Counts by Vulnerability Score			
		VS=10		WHPA B & C	
		# threats	# parcels	# threats	# parcels
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.				
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	1	1		
3	The application of agricultural source material to land.	2	2		
4	The storage of agricultural source material.				
5	The management of agricultural source material.				
6	The application of non-agricultural source material to land.				
7	The handling and storage of non-agricultural source material.				
8	The application of commercial fertilizer to land.				
9	The handling and storage of commercial fertilizer.				
10	The application of pesticide to land.	2	2		
11	The handling and storage of pesticide.				
12	The application of road salt.				
13	The handling and storage of road salt.				
14	The storage of snow.				
15	The handling and storage of fuel.	1	1		
16	The handling and storage of a dense non-aqueous phase liquid.				
17	The handling and storage of an organic solvent.				
18	The management of runoff that contains chemicals used in the de-icing of aircraft.				
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard.				
TOTAL		6	3	0	0
TOTAL NUMBER OF SIGNIFICANT THREATS:		**6**			
TOTAL PARCELS WITH SIGNIFICANT THREATS:		3			
Note: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel.					

10.8.3.5.1 Managed Lands

Technical Rule 16(9) (August 2009) requires the Assessment Report to include maps showing the location of Managed Lands and the percentage of Managed Lands within a Vulnerable Area, including WHPA-A, -B, -C, -D, and –E . This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

Managed Lands were identified and the Managed Lands proportions were determined for the WHPA of the Stayner Water Distribution System as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.8.3.5). The Managed Lands is used in the identification of threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material and commercial fertilizer.

Figure 10f-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Stayner Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.8.3.5.2 Livestock Density

Technical Rule 16(10) (August 2009) requires the Assessment Report to include maps showing the livestock density within WHPA-A, -B, -C, -D, and –E. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The Livestock Density was determined for the delineated WHPA zones of the Stayner Water Distribution System as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.8.3.5). Nutrient Units per farm are used in the identification of threat activities associated with the storage of Agricultural Source Material, and the grazing and/or confinement of livestock.

Figure 10f-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Stayner Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D. The Livestock Density figure reflects the distribution of Agricultural Managed Lands as determined in accordance with Technical Memorandum A5 (Appendix MO).

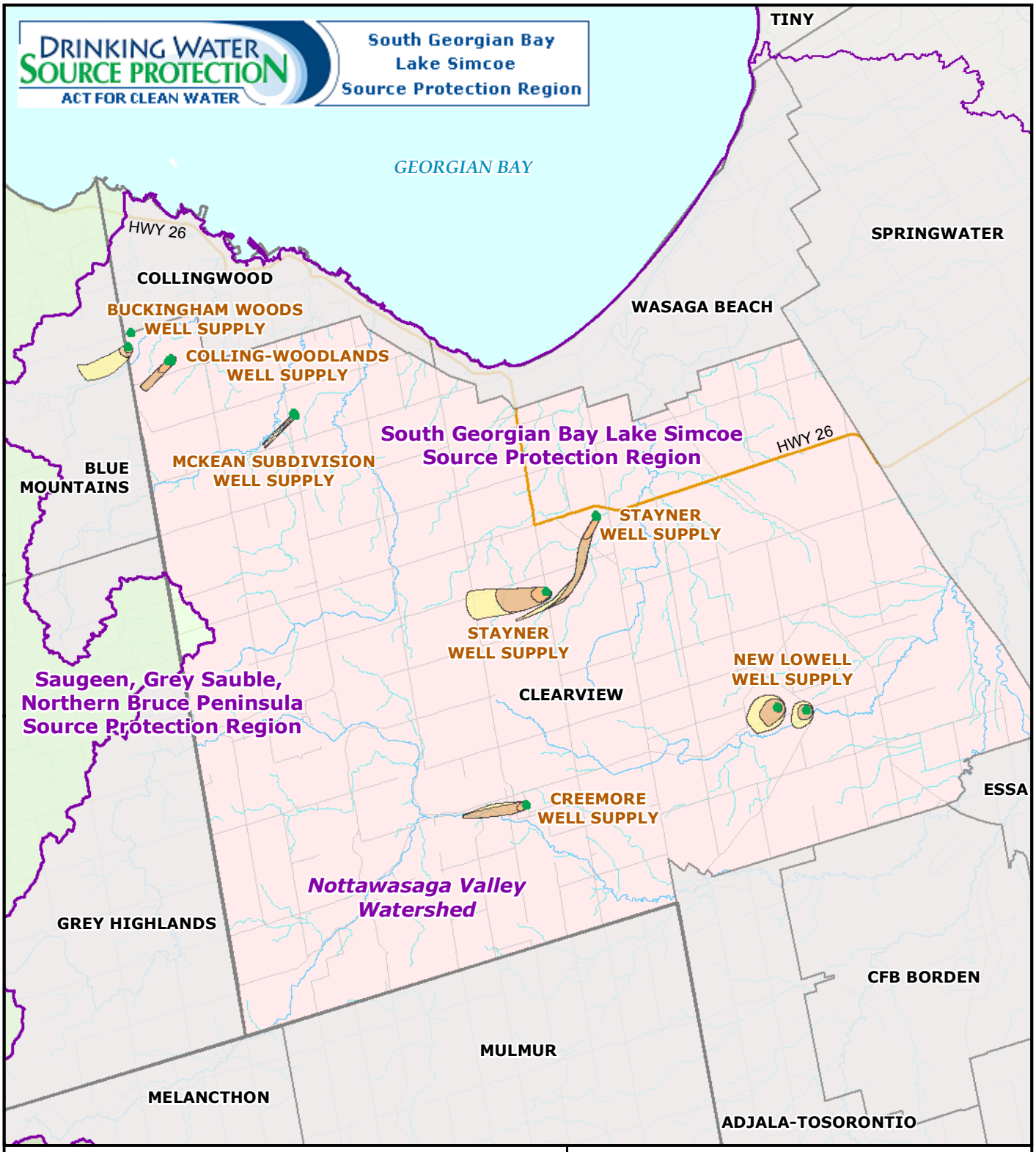
10.8.3.5.3 Impervious Surfaces

Technical Rule 16(11) (August 2009) requires the Assessment Report to include maps showing the percentage of surface area where road salt could be applied to Impervious Surfaces within WHPA-A, -B, -C, -D, and –E . This mapping is not required where the

Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The proportion of impervious surfaces within the delineated WHPA zones for the Stayner Water Distribution System was determined in accordance with the methodology in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.8.3.5). The Impervious Surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt).

Figure 10f-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Stayner Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.



- Municipal Supply Well in Township of Clearview
- WHPA-A (100m)
- WHPA-B (2 years time of travel)
- WHPA-C (5 years time of travel)
- WHPA-C1 (10 years time of travel)
- WHPA-D (25 years time of travel)
- SWP Watershed Region
- SWP Watershed Area
- Municipality Boundary

Drinking Water System Vulnerable Areas in Township of Clearview

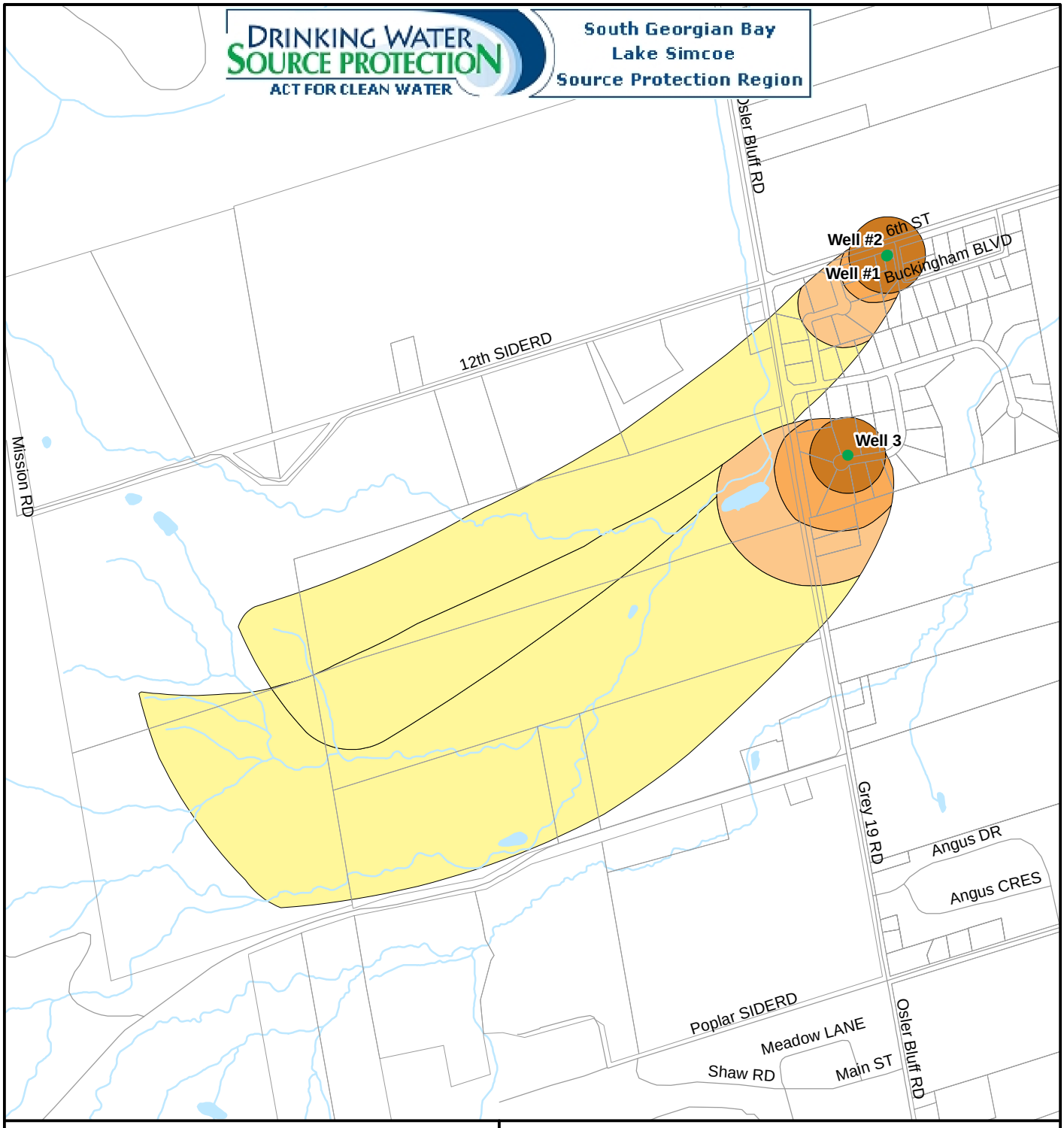
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This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Fig 10-1



Legend

- MUNICIPAL WELL LOCATION
- WHPA-A: 100 m RADIUS
- WHPA-B: 2-YEAR TIME-OF-TRAVEL
- WHPA-C: 5-YEAR TIME-OF-TRAVEL
- WHPA-D: 25-YEAR TIME-OF-TRAVEL

N W E S

200 100 0 200 Metres

WELLHEAD PROTECTION AREAS - BUCKINGHAM WOODS, CLEARVIEW

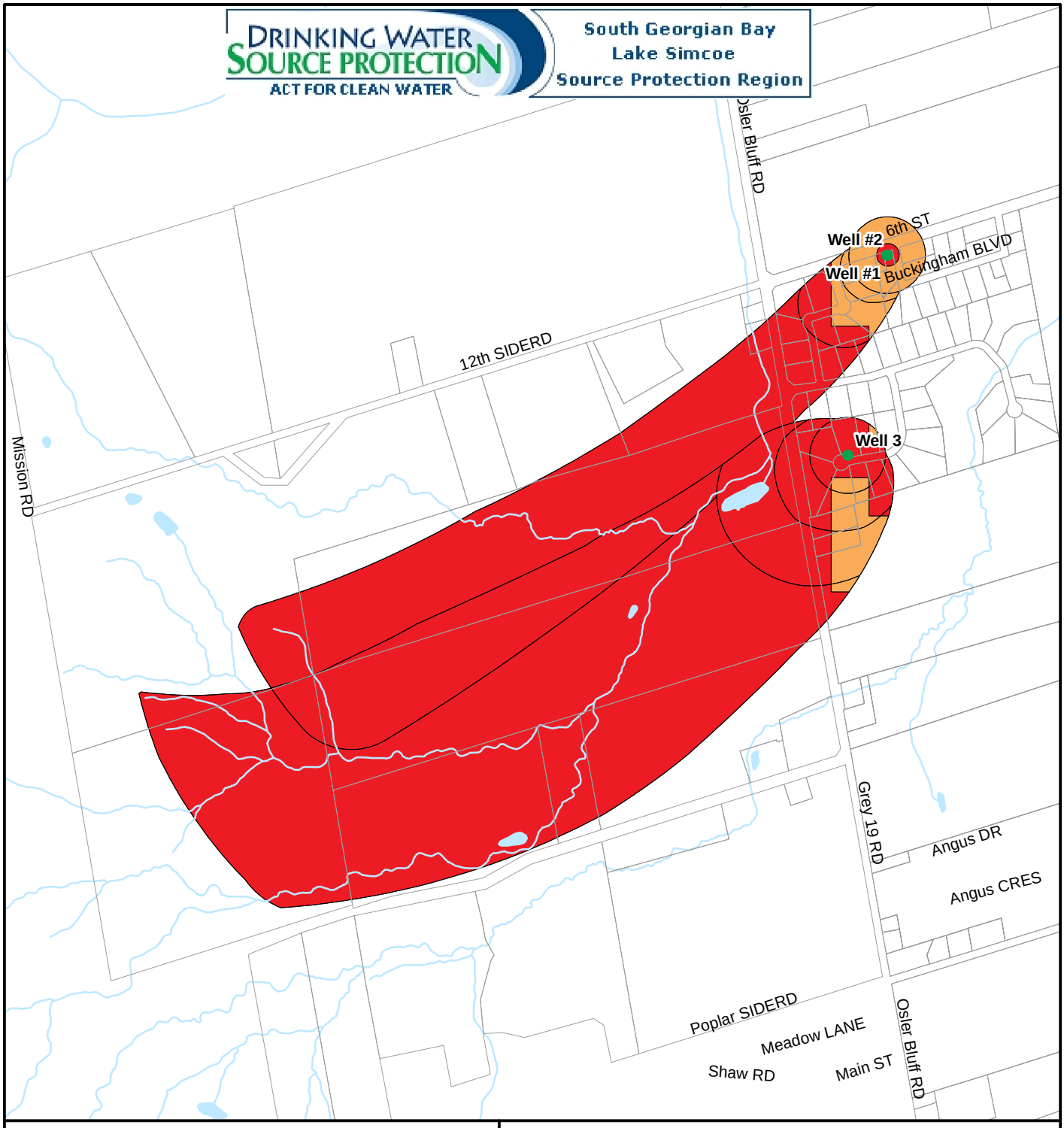
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.1-1

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GENIVAR Ontario

FIGURE **10a-1**



LEGEND

- MUNICIPAL WELL LOCATION

AQUIFER VULNERABILITY INDEX

- HIGH
- MEDIUM
- LOW

N W E S

200 100 0 200 Metres

GROUNDWATER VULNERABILITY - BUCKINGHAM WOODS

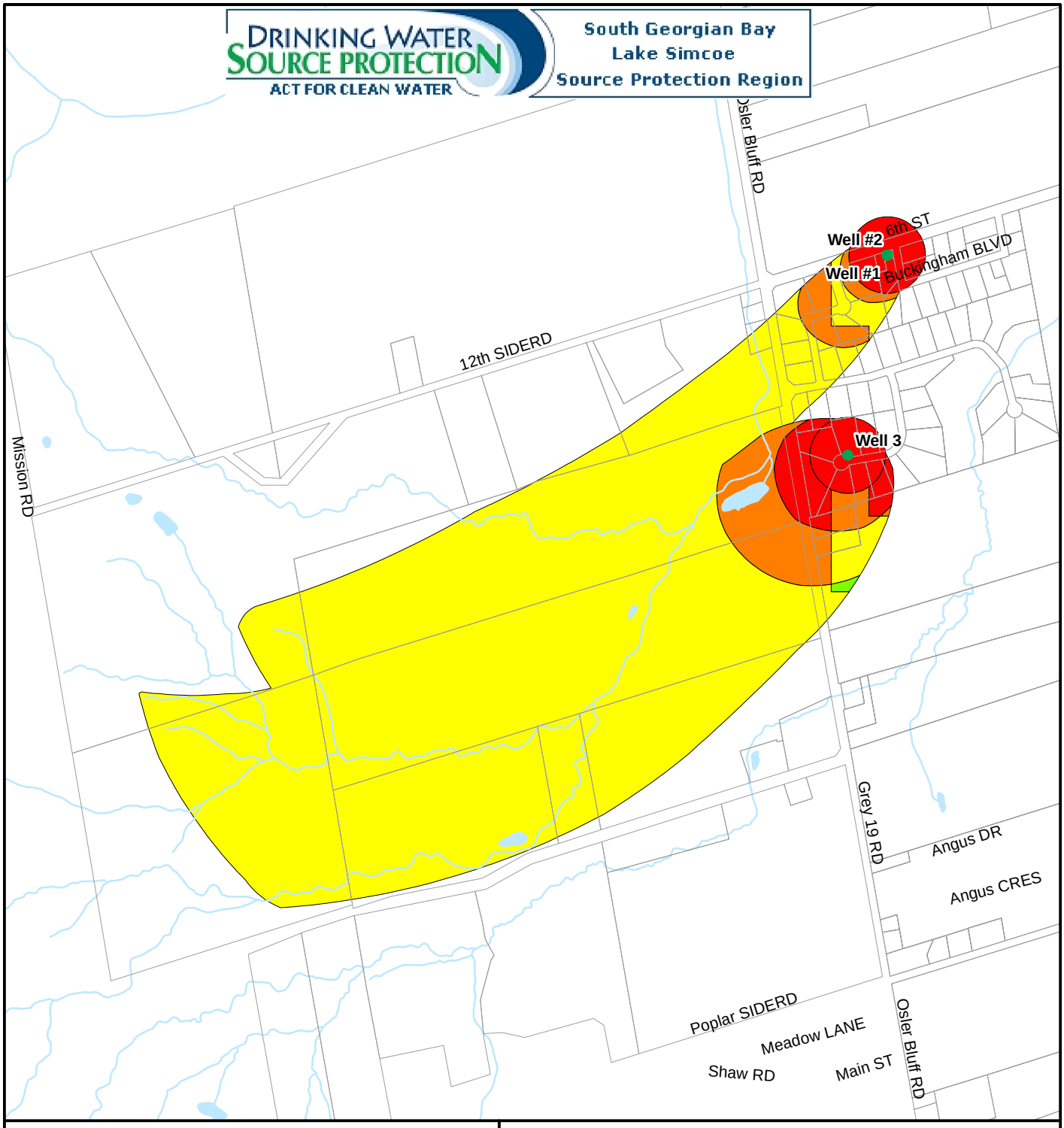
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

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GENIVAR Ontario

FIGURE 10a-2



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6
- 4
- 2

N
W E
S

200 100 0 200 Metres

VULNERABILITY SCORES - BUCKINGHAM WOODS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.1-3

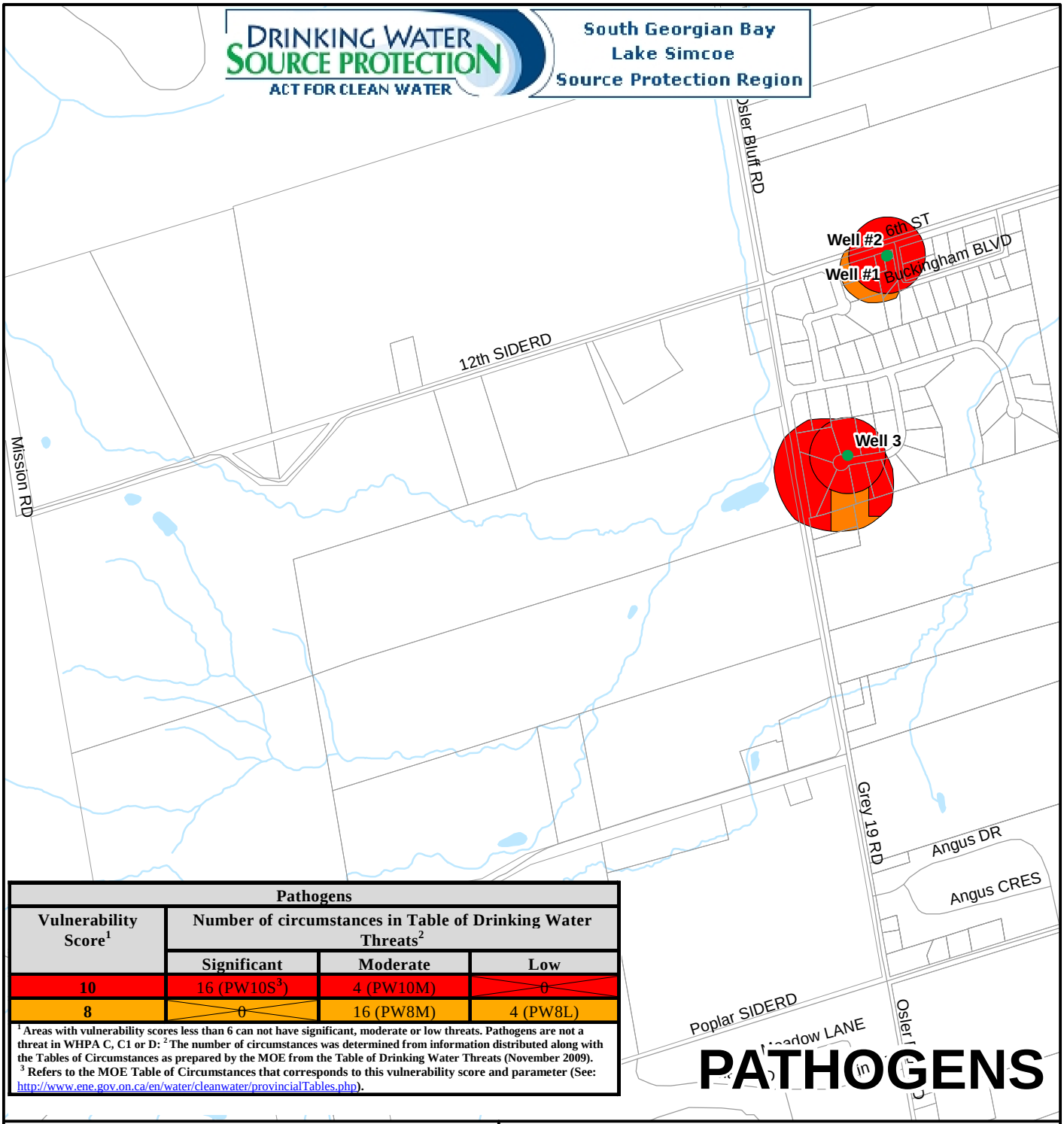
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FIGURE 10a-3

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Pathogens			
Vulnerability Score[1]	Number of circumstances in Table of Drinking Water Threats[2]		
	Significant	Moderate	Low
10	16 (PW10S[3])	4 (PW10M)	~~0~~
8	~~0~~	16 (PW8M)	4 (PW8L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. Pathogens are not a threat in WHPA C, C1 or D: [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009).
[3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

PATHOGENS

LEGEND
- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING
- 10
- 8
- 6

N W E S

200 100 0 200 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - BUCKINGHAM WOODS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
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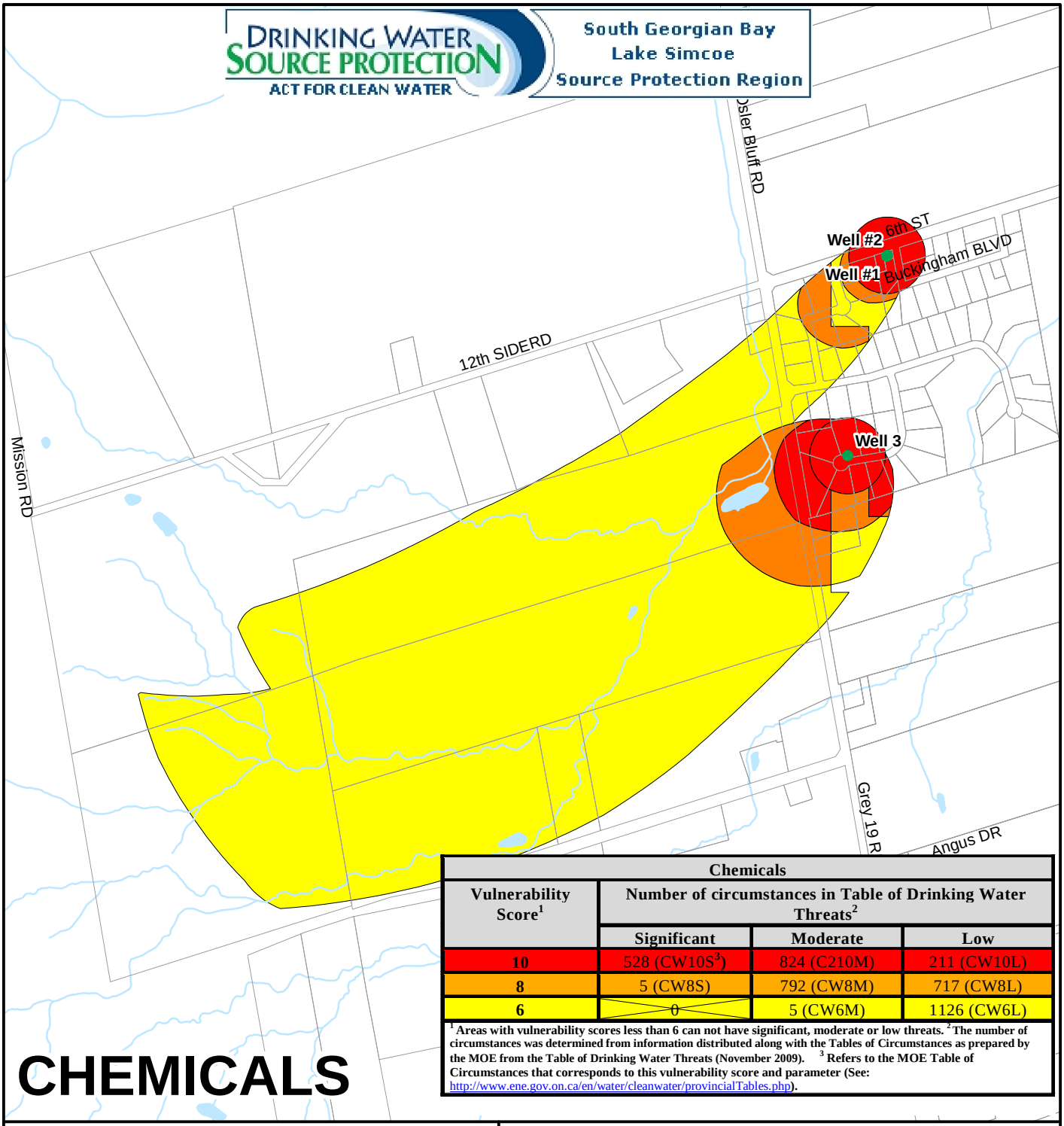
This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

GENIVAR Ontario

FIGURE 10a-4

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



CHEMICALS

Chemicals			
Vulnerability Score[1]	Number of circumstances in Table of Drinking Water Threats[2]		
	Significant	Moderate	Low
10	528 (CW10S[3])	824 (C210M)	211 (CW10L)
8	5 (CW8S)	792 (CW8M)	717 (CW8L)
6	~~0~~	5 (CW6M)	1126 (CW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009). [3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6

N W E S

200 100 0 200 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - BUCKINGHAM WOODS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.1-5

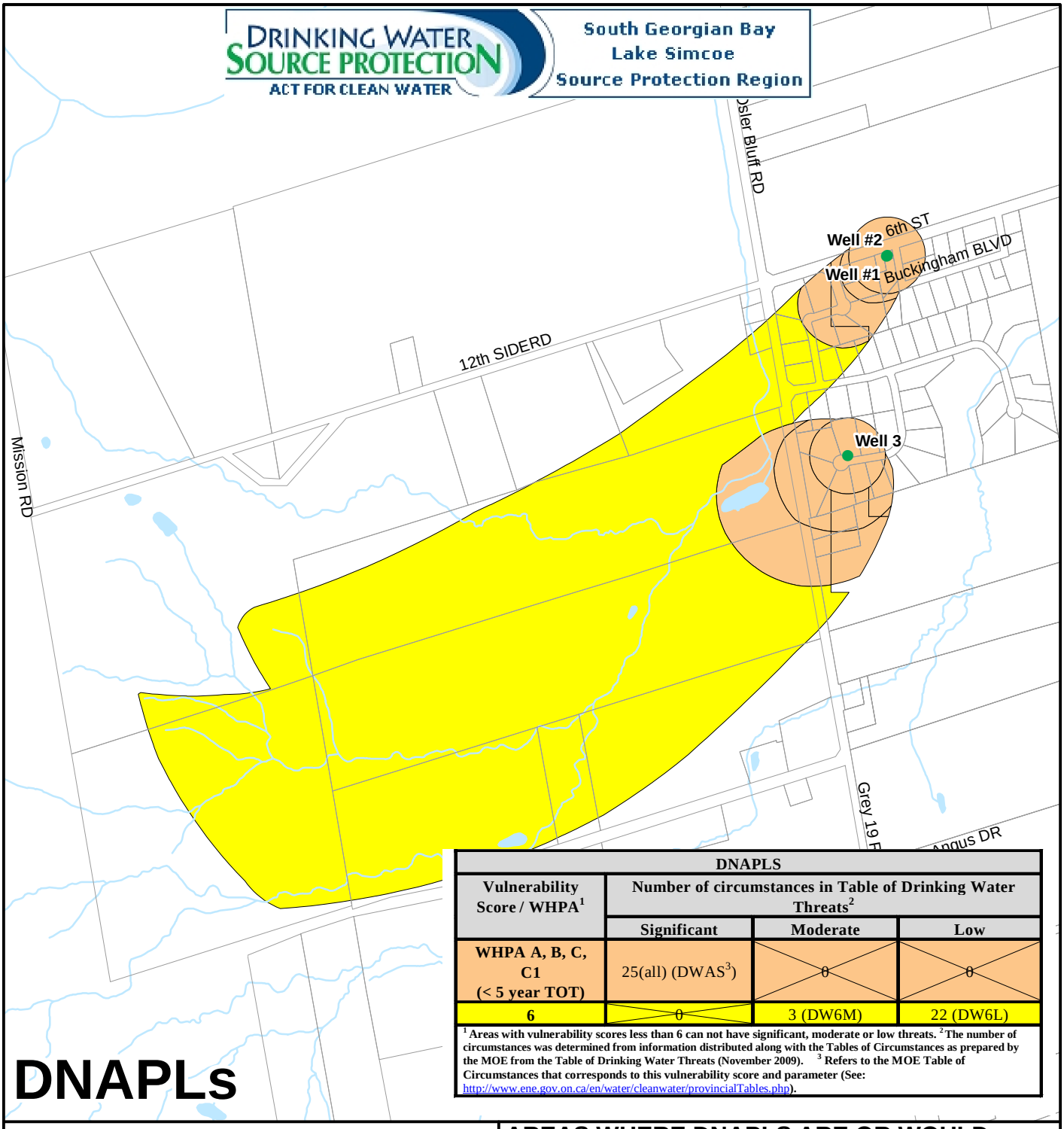
This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

GENIVAR Ontario

FIGURE 10a-5

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



DNAPLs

DNAPLS			
Vulnerability Score / WHPA[1]	**Number of circumstances in Table of Drinking Water Threats[2]**		
	Significant	**Moderate**	**Low**
WHPA A, B, C, C1 (< 5 year TOT)	25(all) (DWAS[3])	~~0~~	~~0~~
6	~~0~~	3 (DW6M)	22 (DW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009). [3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

LEGEND

- MUNICIPAL WELL LOCATION
- WHPA-C: 5 YEAR TIME-OF-TRAVEL

VULNERABILITY SCORING

- 6

N W E S

200 100 0 200 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

AREAS WHERE DNAPLS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - BUCKINGHAM WOODS

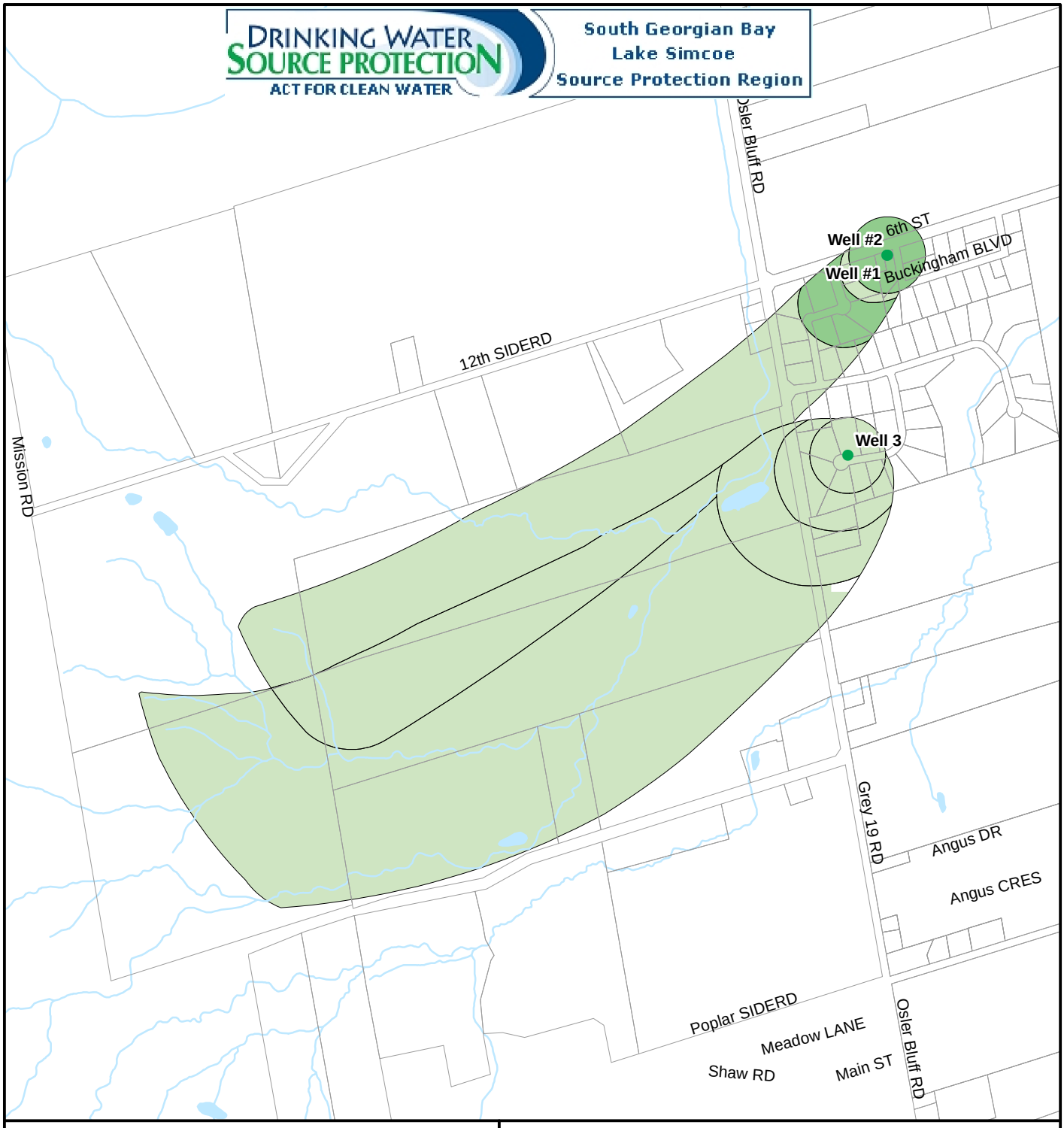
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.1-6

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GENIVAR Ontario

FIGURE **10a-6**



Legend

- MUNICIPAL WELL LOCATION
- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)

N W E S

200 100 0 200 Metres

MANAGED LANDS - BUCKINGHAM WOODS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

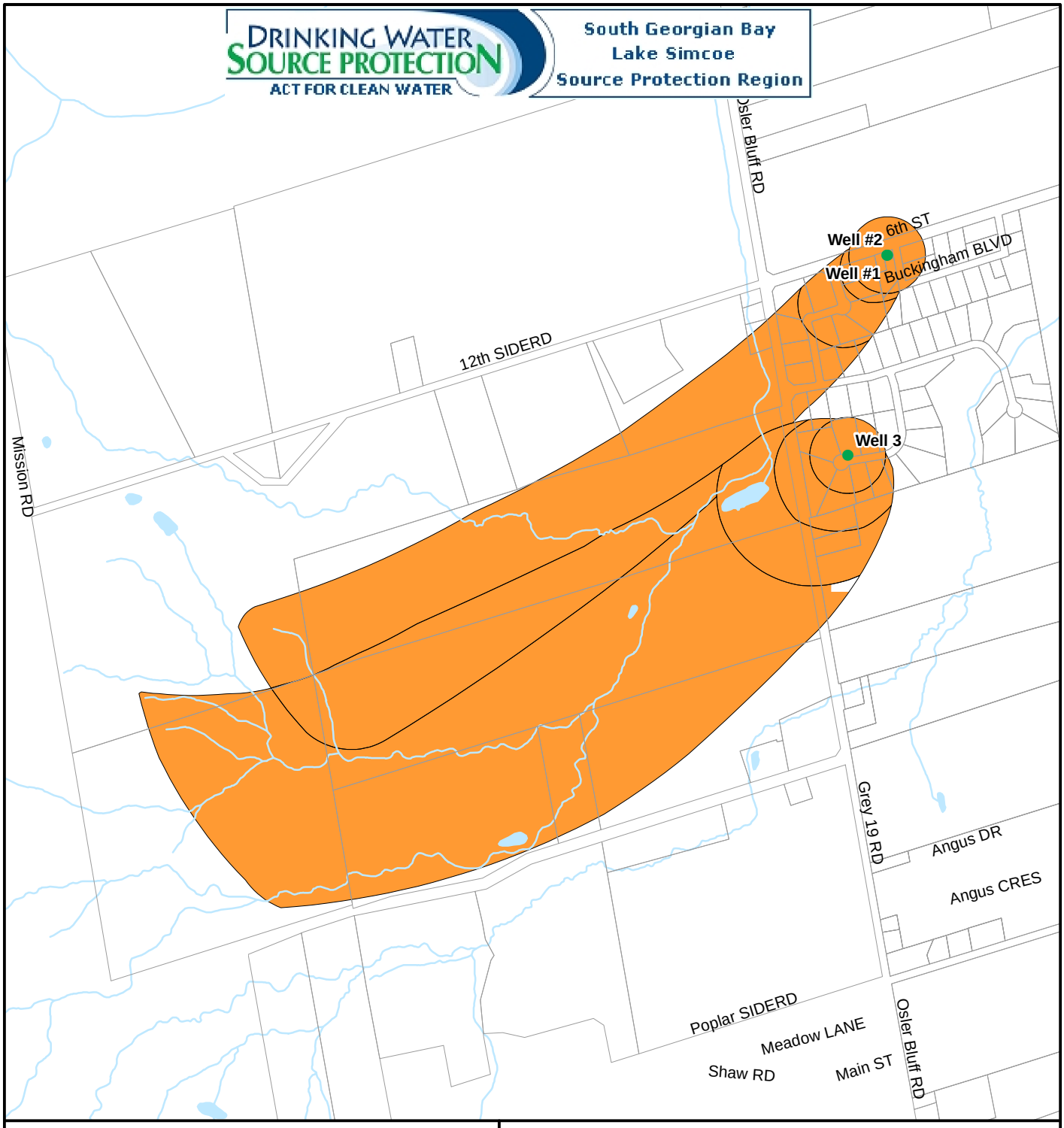
The Managed Land proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.1-7

This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

GENIVAR Ontario

FIGURE **10a-7**



Legend

- MUNICIPAL WELL LOCATION
- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)

N W E S

200 100 0 200 Metres

LIVESTOCK DENSITY - BUCKINGHAM WOODS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

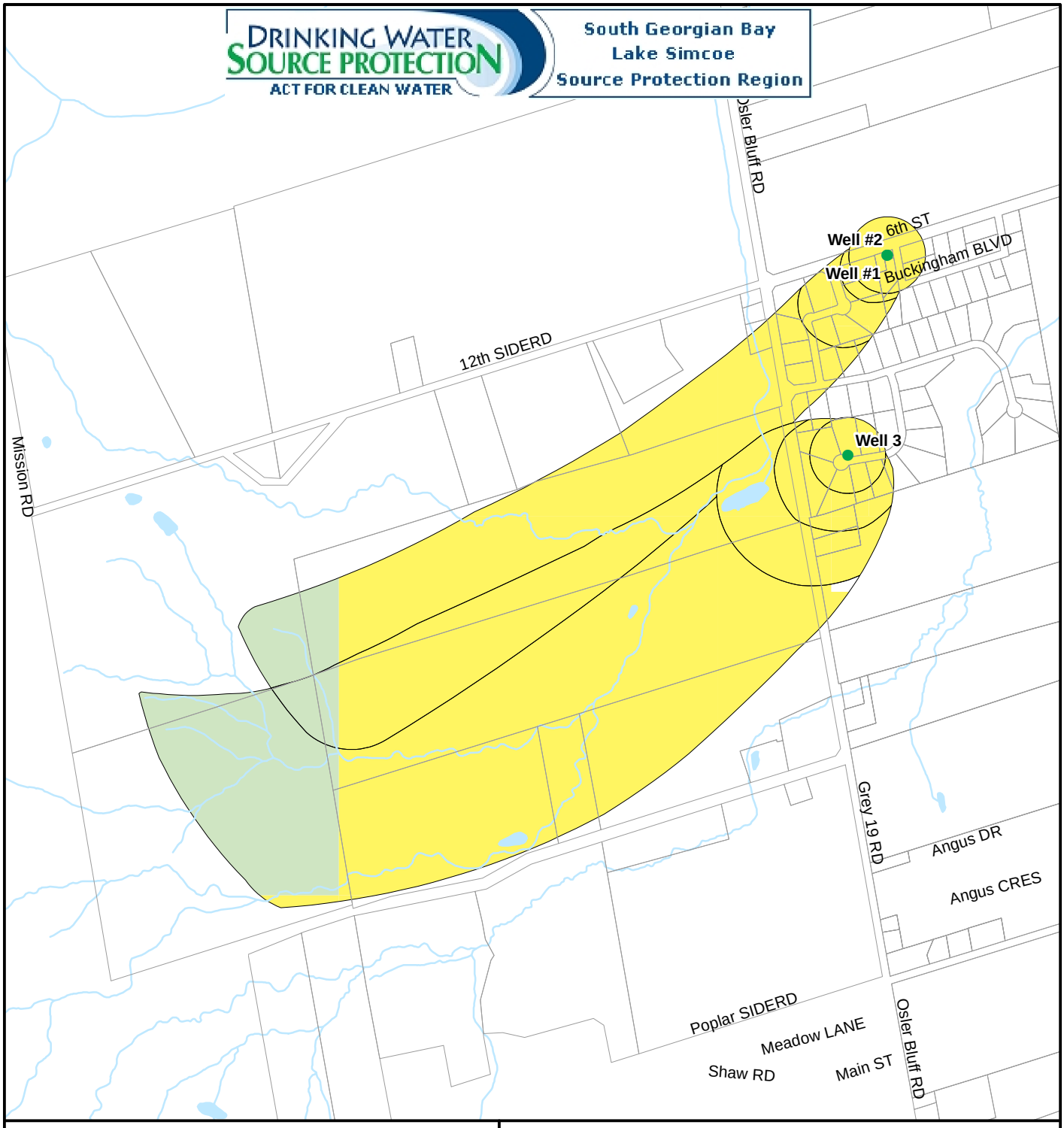
The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.1-8

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GENIVAR Ontario

FIGURE **10a-8**



Legend

- MUNICIPAL WELL LOCATION

IMPERVIOUS SURFACE

- <1%
- >1% and <8%
- >8% and <80%

N W E S

200 100 0 200 Metres

IMPERVIOUS SURFACES - BUCKINGHAM WOODS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

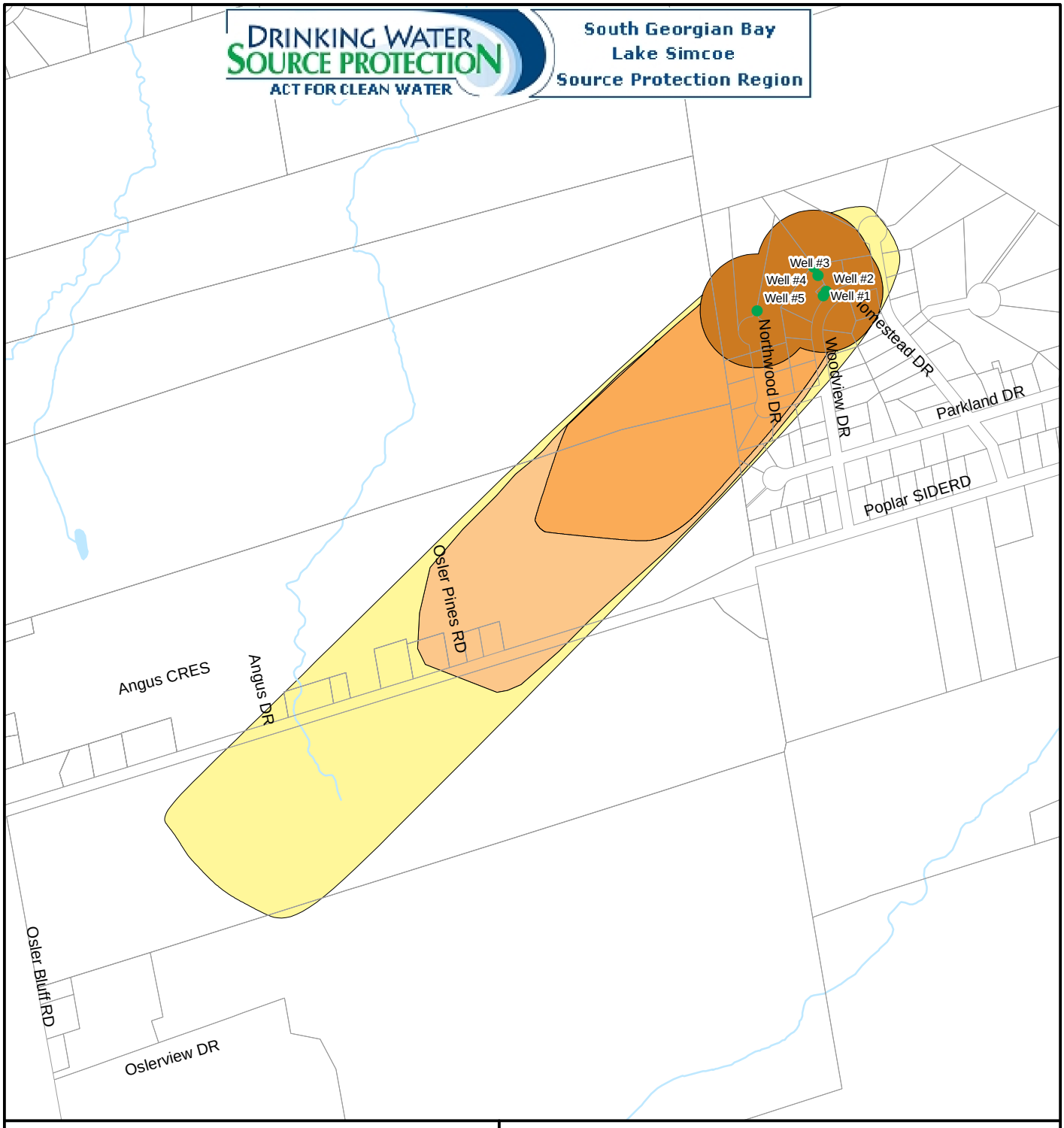
The Impervious Surfaces proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.1-9

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GENIVAR Ontario

FIGURE **10a-9**



Legend

- MUNICIPAL WELL LOCATION
- WHPA-A: 100 m RADIUS
- WHPA-B: 2-YEAR TIME-OF-TRAVEL
- WHPA-C: 5-YEAR TIME-OF-TRAVEL
- WHPA-D: 25-YEAR TIME-OF-TRAVEL

N W E S

100 50 0 100 Metres

WELLHEAD PROTECTION AREAS - COLLINGWOODLANDS, CLEARVIEW

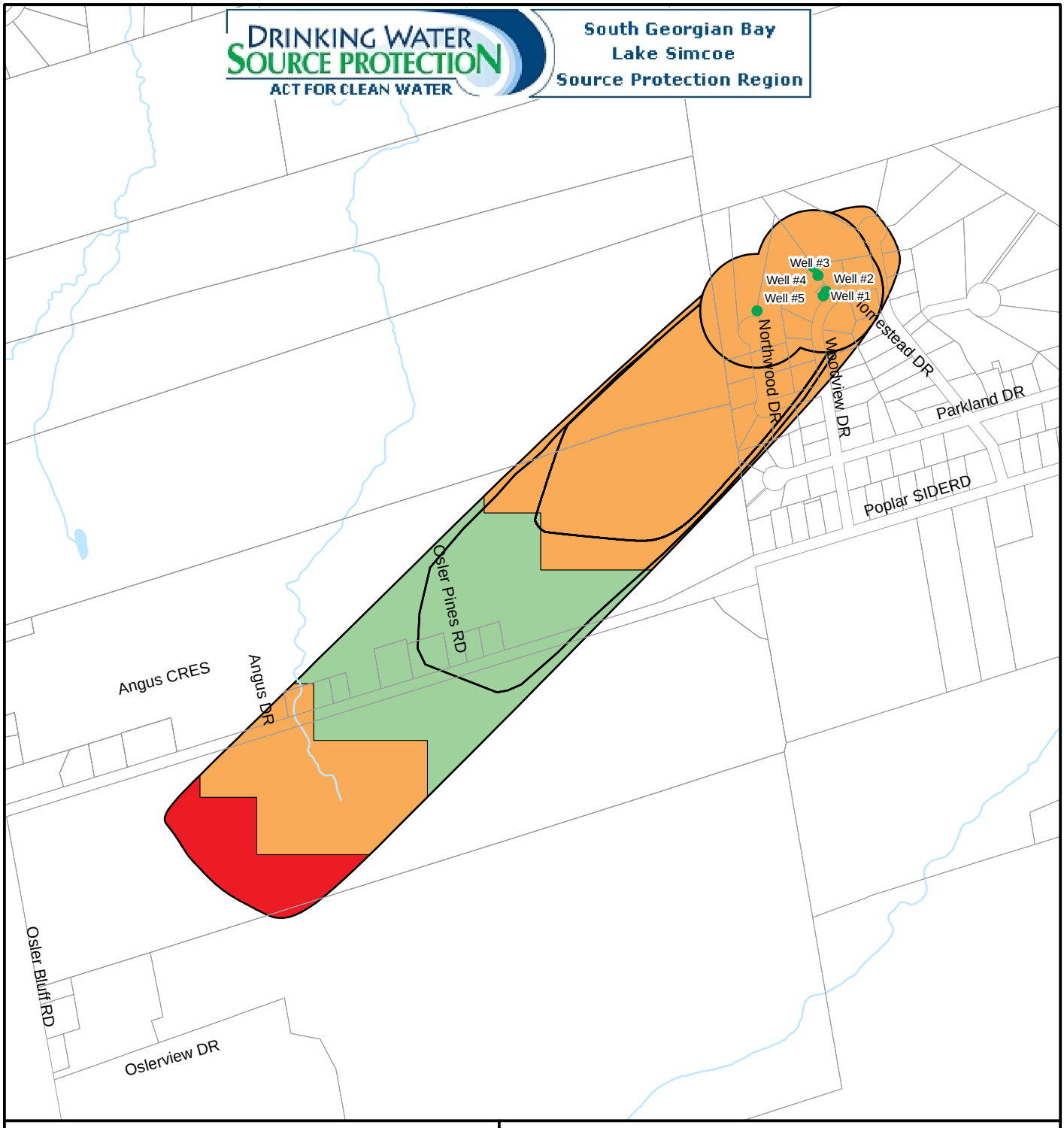
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.2-1

This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

GENIVAR Ontario

FIGURE **10b-1**



LEGEND

- MUNICIPAL WELL LOCATION

AQUIFER VULNERABILITY INDEX

- HIGH
- MEDIUM
- LOW

N
W E
S

90 45 0 90 Metres

GROUNDWATER VULNERABILITY - COLLINGWOODLANDS

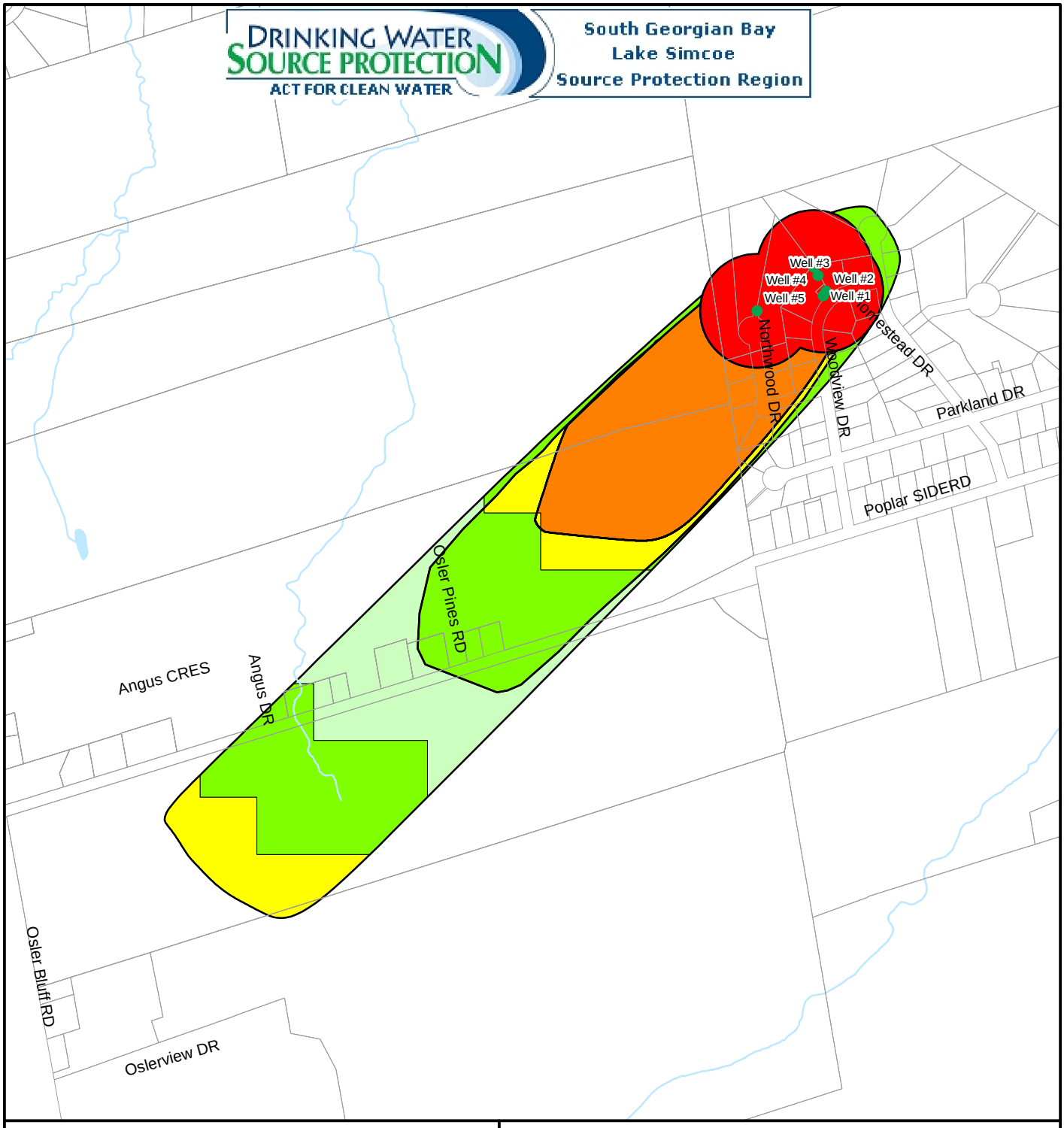
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.2-2

This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

GENIVAR Ontario

FIGURE **10b-2**



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6
- 4
- 2

N
W E
S

100 50 0 100 Metres

VULNERABILITY SCORES - COLLINGWOODLANDS

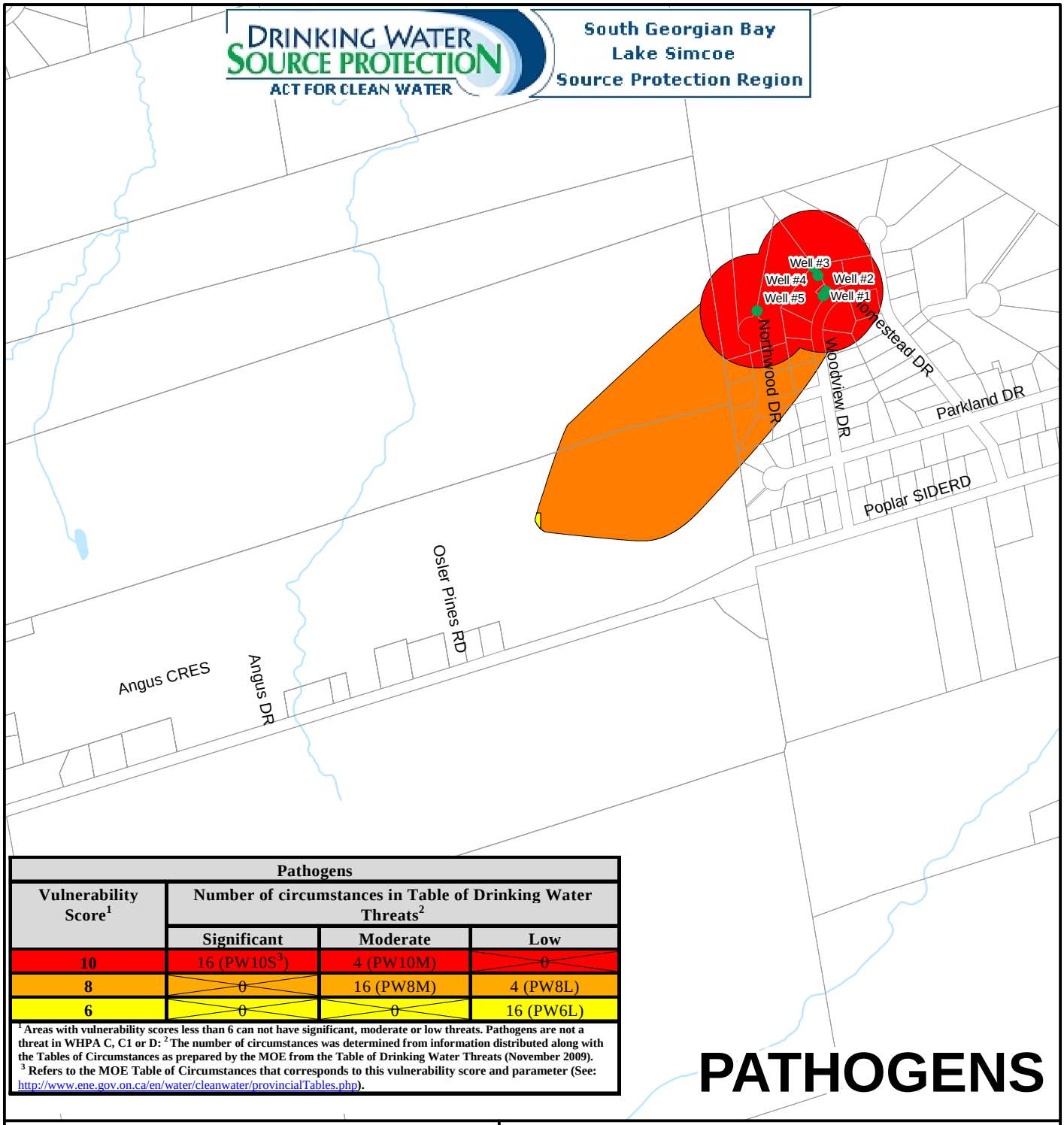
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.2-3

This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

GENIVAR Ontario

FIGURE **10b-3**



Pathogens			
Vulnerability Score[1]	Number of circumstances in Table of Drinking Water Threats[2]		
	Significant	Moderate	Low
10	16 (PW10S[3])	4 (PW10M)	~~0~~
8	~~0~~	16 (PW8M)	4 (PW8L)
6	~~0~~	~~0~~	16 (PW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. Pathogens are not a threat in WHPA C, C1 or D: [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009).
[3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

PATHOGENS

LEGEND
- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING
- 10
- 8
- 6

N W E S

100 50 0 100 Metres

AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - COLLINGWOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.2-4

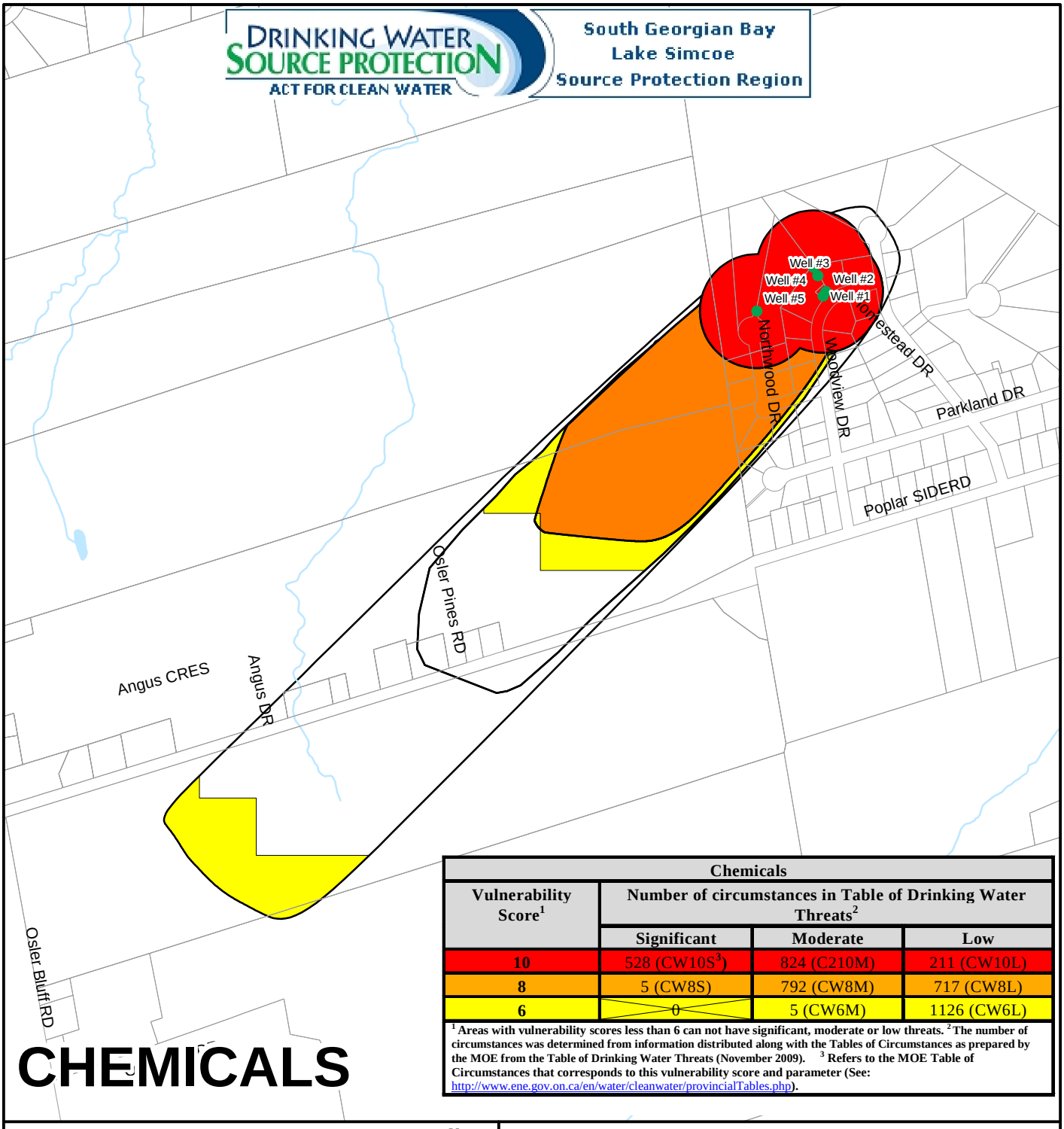
This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

GENIVAR Ontario

FIGURE 10b-4

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



CHEMICALS

Vulnerability Score[1]	Chemicals: Number of circumstances in Table of Drinking Water Threats[2]		
	Significant	Moderate	Low
10	528 (CW10S[3])	824 (C210M)	211 (CW10L)
8	5 (CW8S)	792 (CW8M)	717 (CW8L)
6	~~0~~	5 (CW6M)	1126 (CW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009). [3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

LEGEND
- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING
- 10
- 8
- 6

N W E S

100 50 0 100 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - COLLINGWOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.2-5

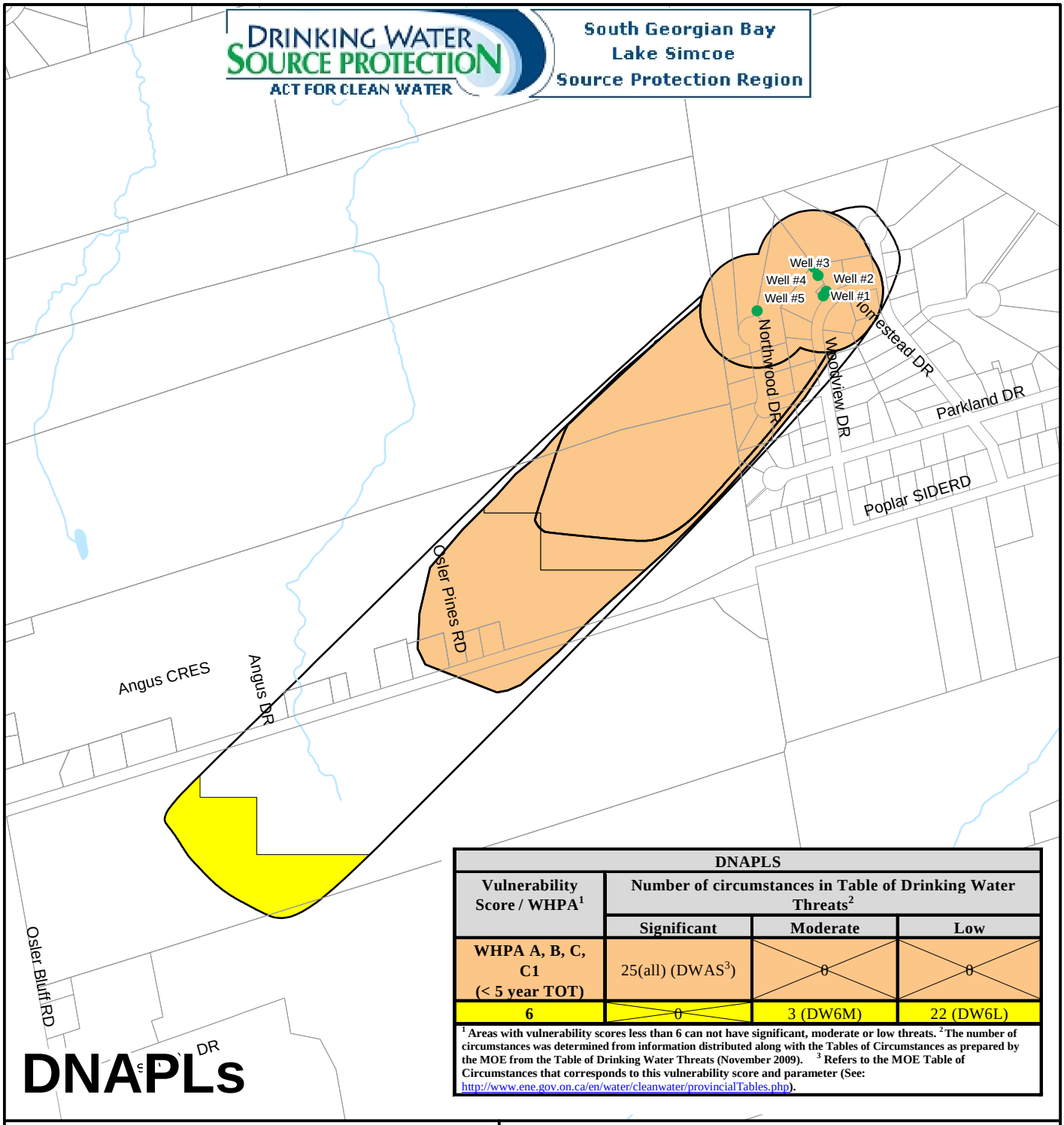
This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

GENIVAR Ontario

FIGURE 10b-5

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



DNAPLs

DNAPLS			
Vulnerability Score / WHPA[1]	Number of circumstances in Table of Drinking Water Threats[2]		
	Significant	Moderate	Low
WHPA A, B, C, C1 (< 5 year TOT)	25(all) (DWAS[3])	~~0~~	~~0~~
6	~~0~~	3 (DW6M)	22 (DW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009). [3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

LEGEND

- MUNICIPAL WELL LOCATION
- WHPA-C: 5 YEAR TIME-OF-TRAVEL

VULNERABILITY SCORING

- 6

N W E S

100 50 0 100 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

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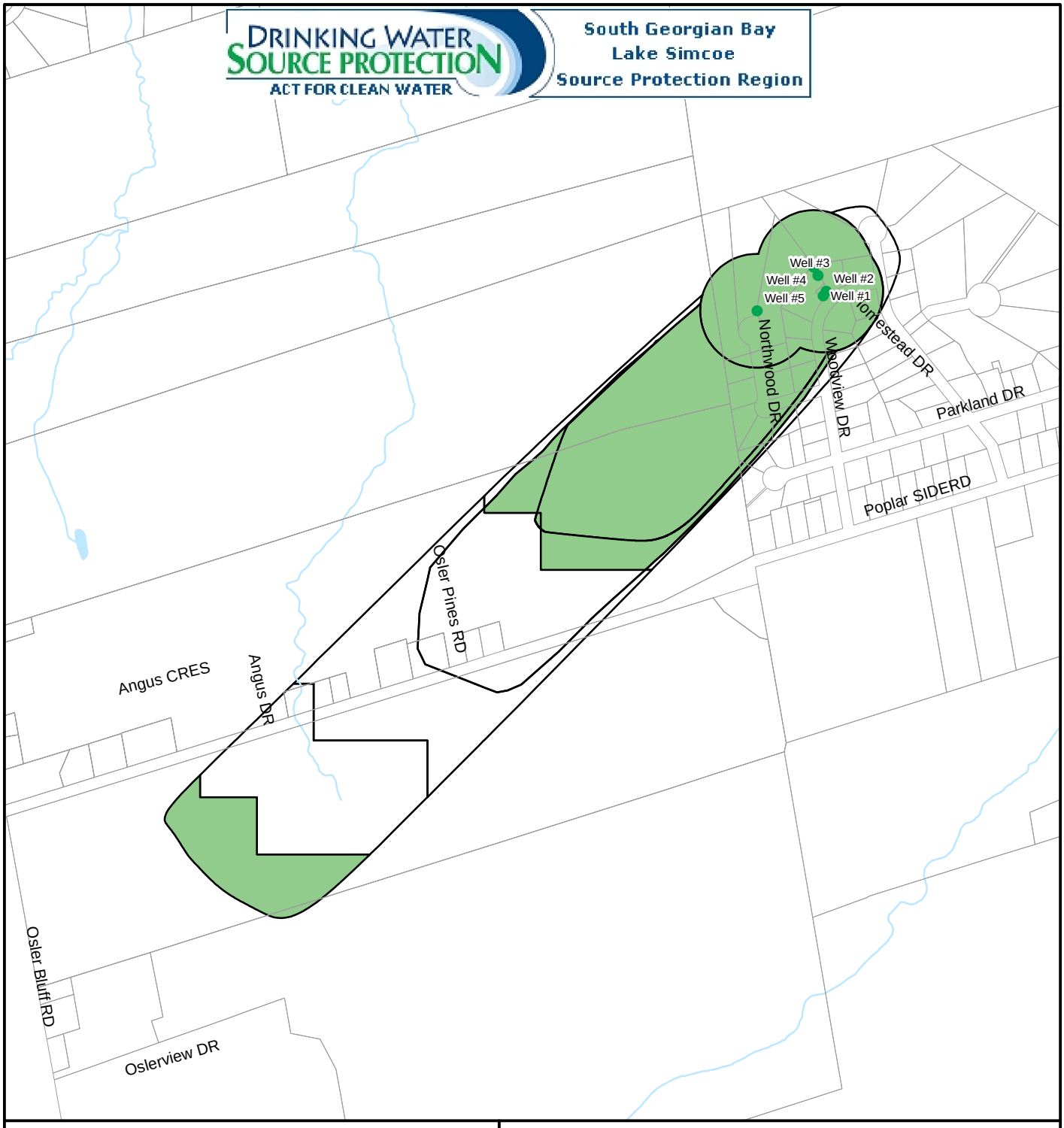
AREAS WHERE DNAPLS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - COLLINGWOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.2-6

GENIVAR Ontario

FIGURE **10b-6**



Legend

- MUNICIPAL WELL LOCATION
- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)

N W E S

90 45 0 90 Metres

MANAGED LANDS - COLLINGWOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

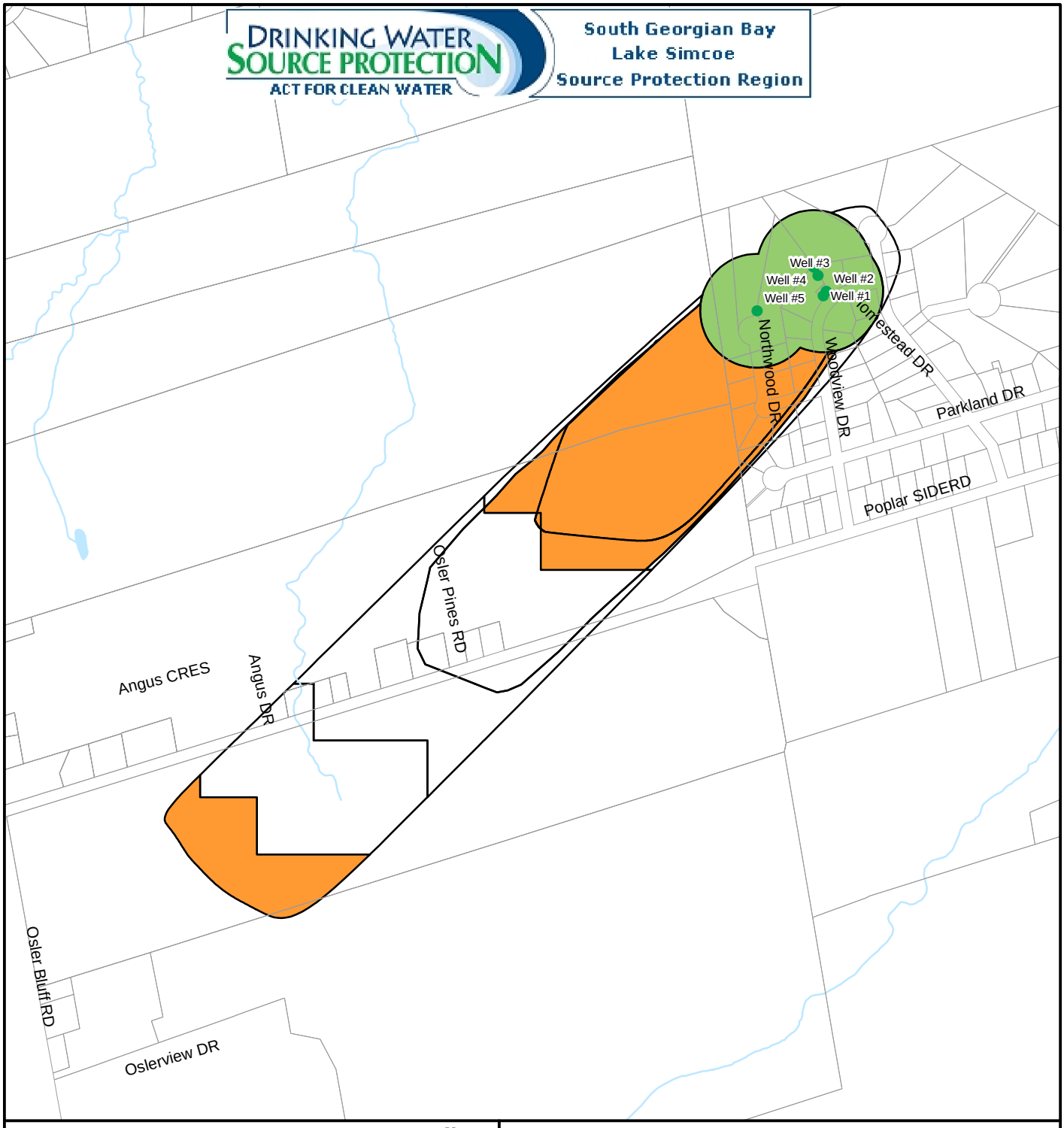
The Managed Land proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.2-7

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GENIVAR Ontario

FIGURE **10b-7**



Legend

- MUNICIPAL WELL LOCATION
- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)

N W E S

100 50 0 100 Metres

LIVESTOCK DENSITY - COLLINGWOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

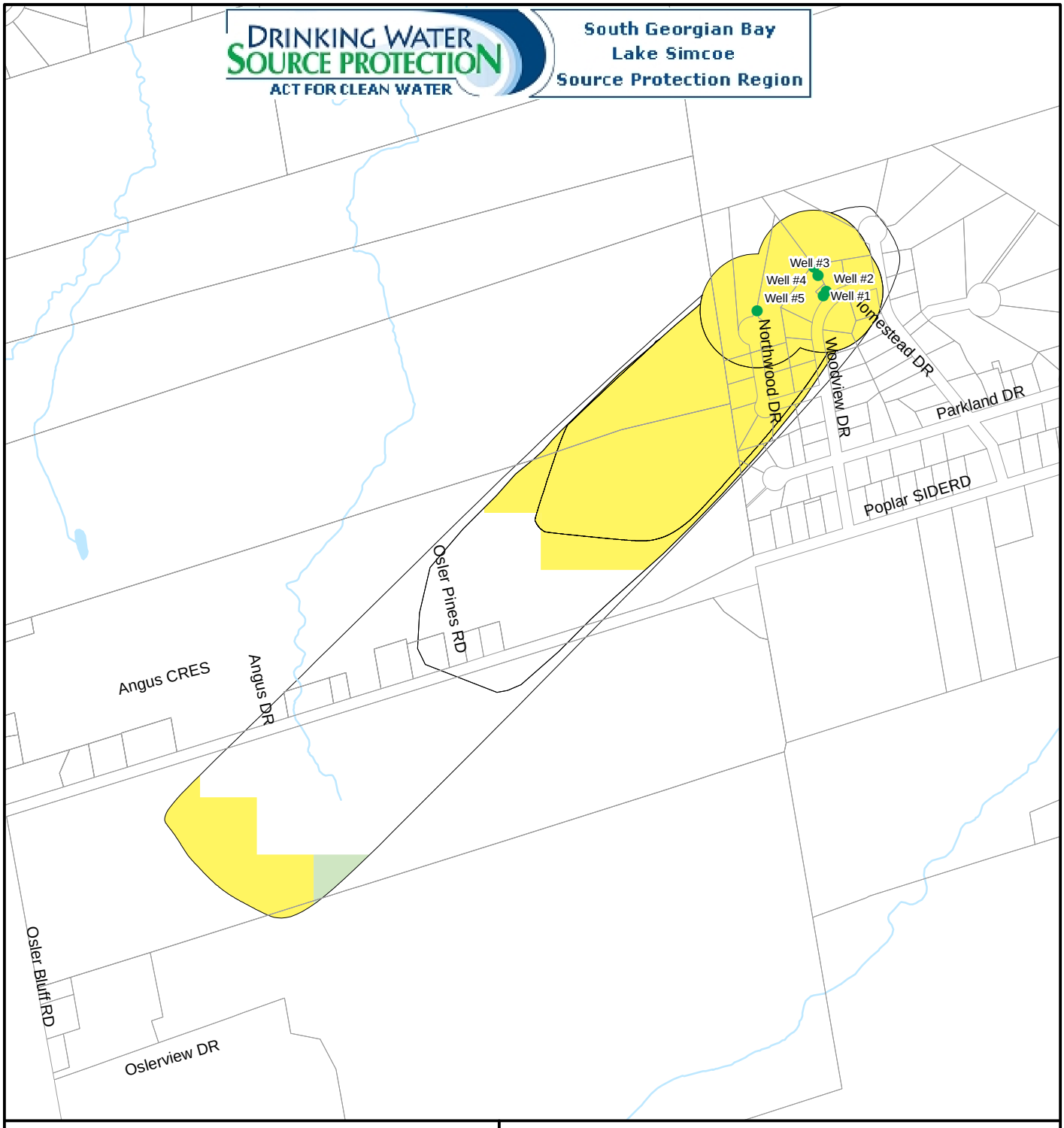
The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.2-8

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GENIVAR Ontario

FIGURE **10b-8**



Legend

MUNICIPAL WELL LOCATION

IMPERVIOUS SURFACE

- <1%
- >1% and <8%
- >8% and <80%

N W E S

100 50 0 100 Metres

IMPERVIOUS SURFACES - COLLINGWOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

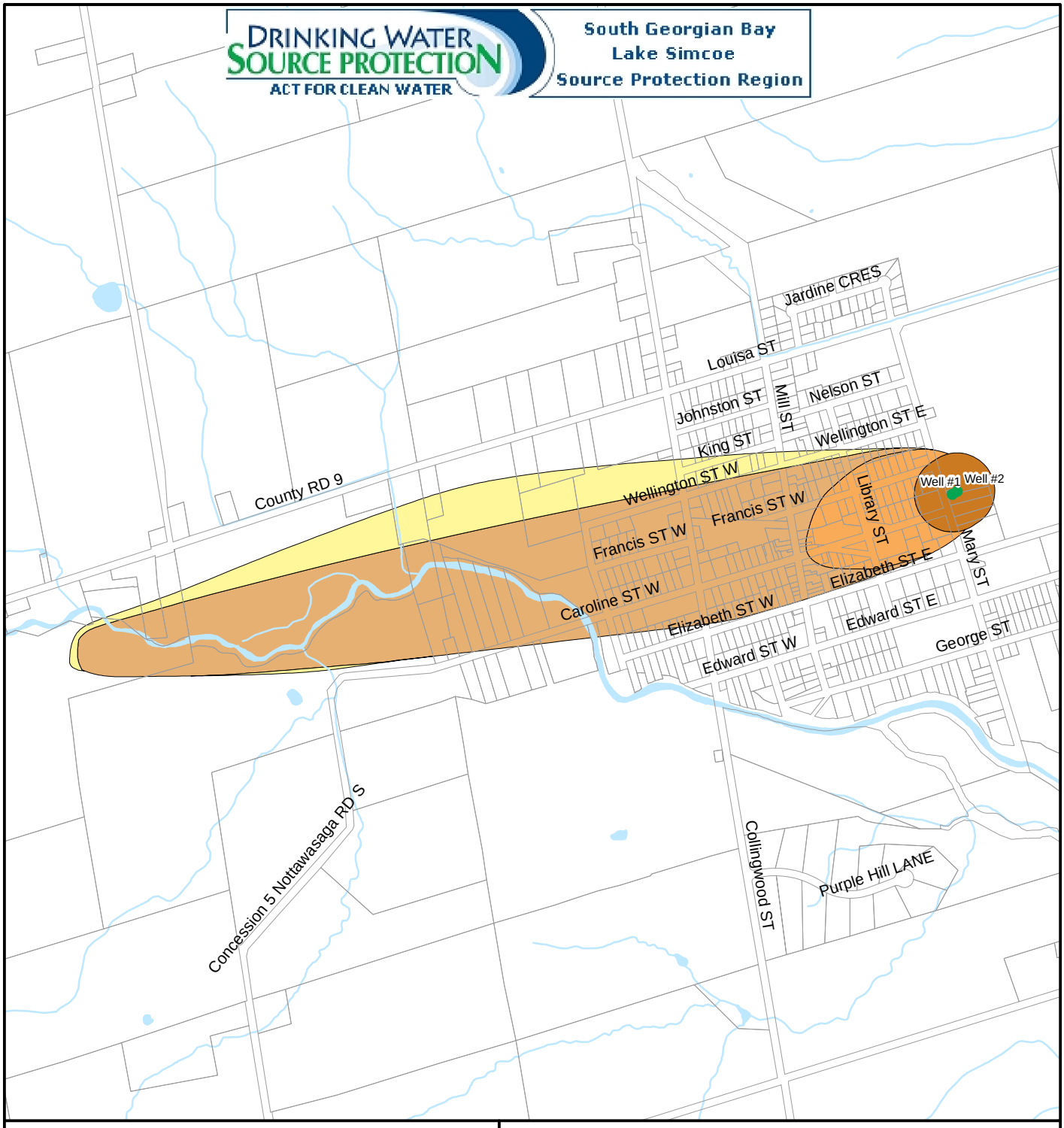
The Impervious Surfaces proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.2-9

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GENIVAR Ontario

FIGURE **10b-9**



Legend

- MUNICIPAL WELL LOCATION
- WHPA-A: 100 m RADIUS
- WHPA-B: 2-YEAR TIME-OF-TRAVEL
- WHPA-C1: 10-YEAR TIME-OF-TRAVEL
- WHPA-D: 25-YEAR TIME-OF-TRAVEL

N W E S

100 50 0 100 Metres

WELLHEAD PROTECTION AREAS - CREEMORE, CLEARVIEW

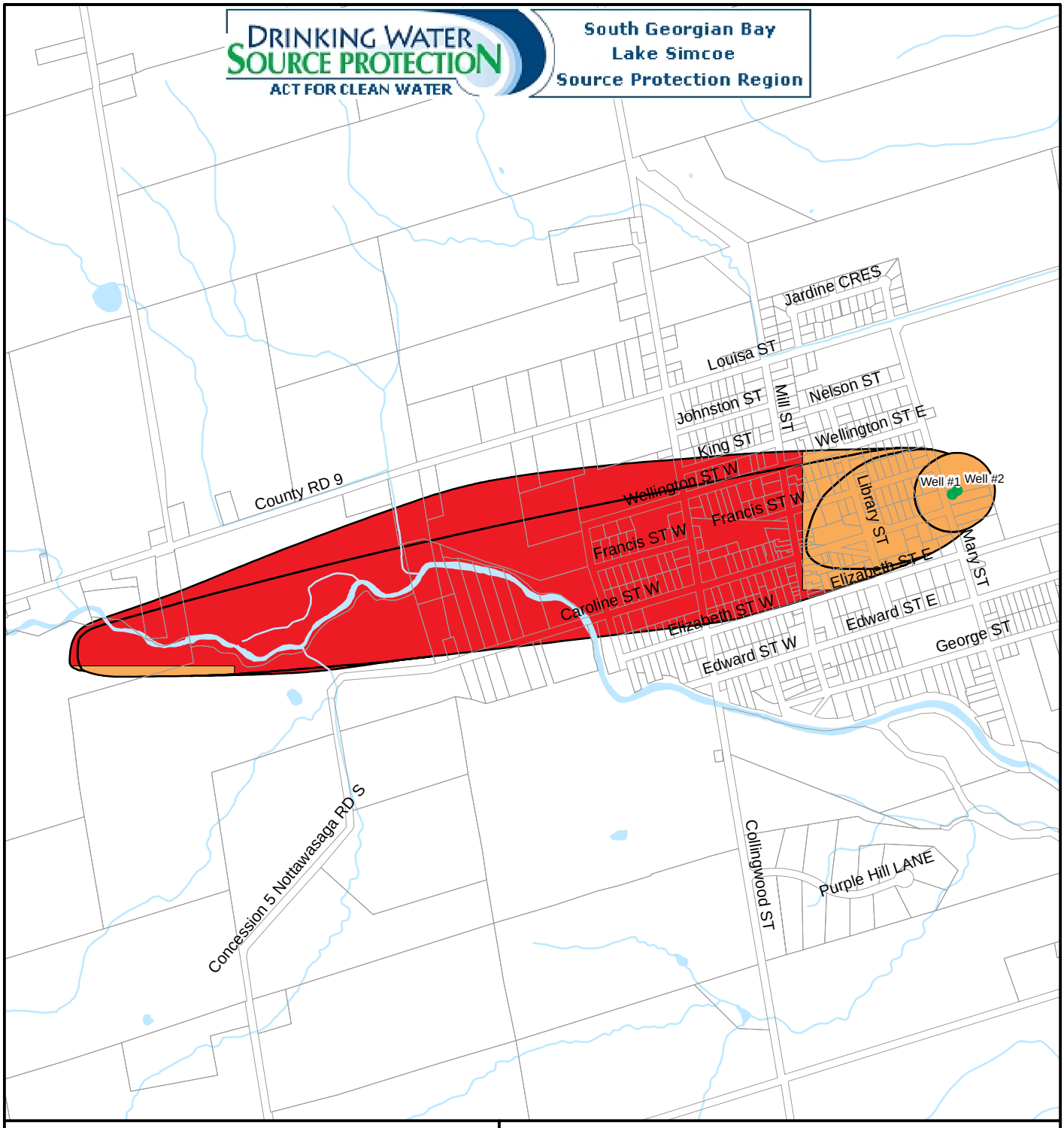
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.3-1

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GENIVAR Ontario

FIGURE 10c-1



LEGEND

- MUNICIPAL WELL LOCATION

AQUIFER VULNERABILITY INDEX

- HIGH
- MEDIUM
- LOW

N W E S

100 50 0 100 Metres

GROUNDWATER VULNERABILITY - CREEMORE

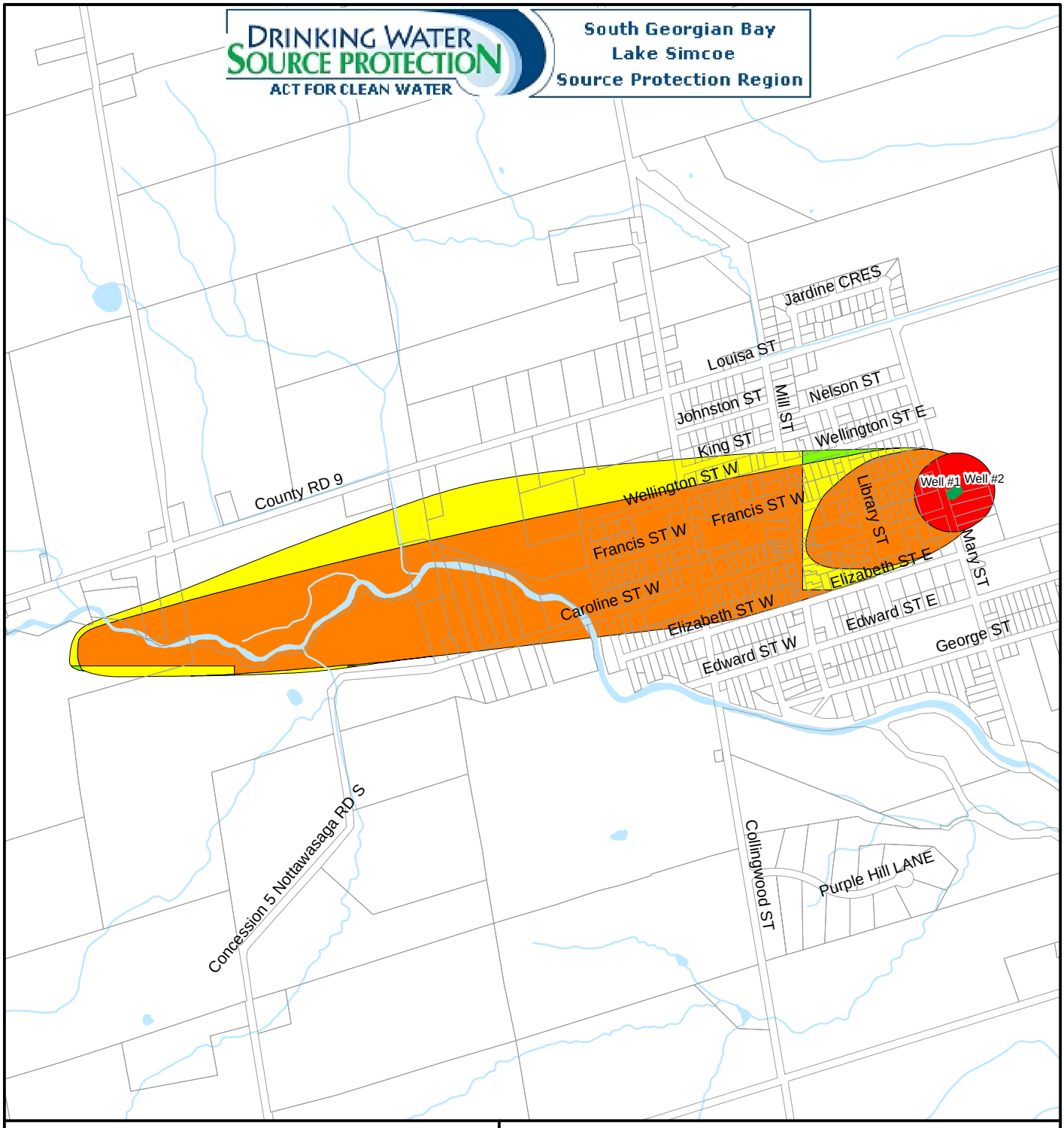
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.3-2

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GENIVAR Ontario

FIGURE 10c-2



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6
- 4
- 2

N
W E
S

90 45 0 90 Metres

VULNERABILITY SCORES - CREEMORE

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: MAY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.3-3

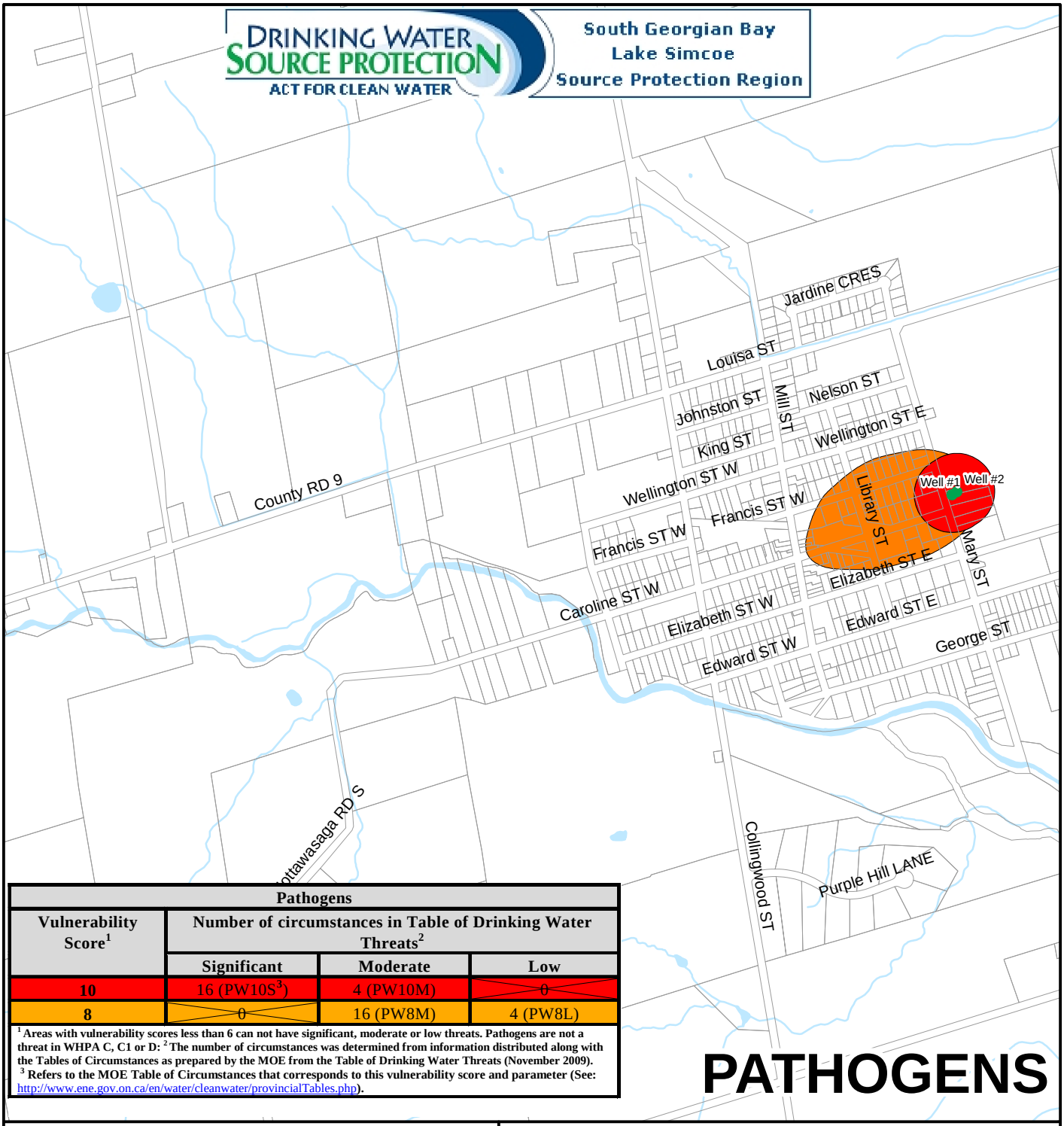
This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

GENIVAR Ontario

FIGURE 10c-3

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Pathogens			
Vulnerability Score[1]	Number of circumstances in Table of Drinking Water Threats[2]		
	Significant	Moderate	Low
10	16 (PW10S[3])	4 (PW10M)	~~0~~
8	~~0~~	16 (PW8M)	4 (PW8L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. Pathogens are not a threat in WHPA C, C1 or D: [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009).
[3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

PATHOGENS

LEGEND
- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING
- 10
- 8
- 6

N W E S

100 50 0 100 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - CREEMORE

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.3-4

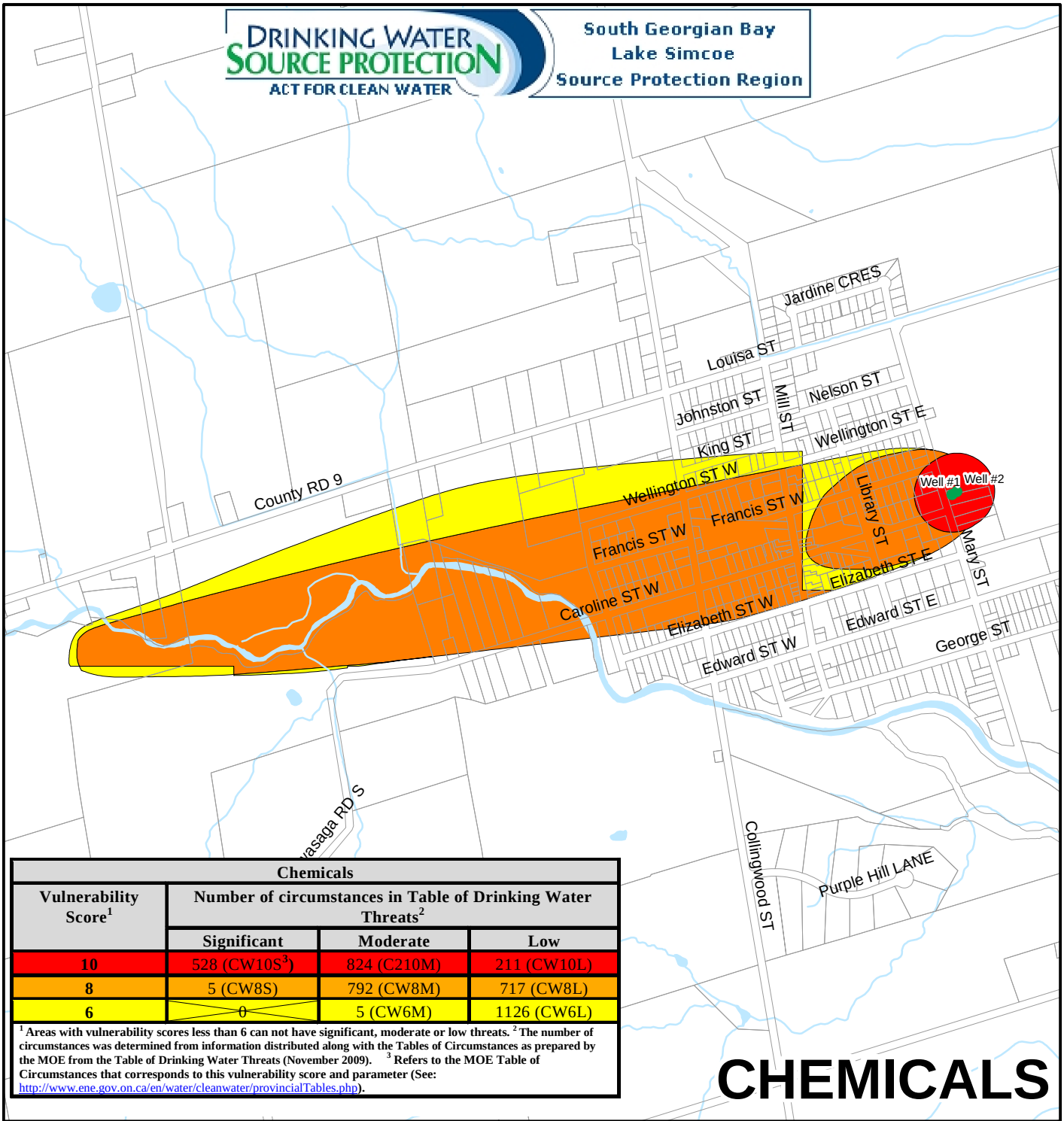
This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

GENIVAR Ontario

FIGURE 10c-4

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Chemicals			
Vulnerability Score[1]	Number of circumstances in Table of Drinking Water Threats[2]		
	Significant	Moderate	Low
10	528 (CW10S[3])	824 (C210M)	211 (CW10L)
8	5 (CW8S)	792 (CW8M)	717 (CW8L)
6	~~0~~	5 (CW6M)	1126 (CW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009). [3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

CHEMICALS

LEGEND
- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING
- 10
- 8
- 6

N W E S

100 50 0 100 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - CREEMORE

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.3-5

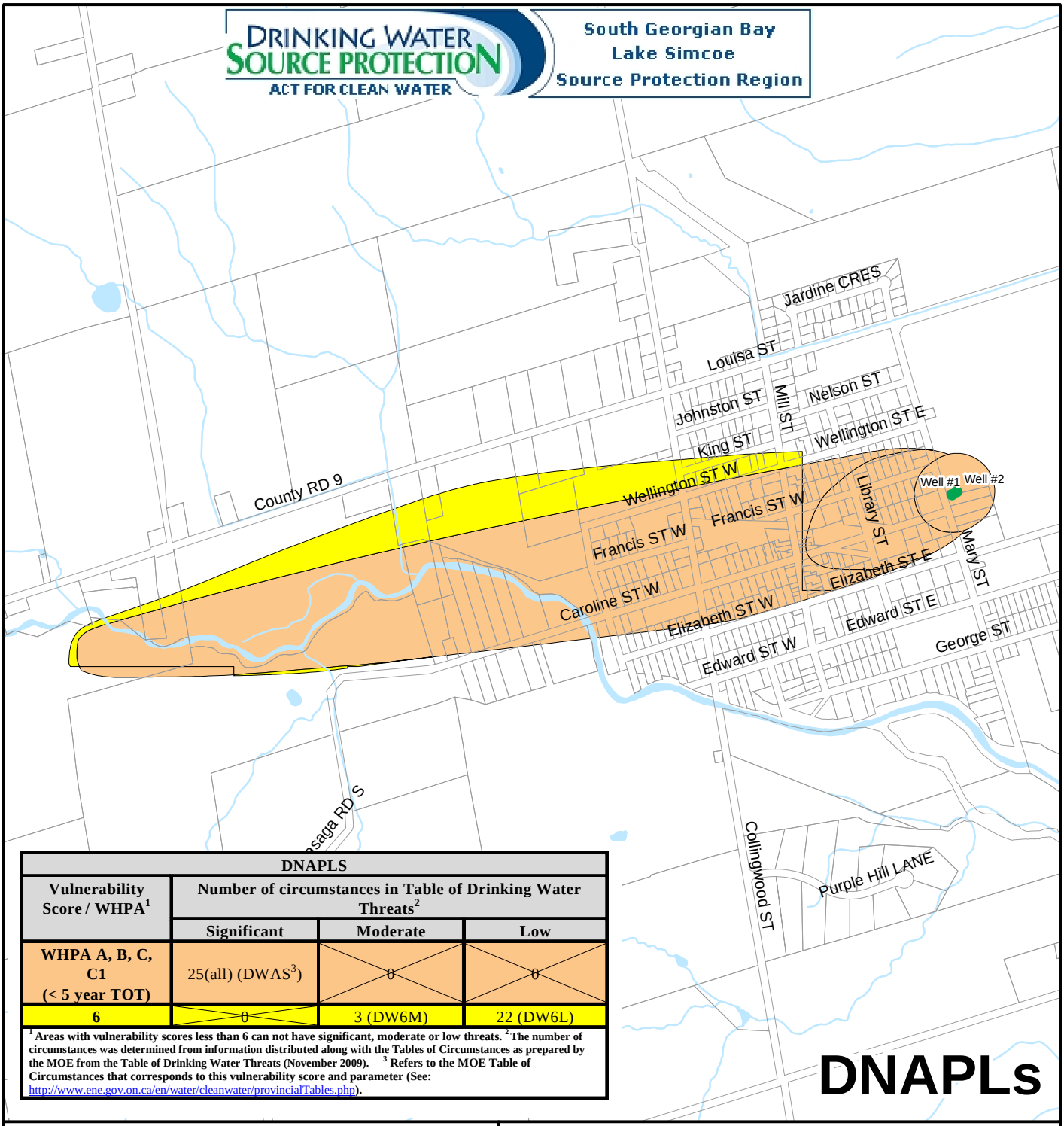
This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

GENIVAR Ontario

FIGURE 10c-5

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



DNAPLS			
Vulnerability Score / WHPA[1]	**Number of circumstances in Table of Drinking Water Threats[2]**		
	Significant	**Moderate**	**Low**
WHPA A, B, C, C1 (< 5 year TOT)	25(all) (DWAS[3])	~~0~~	~~0~~
6	~~0~~	3 (DW6M)	22 (DW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009). [3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

DNAPLs

LEGEND
- MUNICIPAL WELL LOCATION
- WHPA-C: 5 YEAR TIME-OF-TRAVEL

VULNERABILITY SCORING
- 6

N W E S

100 50 0 100 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

AREAS WHERE DNAPLS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - CREEMORE

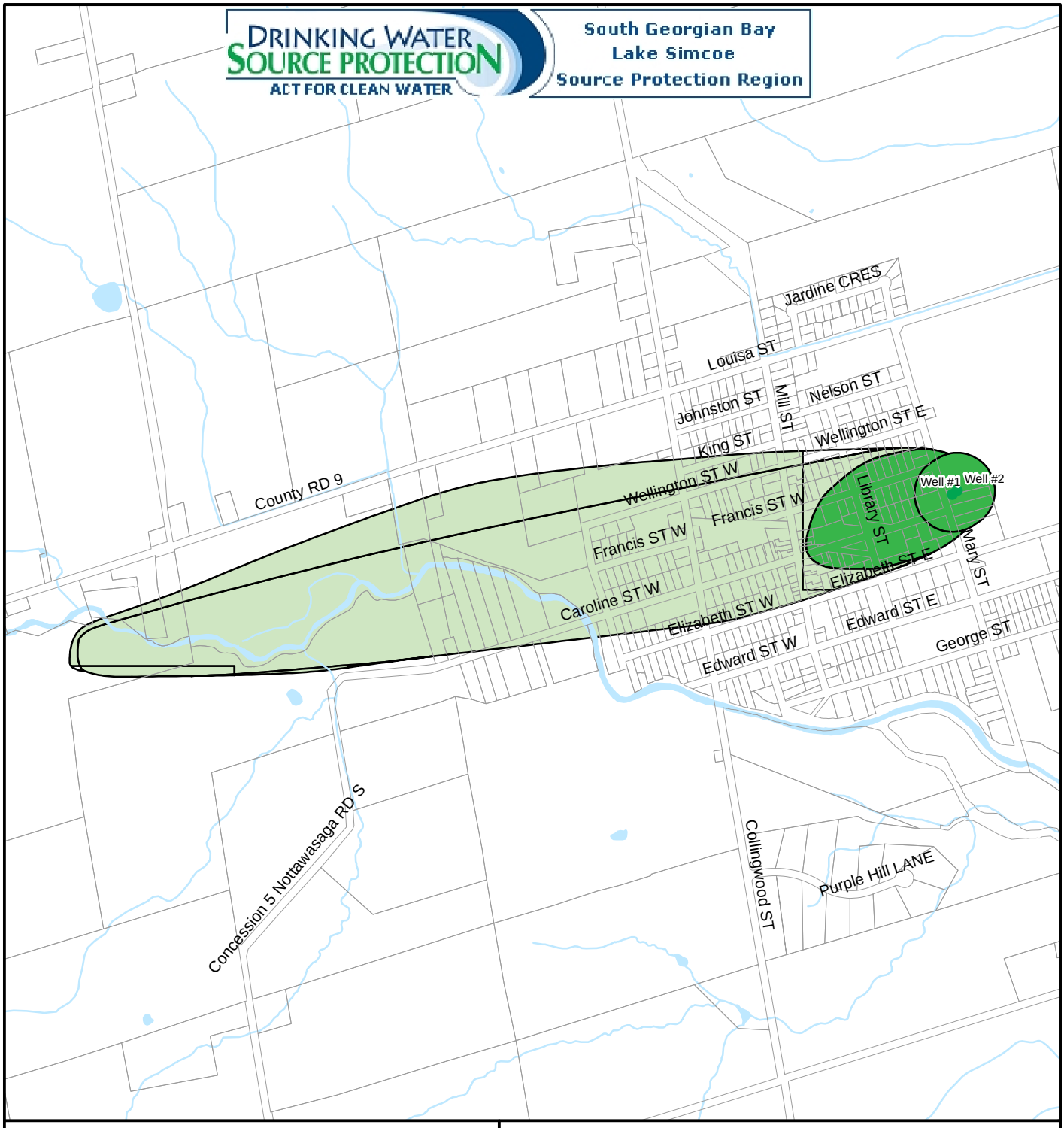
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.3-6

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GENIVAR Ontario

FIGURE 10c-6



Legend

- MUNICIPAL WELL LOCATION
- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)

N W E S

100 50 0 100 Metres

MANAGED LANDS - CREEMORE

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

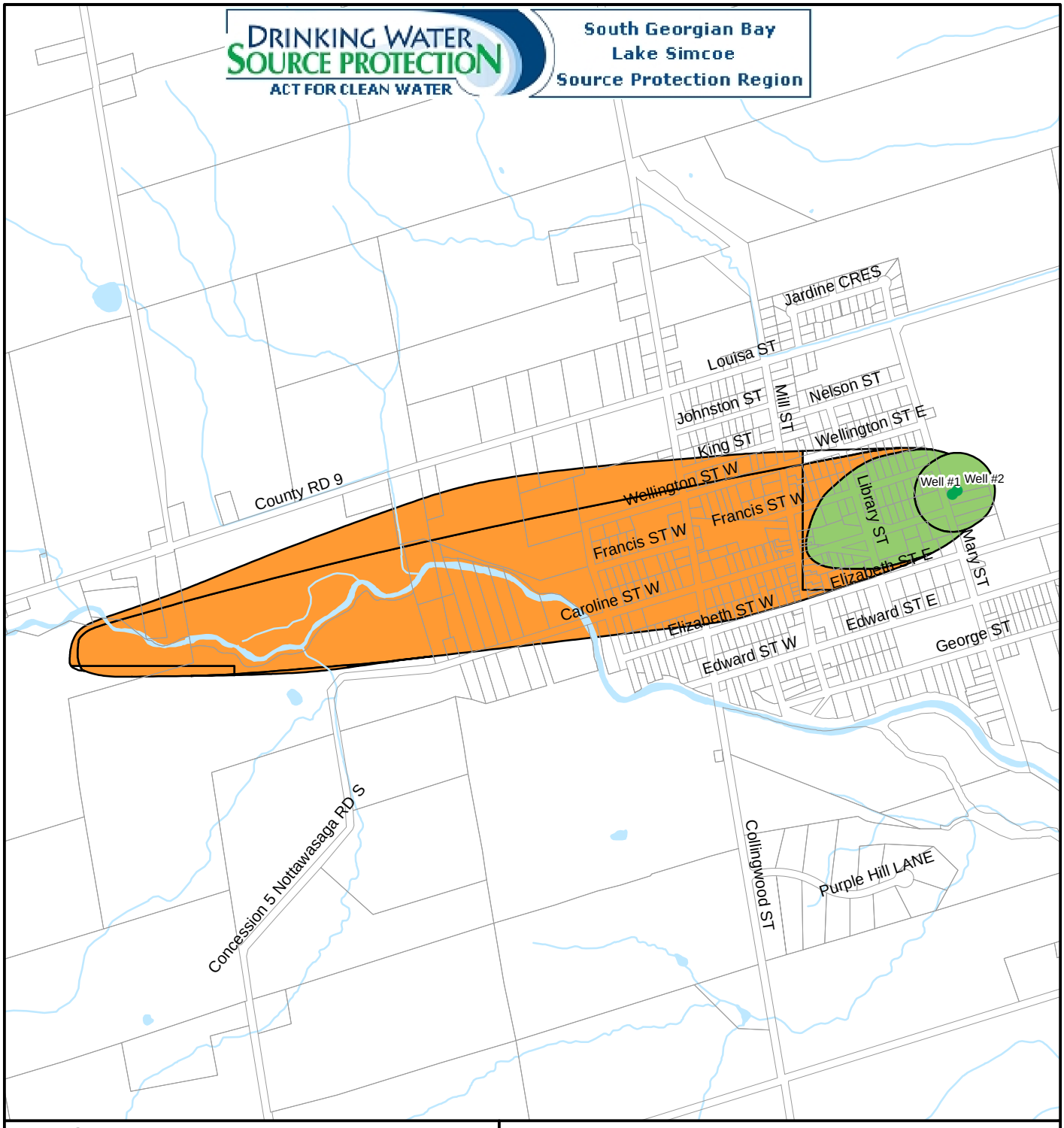
The Managed Land proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.3-7

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GENIVAR Ontario

FIGURE **10c-7**



Legend

- MUNICIPAL WELL LOCATION
- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)

N W E S

100 50 0 100 Metres

LIVESTOCK DENSITY - CREEMORE

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

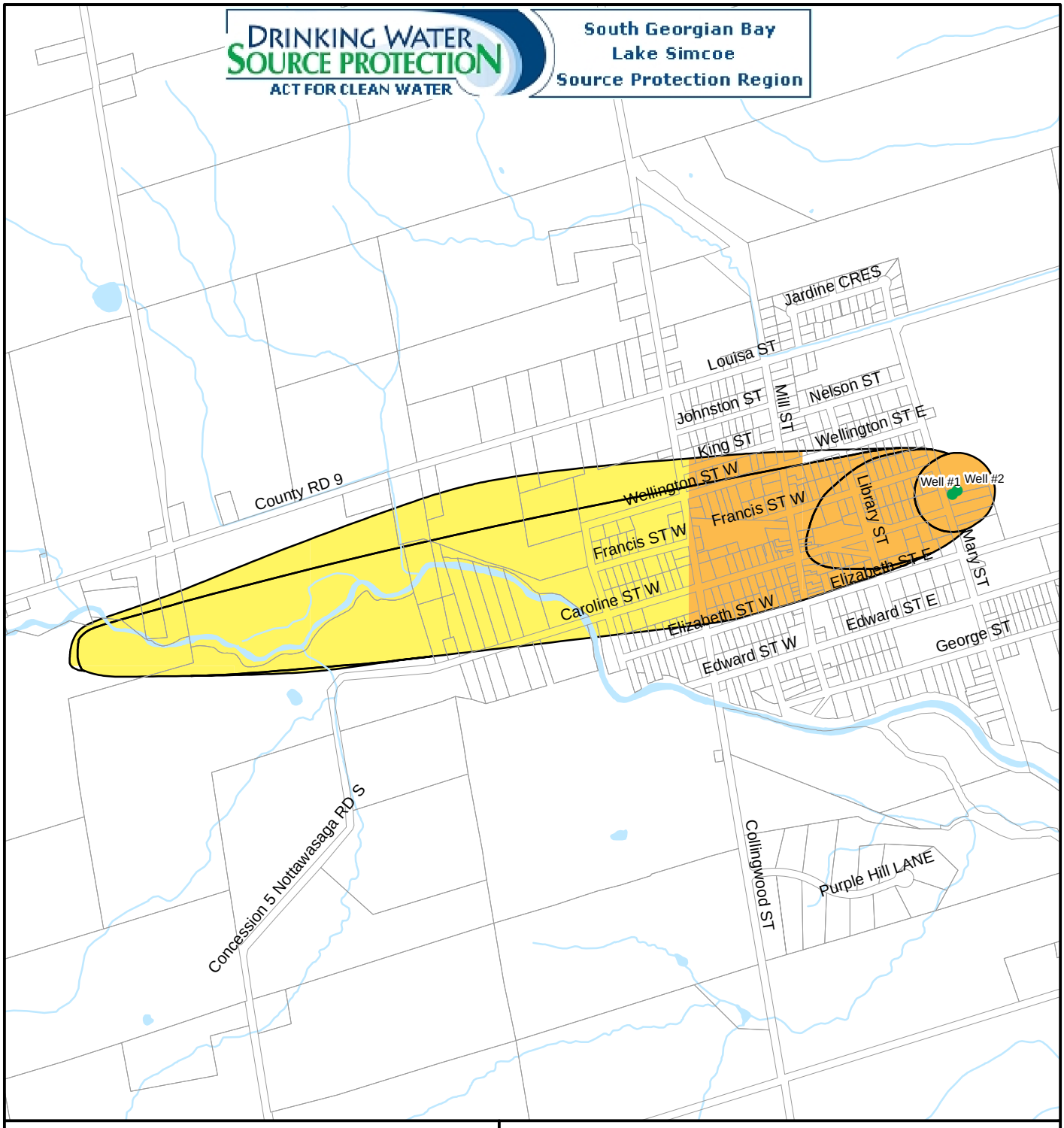
DATE: JULY 2010 | SCALE: 1:15000

PROJECT: 0-071948.01 | FILE. NO.:0-07194801F6.3-8

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GENIVAR Ontario

FIGURE **10c-8**



Legend

- MUNICIPAL WELL LOCATION

IMPERVIOUS SURFACE

- <1%
- >1% and <8%
- >8% and <80%

N W E S

100 50 0 100 Metres

IMPERVIOUS SURFACES - CREEMORE

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

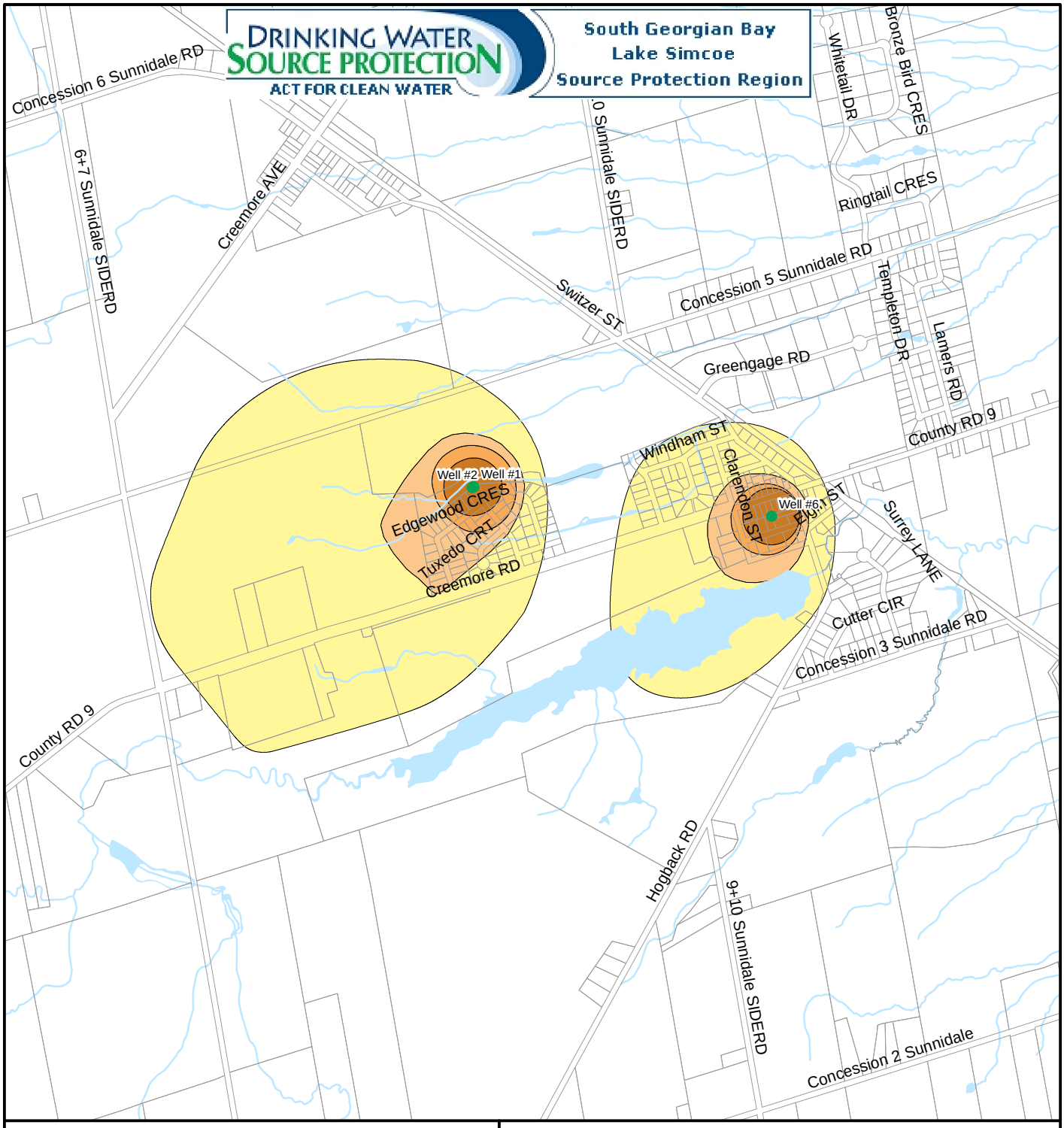
The Impervious Surfaces proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

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PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.3-9

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GENIVAR Ontario

FIGURE 10c-9



Legend

- MUNICIPAL WELL LOCATION
- WHPA-A: 100 m RADIUS
- WHPA-B: 2-YEAR TIME-OF-TRAVEL
- WHPA-C: 5-YEAR TIME-OF-TRAVEL
- WHPA-D: 25-YEAR TIME-OF-TRAVEL

WELLHEAD PROTECTION AREAS - NEW LOWELL, CLEARVIEW

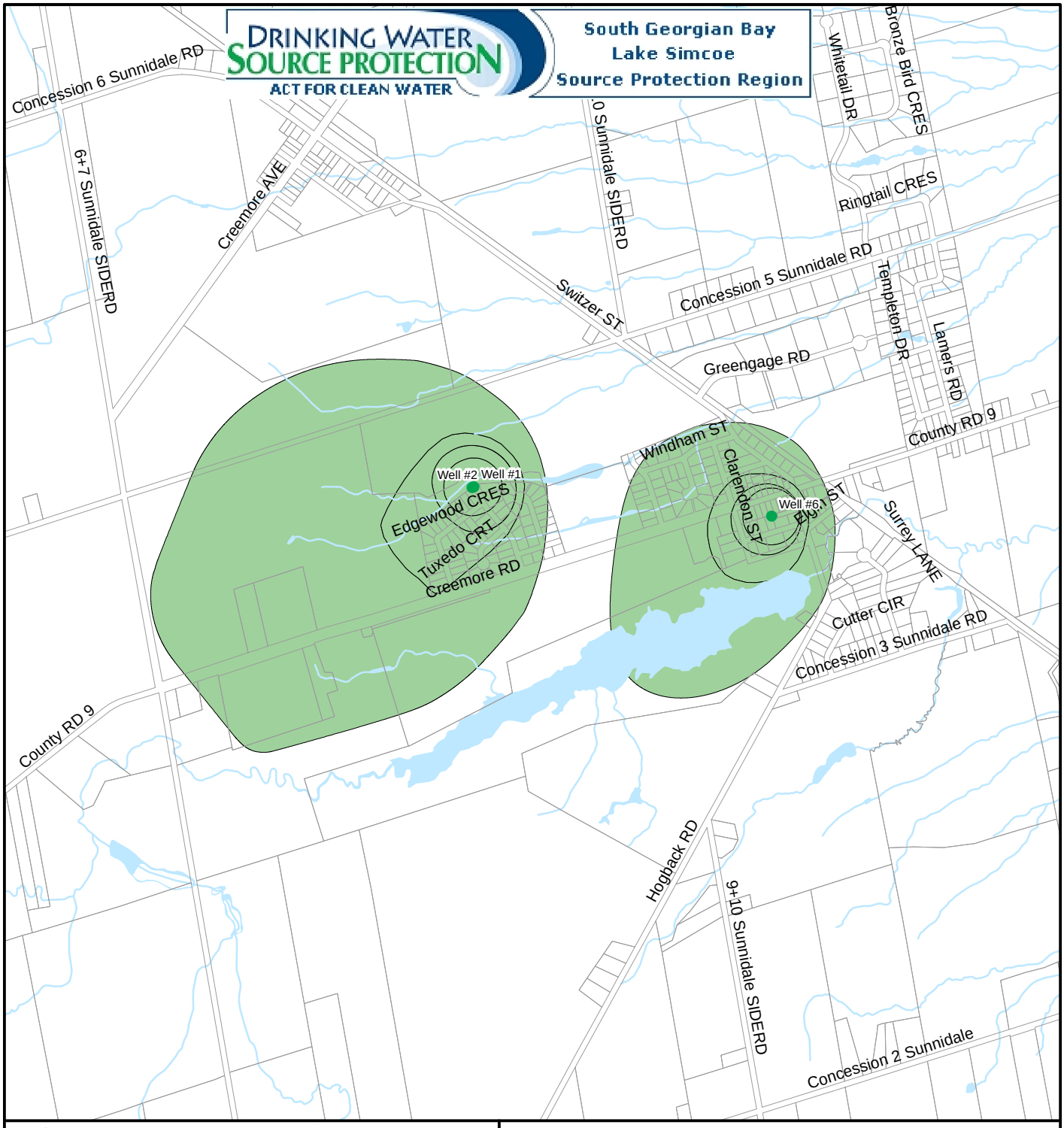
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:20000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.4-1

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GENIVAR Ontario

FIGURE **10d-1**



GROUNDWATER VULNERABILITY - NEW LOWELL

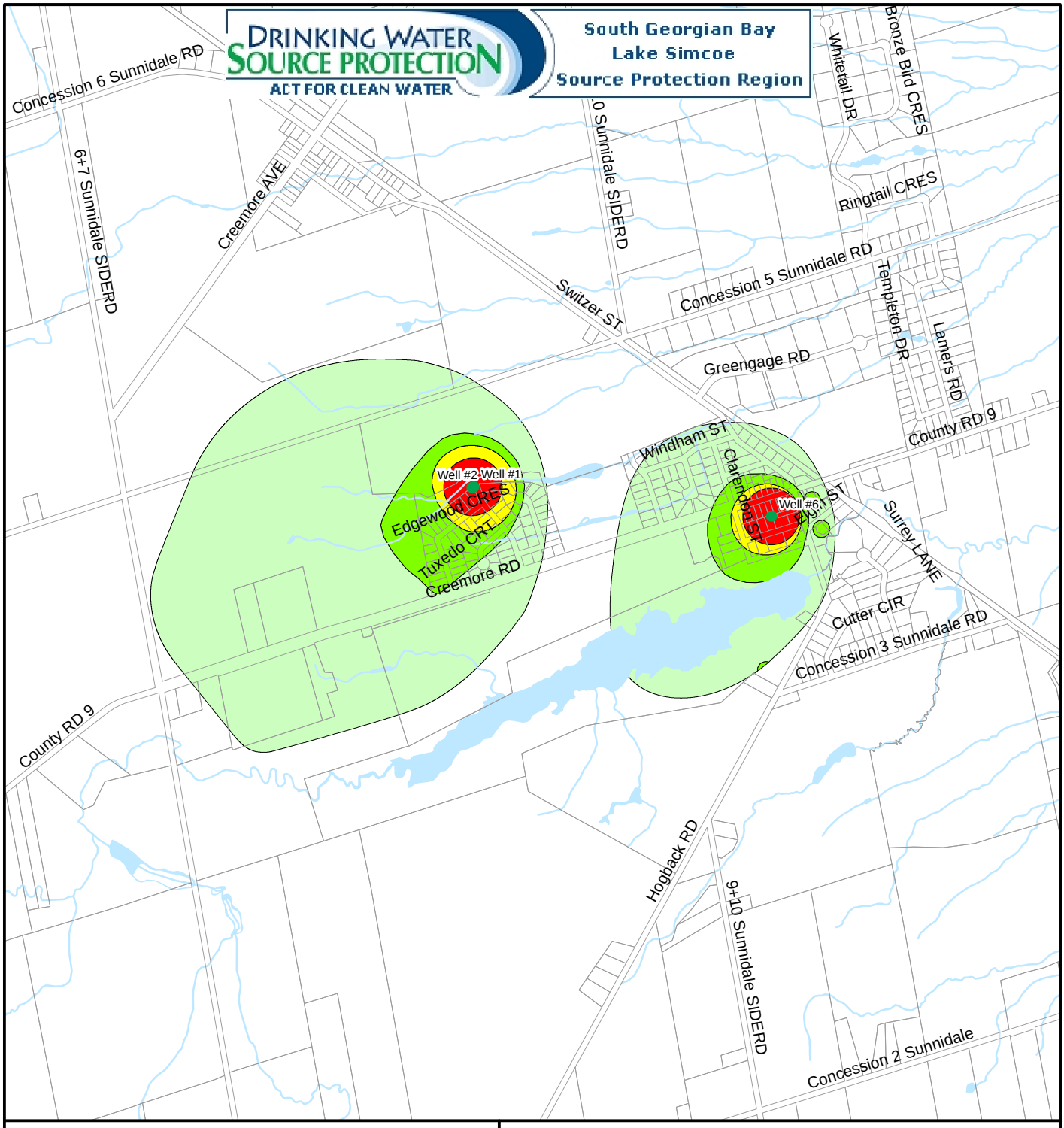
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:20000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.4-2

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GENIVAR Ontario

FIGURE **10d-2**



VULNERABILITY SCORES - NEW LOWELL

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

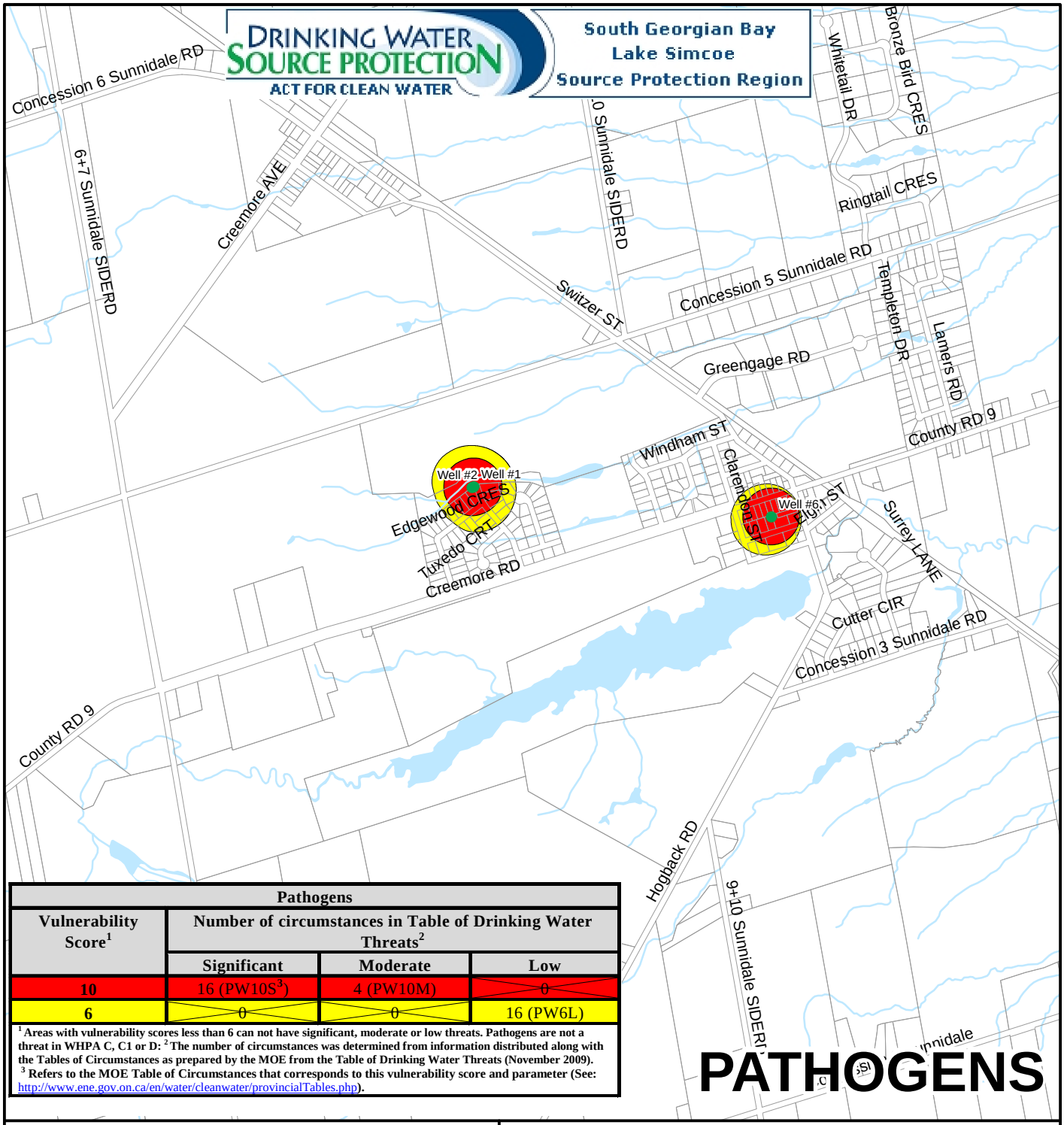
DATE: JULY 2010	SCALE: 1:20000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.4-5

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GENIVAR

Ontario

FIGURE **10d-3**



Pathogens			
Vulnerability Score[1]	Number of circumstances in Table of Drinking Water Threats[2]		
	Significant	Moderate	Low
10	16 (PW10S[3])	4 (PW10M)	~~0~~
6	~~0~~	~~0~~	16 (PW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. Pathogens are not a threat in WHPA C, C1 or D: [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009). [3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6

N W E S

200 100 0 200 Metres

AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - NEW LOWELL

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

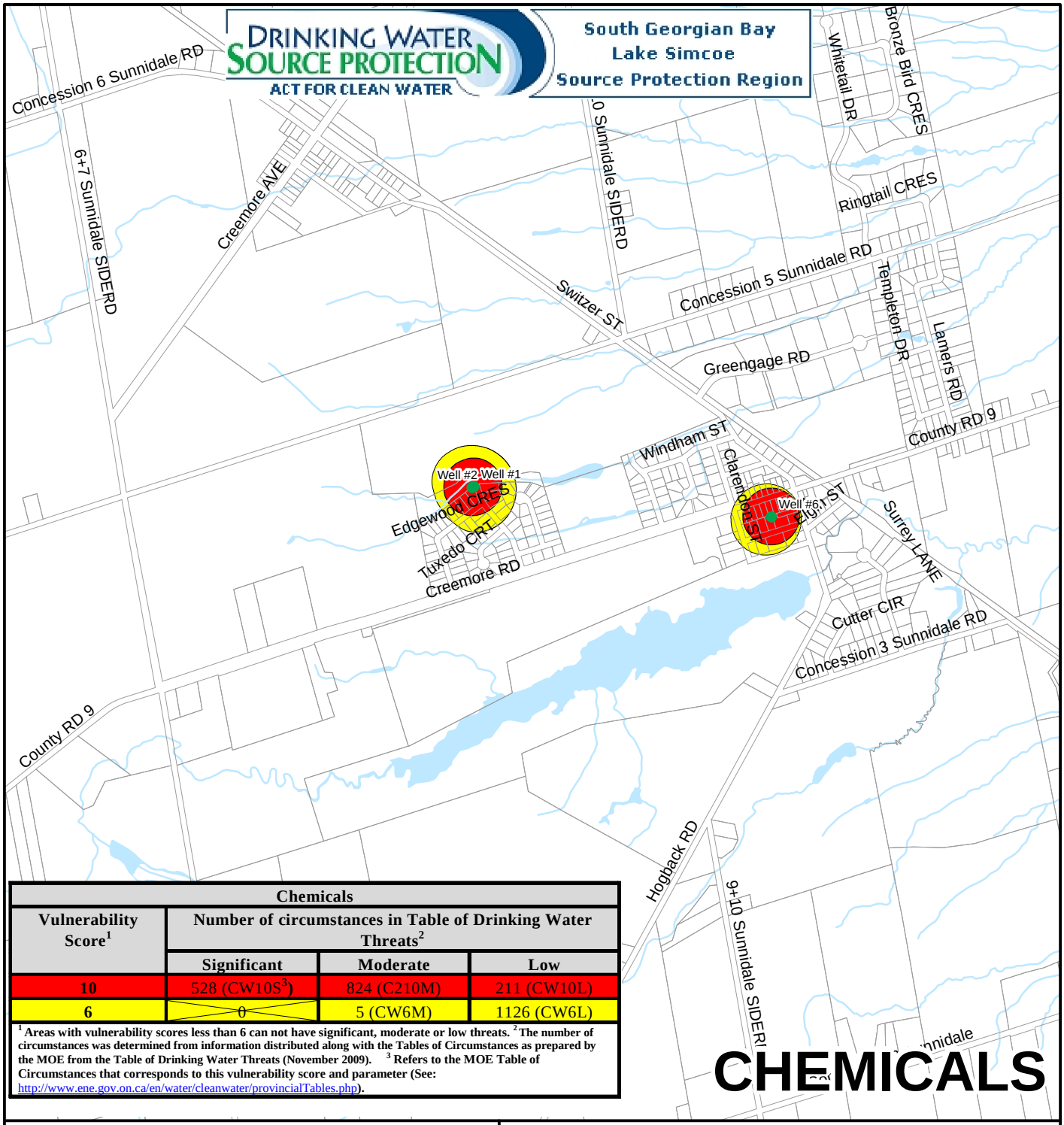
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

DATE: JULY 2010	SCALE: 1:20000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.4-6

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GENIVAR Ontario

FIGURE 10d-4



Chemicals			
Vulnerability Score[1]	Number of circumstances in Table of Drinking Water Threats[2]		
	Significant	Moderate	Low
10	528 (CW10S[3])	824 (C210M)	211 (CW10L)
6	~~0~~	5 (CW6M)	1126 (CW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009). [3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6

N W E S

200 100 0 200 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - NEW LOWELL

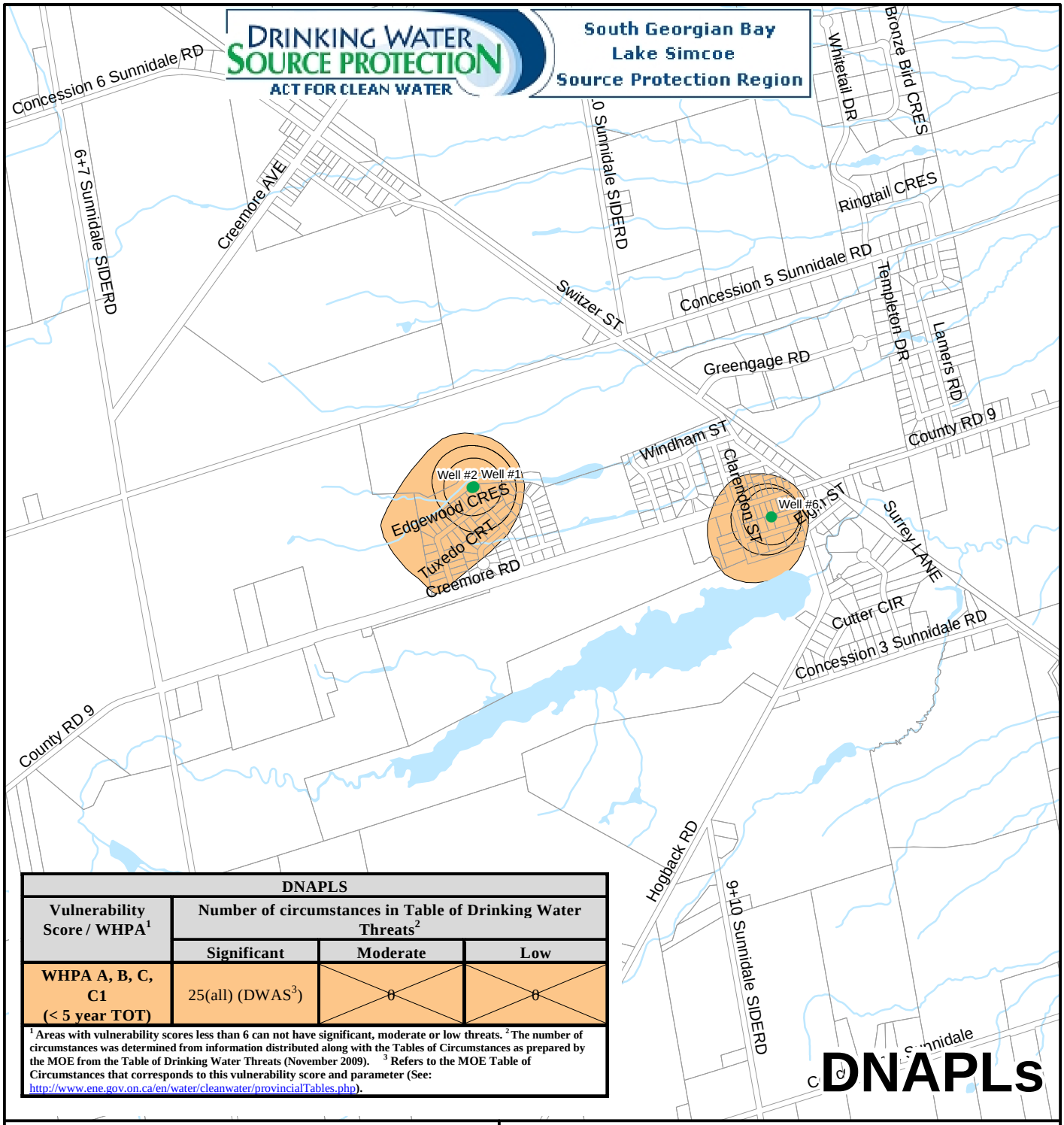
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:20000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.4-7

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GENIVAR Ontario

FIGURE 10d-5



DNAPLS			
Vulnerability Score / WHPA[1]	**Number of circumstances in Table of Drinking Water Threats[2]**		
	Significant	**Moderate**	**Low**
WHPA A, B, C, C1 (< 5 year TOT)	25(all) (DWAS[3])	0	0

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009). [3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

LEGEND

- MUNICIPAL WELL LOCATION
- WHPA-C: 5 YEAR TIME-OF-TRAVEL

N W E S

200 100 0 200 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

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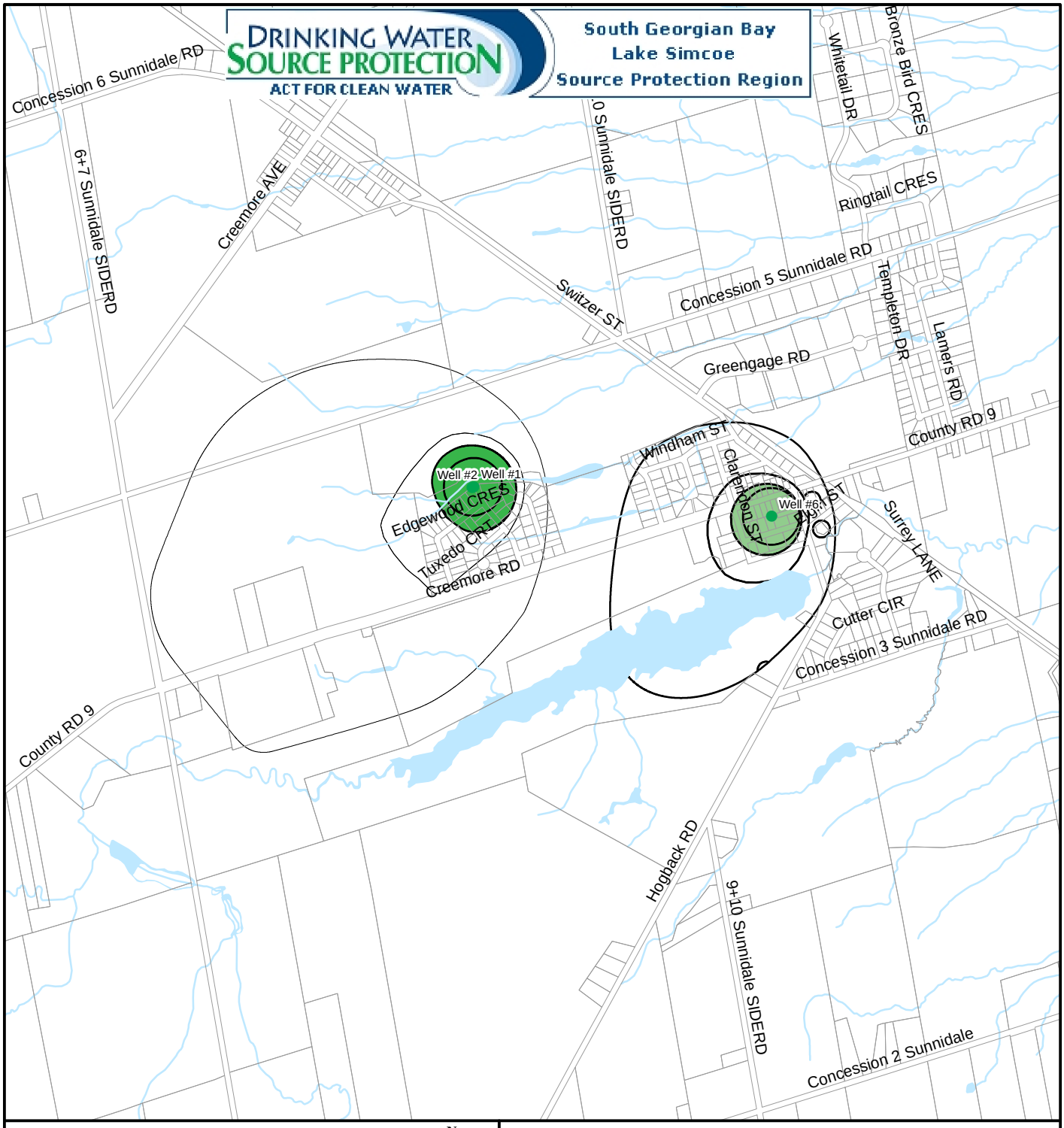
AREAS WHERE DNAPLS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - NEW LOWELL

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:20000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.4-8

GENIVAR Ontario

FIGURE **10d-6**



Legend

- MUNICIPAL WELL LOCATION
- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)

N W E S

190 95 0 190 Metres

MANAGED LANDS - NEW LOWELL

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Managed Land proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

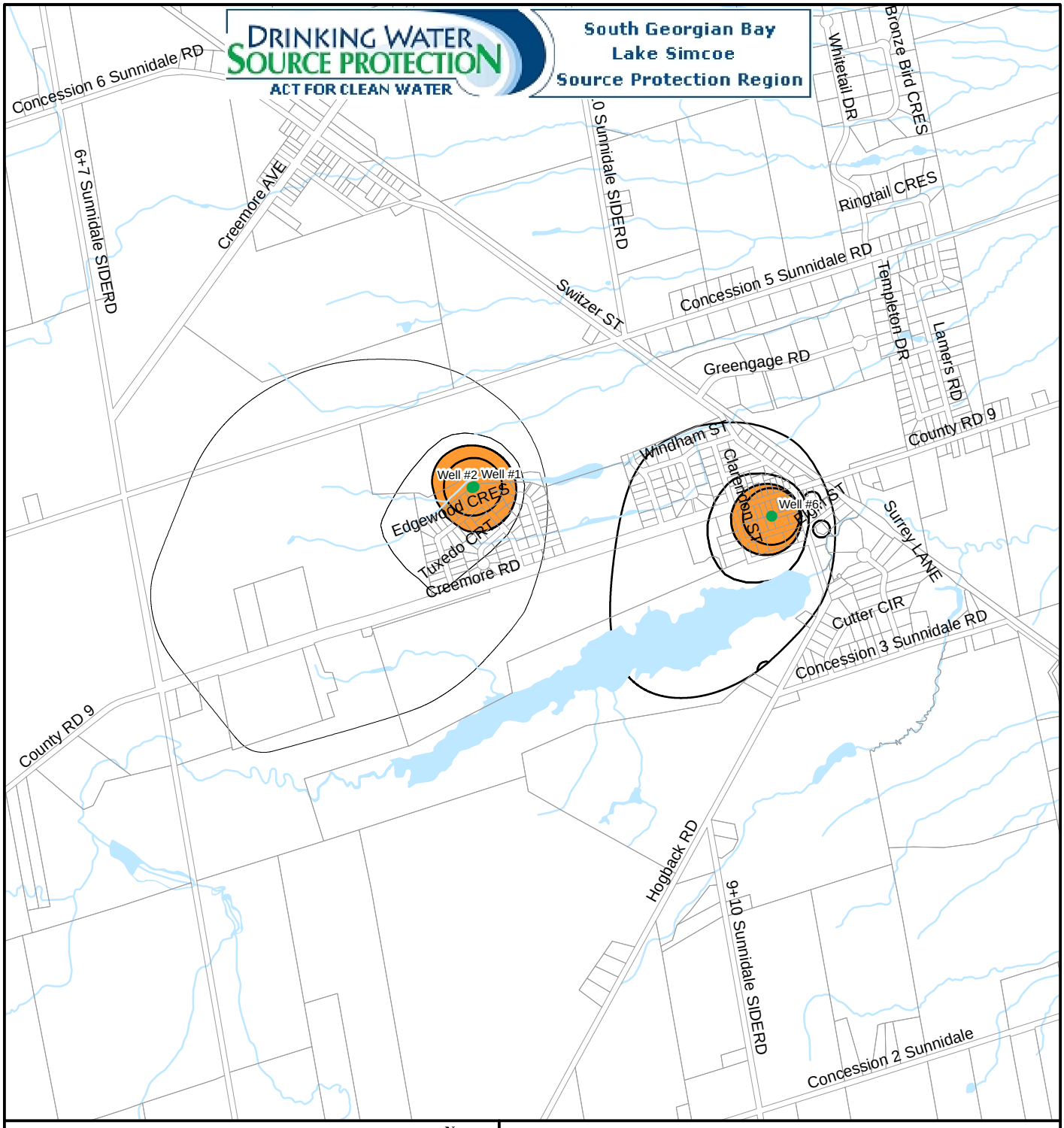
DATE: JULY 2010 | SCALE: 1:20000

PROJECT: 0-071948.01 | FILE. NO.:0-07194801F6.4-9

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GENIVAR Ontario

FIGURE **10d-7**



Legend

- MUNICIPAL WELL LOCATION
- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)

LIVESTOCK DENSITY - NEW LOWELL

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

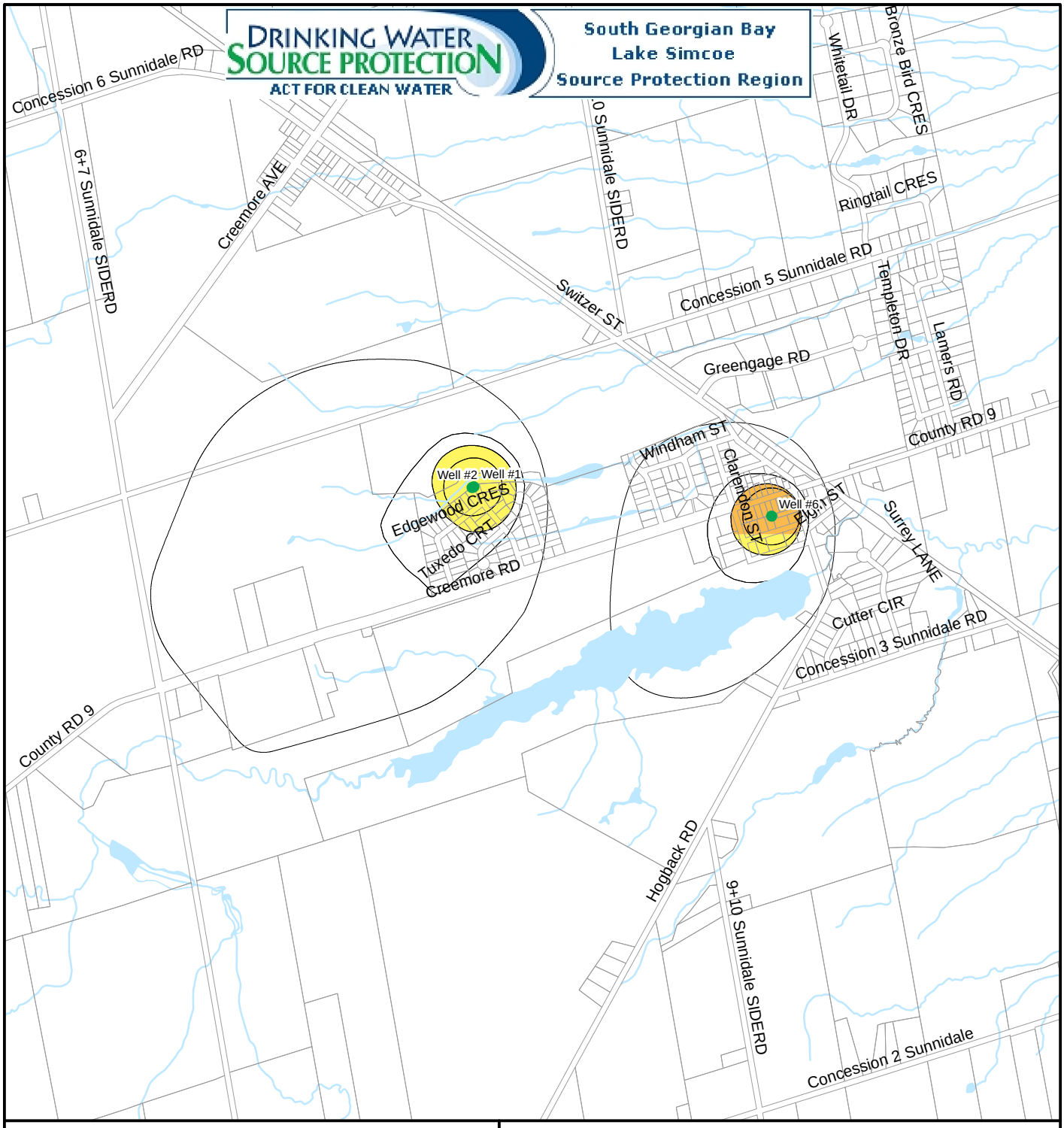
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GENIVAR Ontario

FIGURE **10d-8**



Legend

- MUNICIPAL WELL LOCATION

IMPERVIOUS SURFACE

- <1%
- >1% and <8%
- >8% and <80%

N W E S

200 100 0 200 Metres

IMPERVIOUS SURFACES - NEW LOWELL

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Impervious Surfaces proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

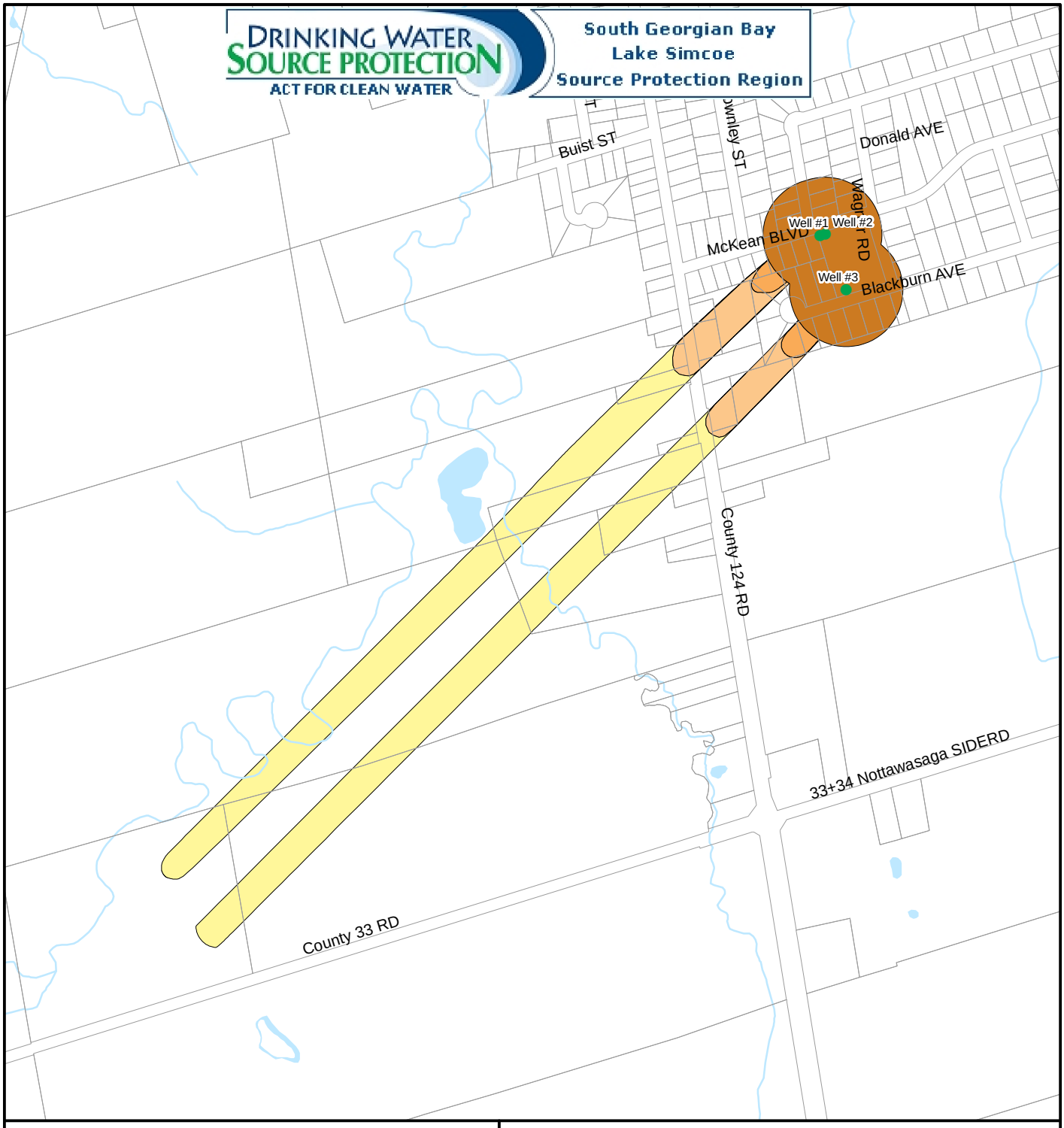
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PROJECT: 0-071948.01 | FILE. NO.:0-07194801F6.4-11

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GENIVAR Ontario

FIGURE **10d-9**



Legend

- MUNICIPAL WELL LOCATION
- WHPA-A: 100 m RADIUS
- WHPA-B: 2-YEAR TIME-OF-TRAVEL
- WHPA-C: 5-YEAR TIME-OF-TRAVEL
- WHPA-D: 25-YEAR TIME-OF-TRAVEL

N W E S

90 45 0 90 Metres

WELLHEAD PROTECTION AREAS - McKEAN, CLEARVIEW

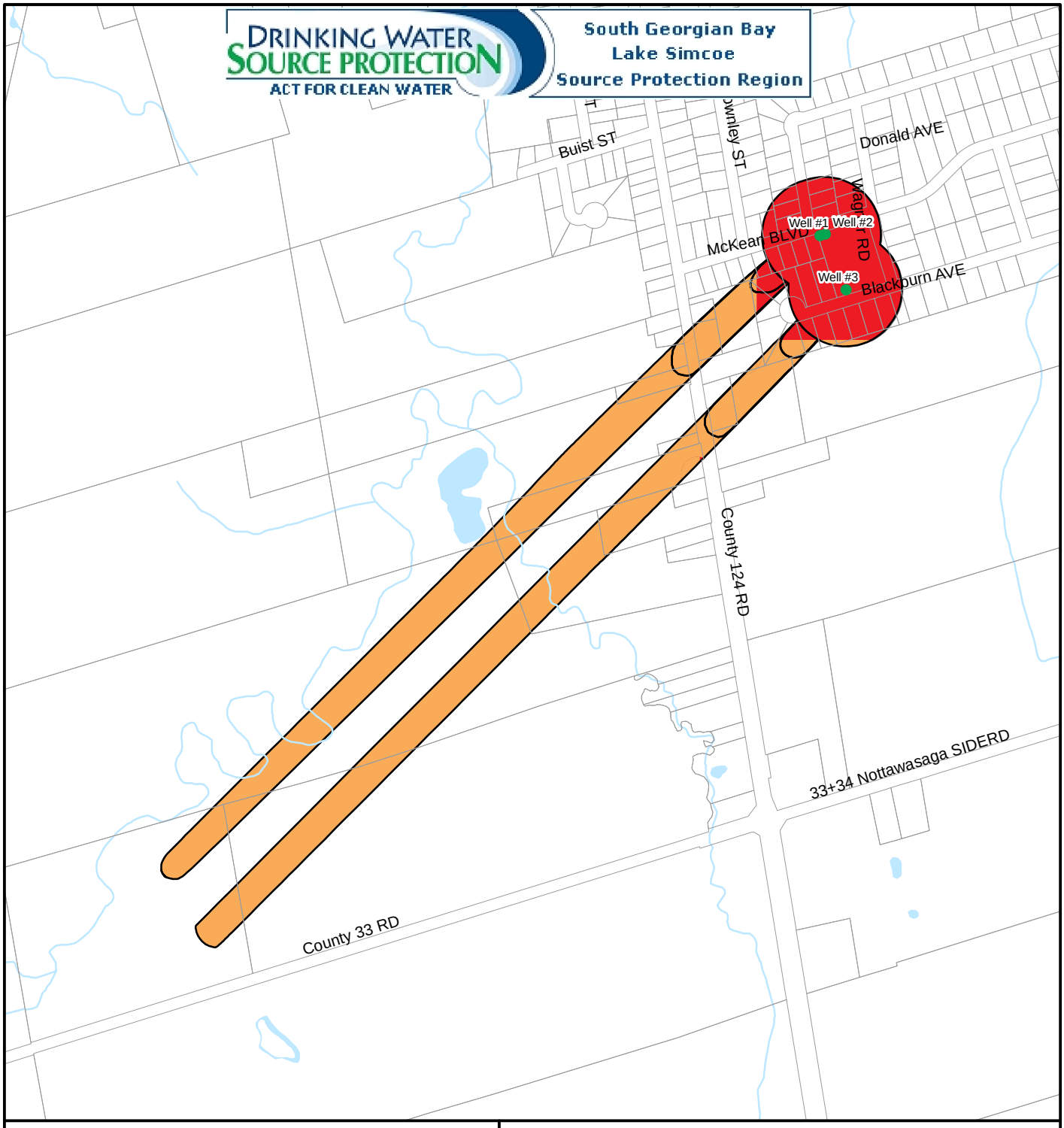
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.5-1

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GENIVAR Ontario

FIGURE **10e-1**



LEGEND

- MUNICIPAL WELL LOCATION

AQUIFER VULNERABILITY INDEX

- HIGH
- MEDIUM
- LOW

N W E S

90 45 0 90 Metres

GROUNDWATER VULNERABILITY - McKEAN

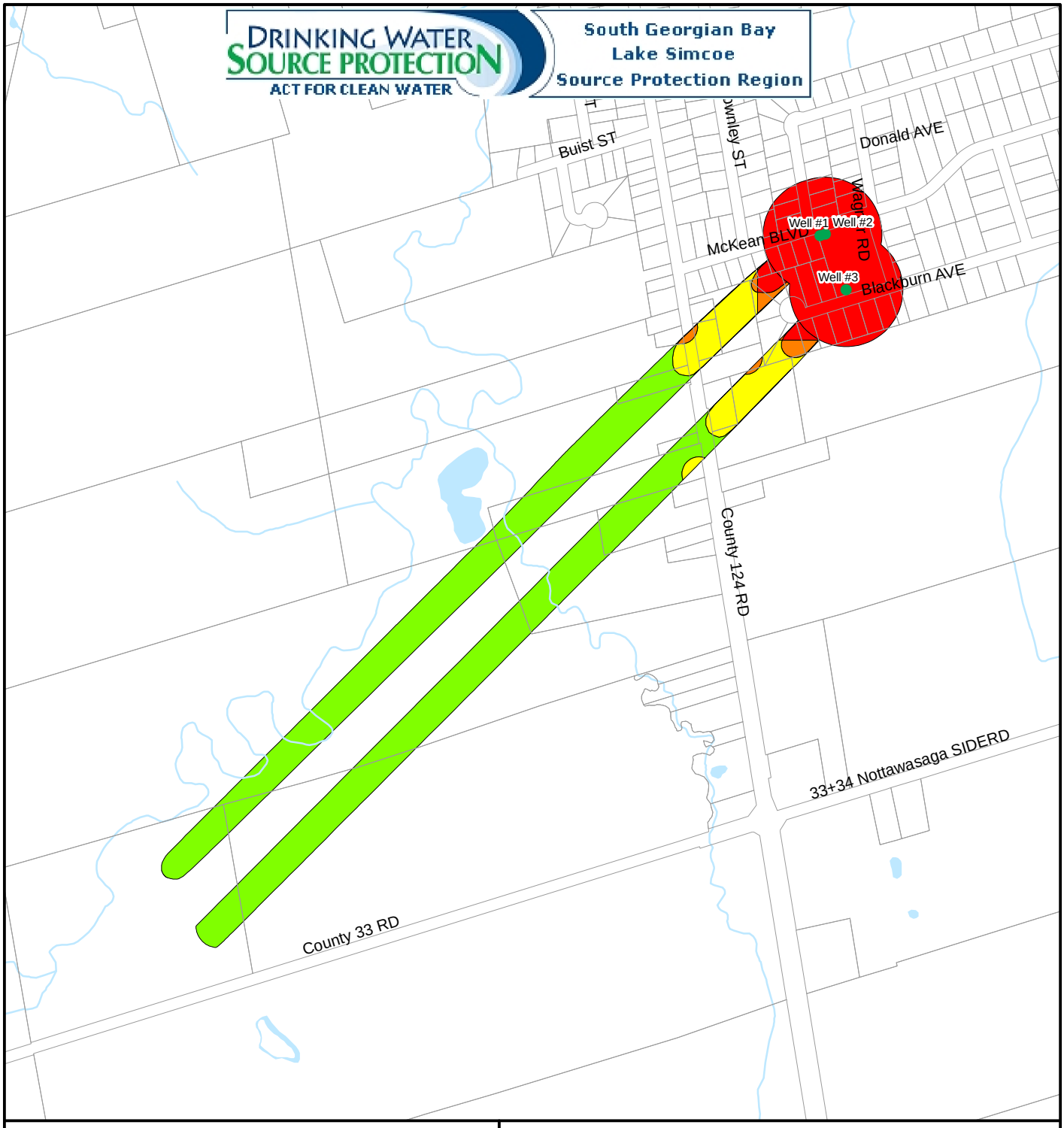
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.5-2

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GENIVAR Ontario

FIGURE **10e-2**



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6
- 4
- 2

N
W E
S

100 50 0 100 Metres

VULNERABILITY SCORES - McKEAN

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.5-5

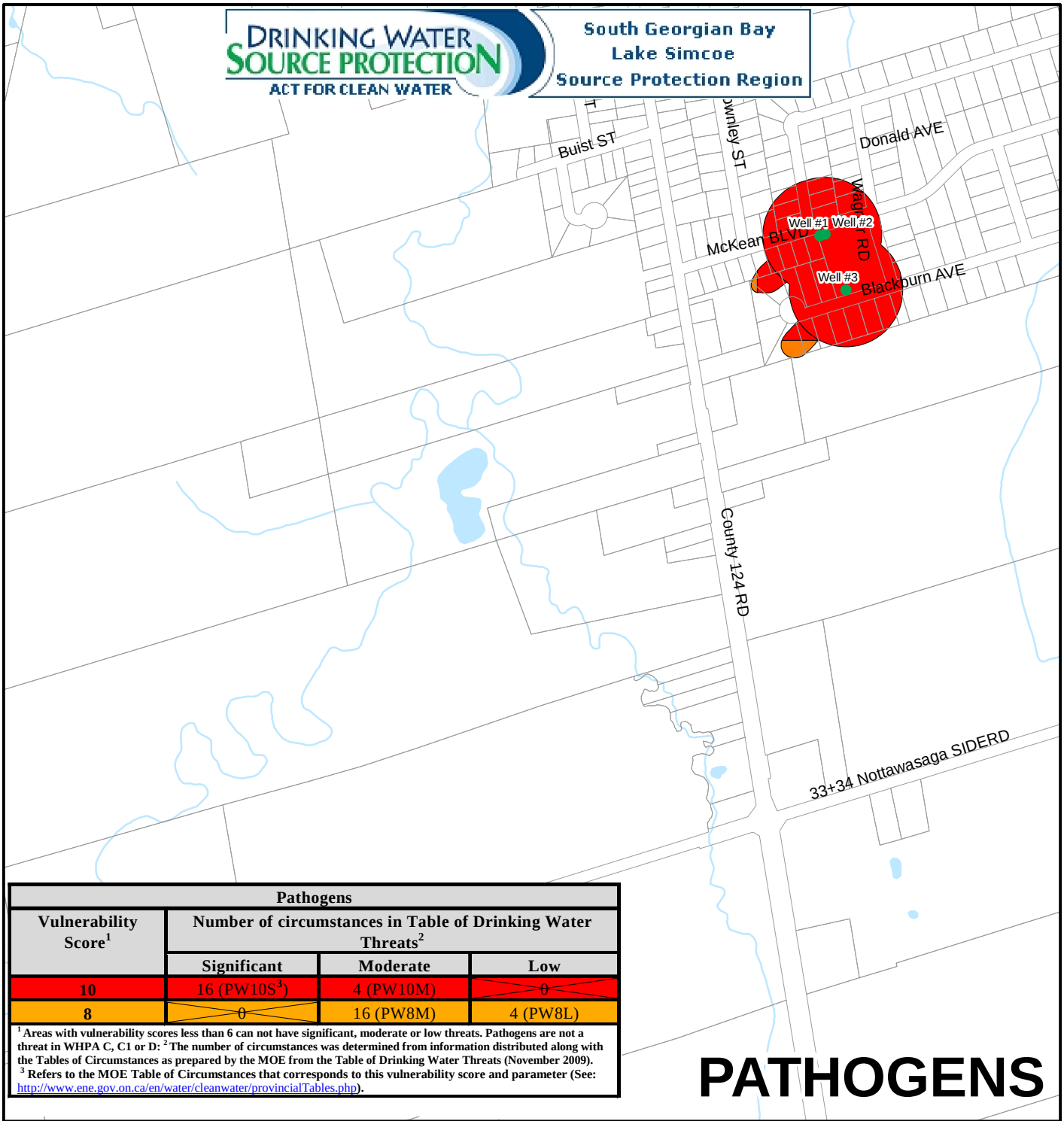
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GENIVAR Ontario

FIGURE **10e-3**

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Pathogens			
Vulnerability Score[1]	Number of circumstances in Table of Drinking Water Threats[2]		
	Significant	Moderate	Low
10	16 (PW10S[3])	4 (PW10M)	~~0~~
8	~~0~~	16 (PW8M)	4 (PW8L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. Pathogens are not a threat in WHPA C, C1 or D: [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009).
[3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

PATHOGENS

LEGEND
- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING
- 10
- 8
- 6

N W E S

100 50 0 100 Metres

AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - NOTTAWA-McKEAN

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.5-6

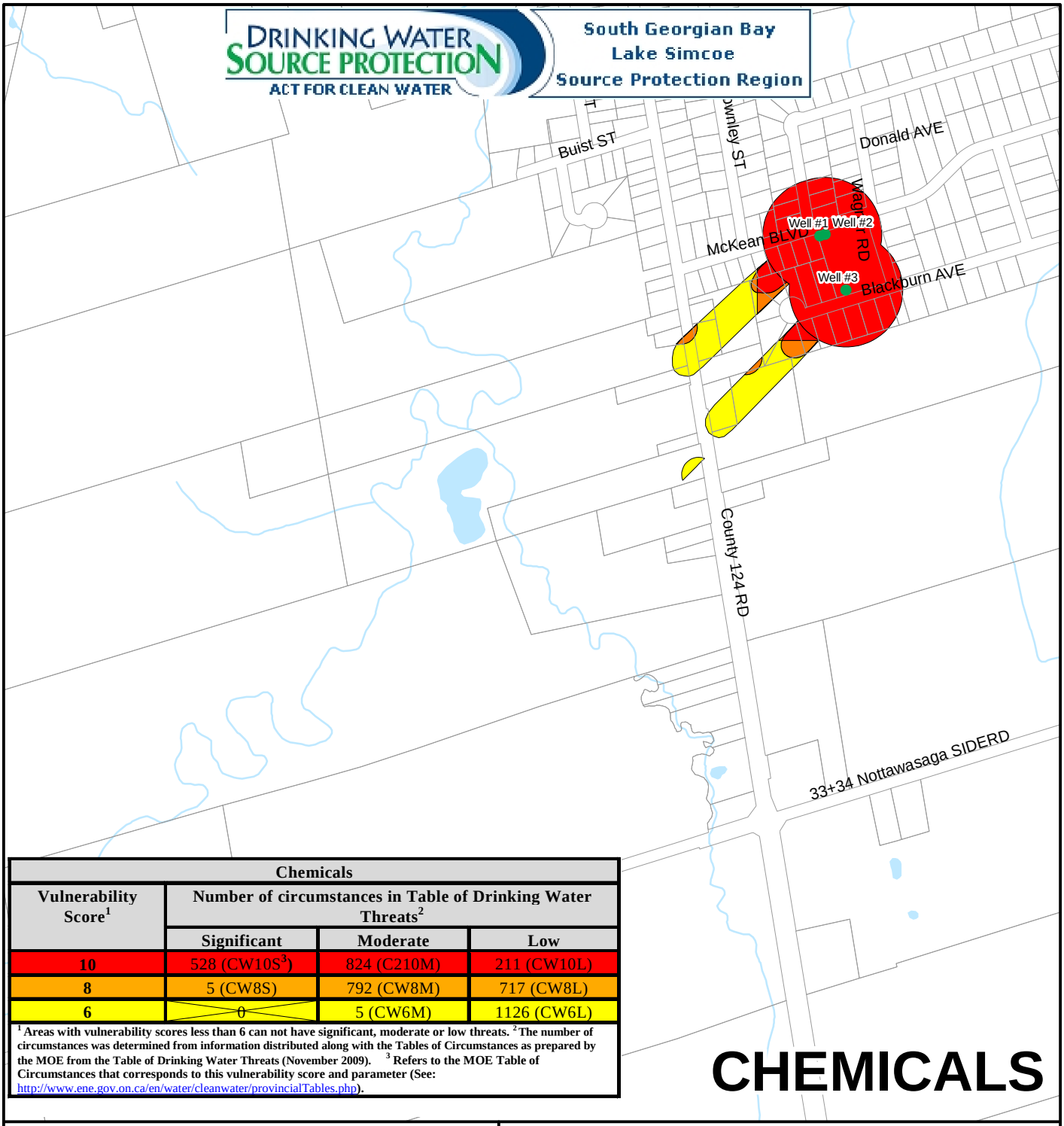
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GENIVAR Ontario

FIGURE 10e-4

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Chemicals			
Vulnerability Score[1]	Number of circumstances in Table of Drinking Water Threats[2]		
	Significant	Moderate	Low
10	528 (CW10S[3])	824 (C210M)	211 (CW10L)
8	5 (CW8S)	792 (CW8M)	717 (CW8L)
6	~~0~~	5 (CW6M)	1126 (CW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009). [3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

CHEMICALS

LEGEND
- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING
- 10
- 8
- 6

N W E S

100 50 0 100 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - NOTTAWA-McKEAN

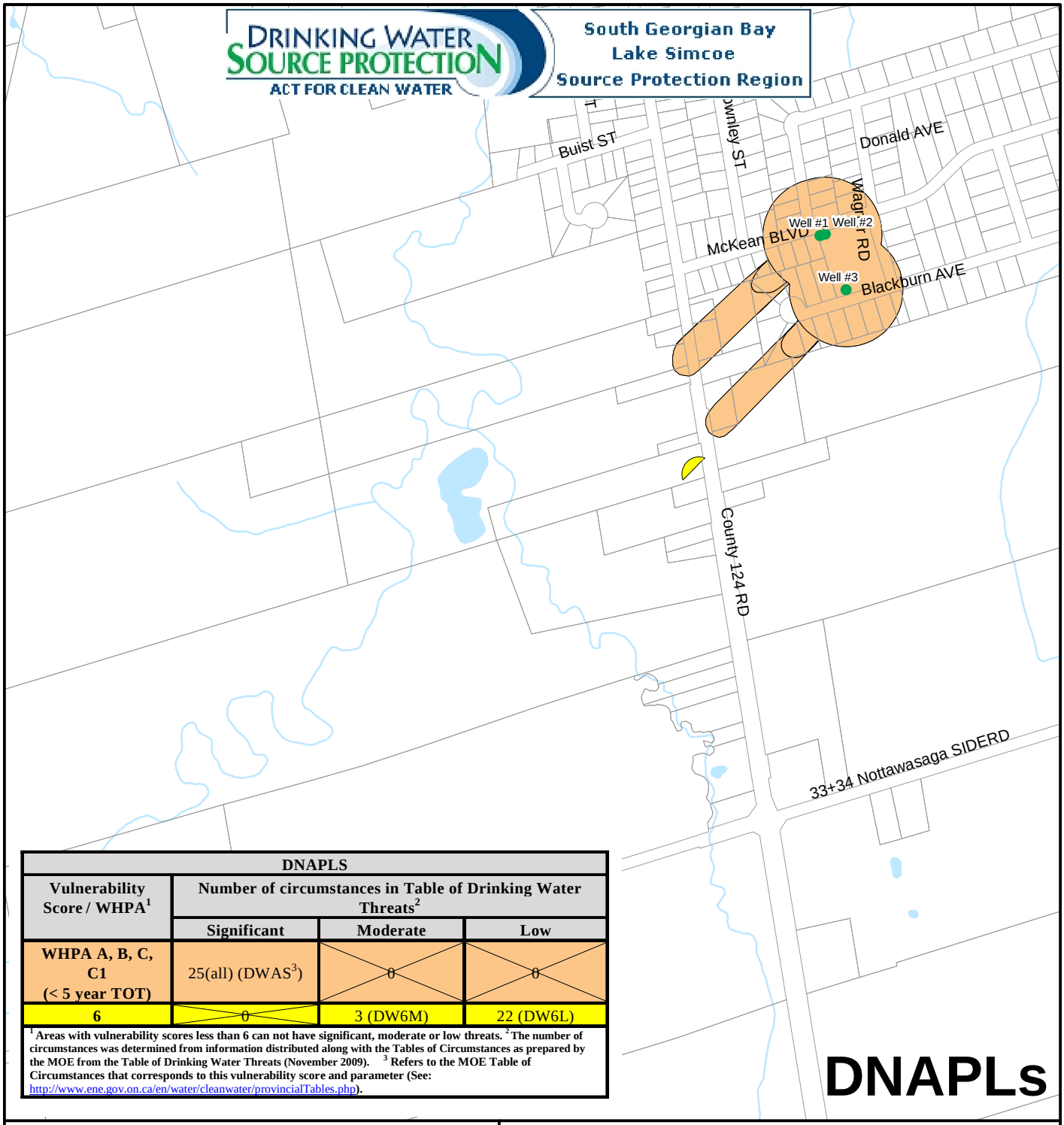
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.5-7

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GENIVAR Ontario

FIGURE 10e-5



DNAPLS			
Vulnerability Score / WHPA[1]	**Number of circumstances in Table of Drinking Water Threats[2]**		
	Significant	**Moderate**	**Low**
WHPA A, B, C, C1 (< 5 year TOT)	25(all) (DWAS[3])	~~0~~	~~0~~
6	~~0~~	3 (DW6M)	22 (DW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009). [3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

DNAPLs

LEGEND

- MUNICIPAL WELL LOCATION
- WHPA-C: 5 YEAR TIME-OF-TRAVEL

VULNERABILITY SCORING

- 6

N W E S

100 50 0 100 Metres

AREAS WHERE DNAPLs ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - NOTTAWA-McKEAN

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

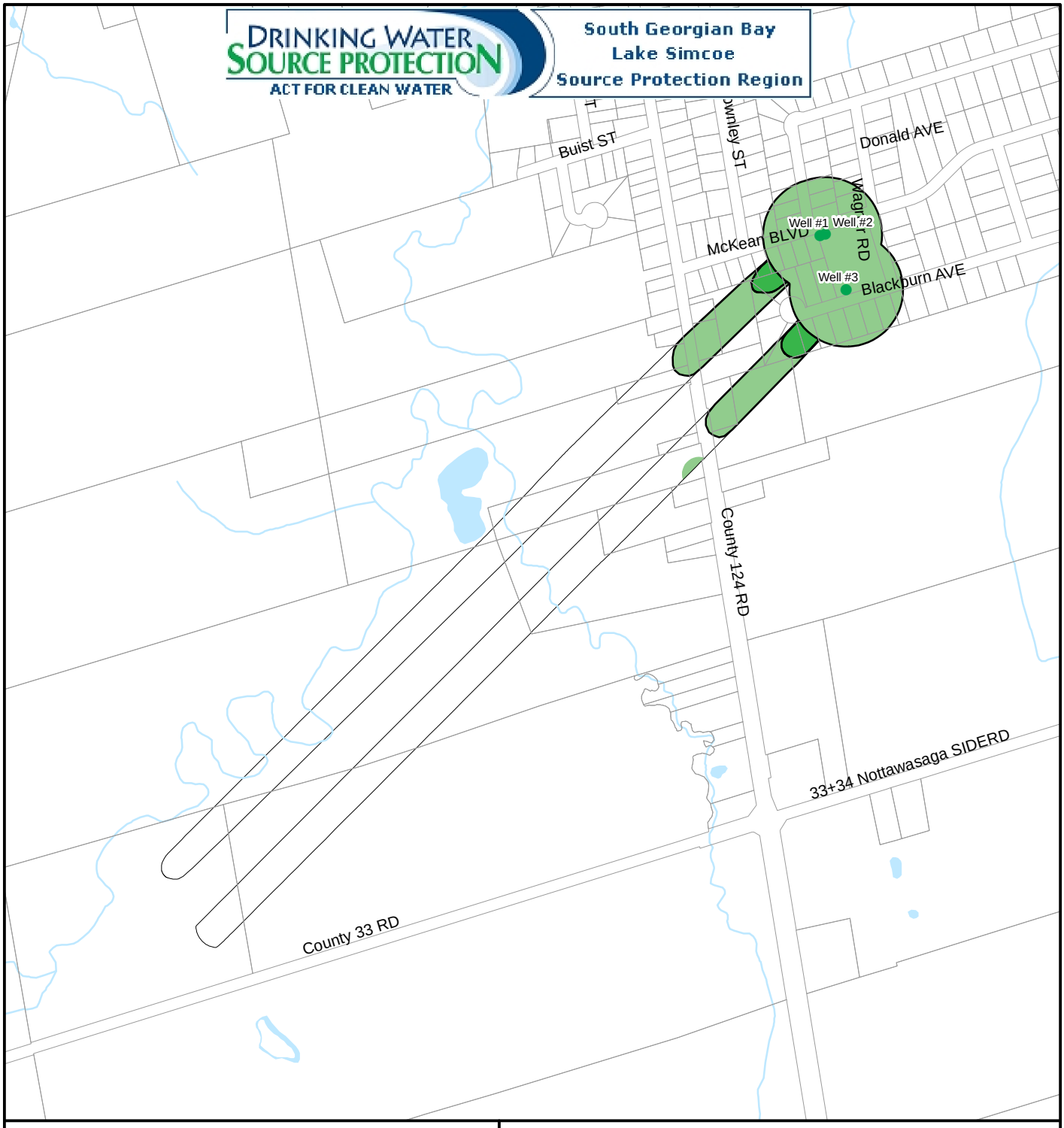
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PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.5-8

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GENIVAR Ontario

FIGURE **10e-6**



Legend

- MUNICIPAL WELL LOCATION
- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)

N W E S

100 50 0 100 Metres

MANAGED LANDS - McKEAN

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

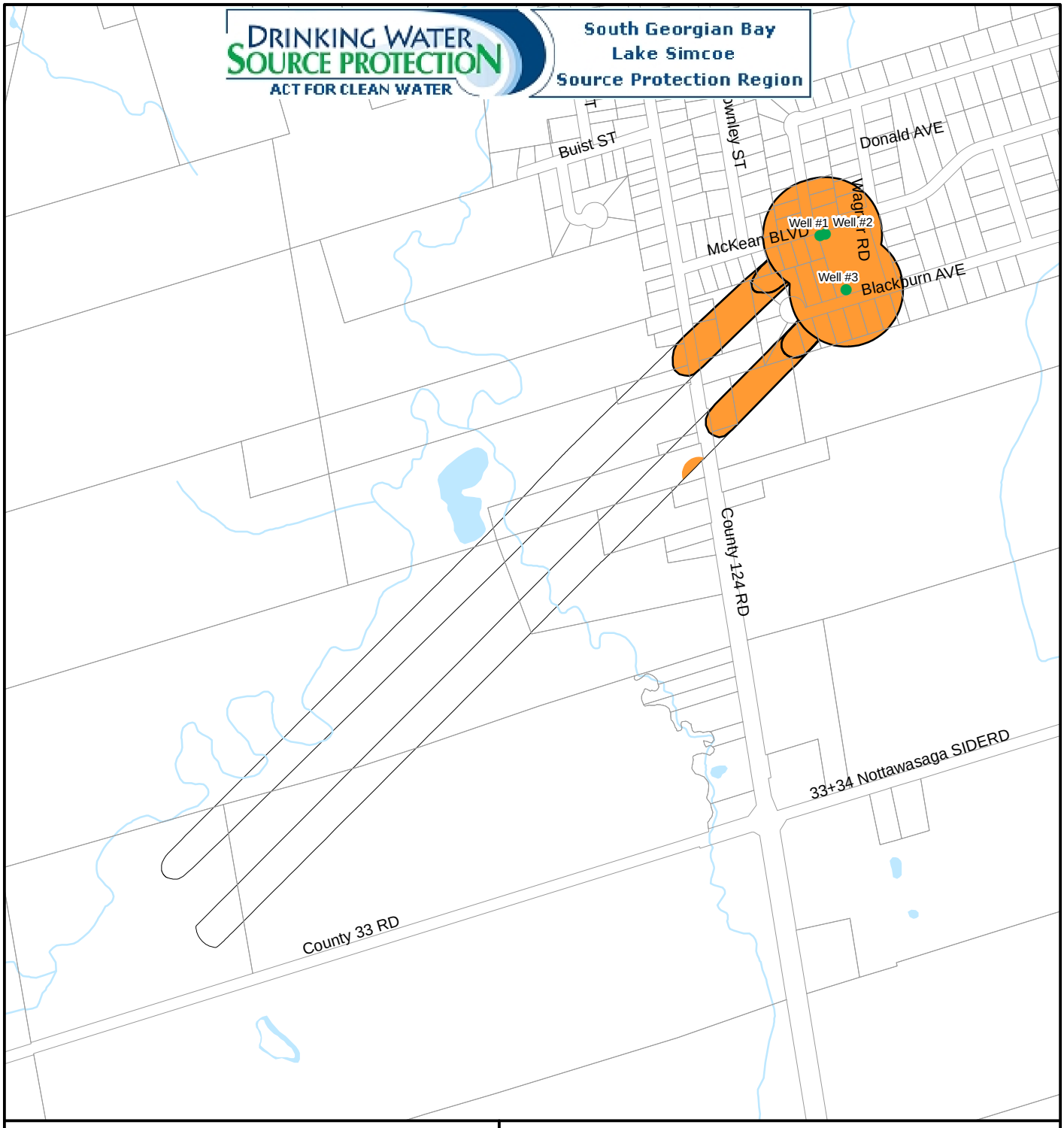
The Managed Land proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.5-9

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GENIVAR Ontario

FIGURE **10e-7**



Legend

- MUNICIPAL WELL LOCATION
- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)

N W E S

100 50 0 100 Metres

LIVESTOCK DENSITY - McKEAN

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

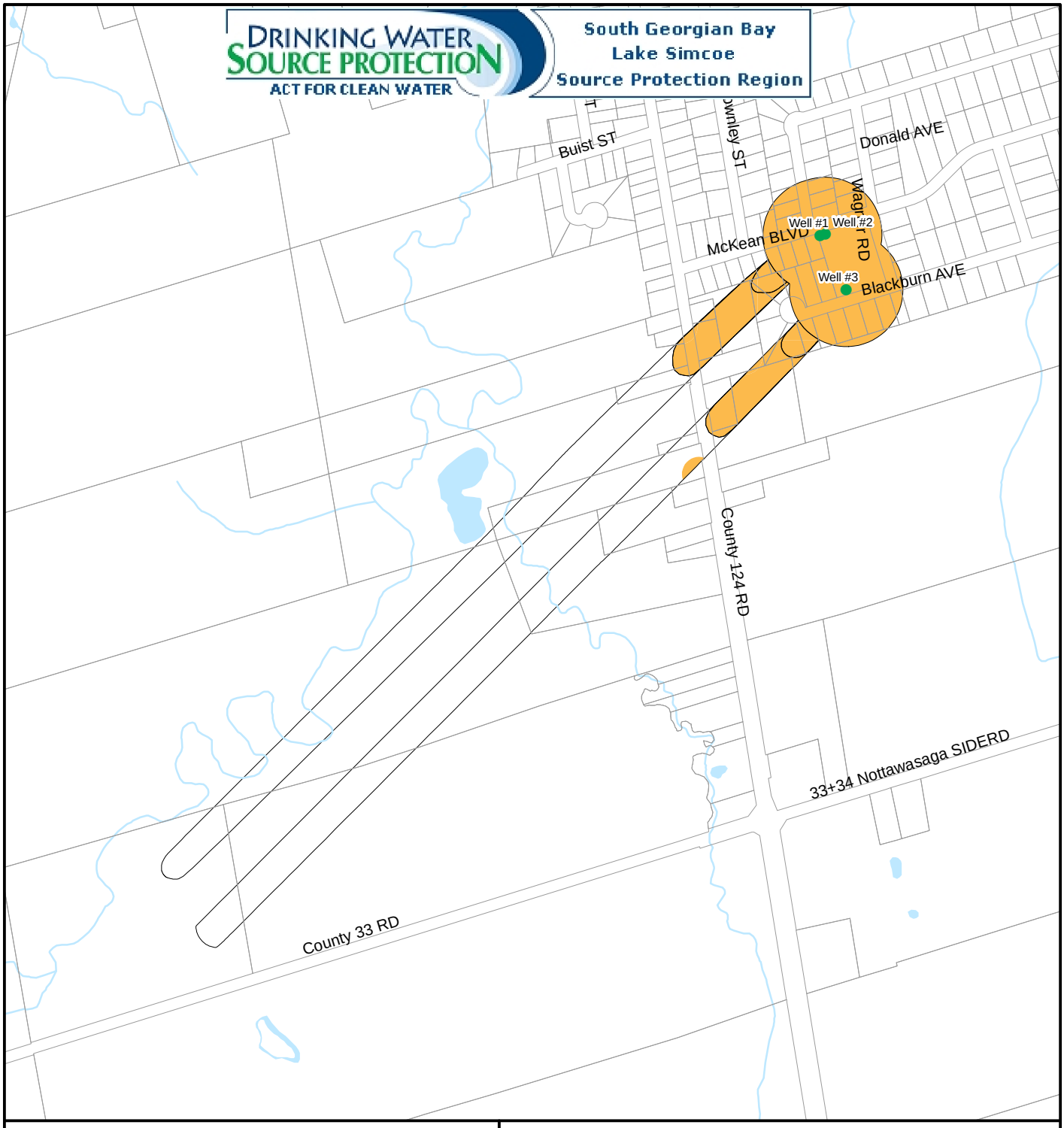
DATE: JULY 2010 | SCALE: 1:10000

PROJECT: 0-071948.01 | FILE. NO.:0-07194801F6.5-10

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GENIVAR Ontario

FIGURE **10e-8**



Legend

MUNICIPAL WELL LOCATION

IMPERVIOUS SURFACE

- <1%
- >1% and <8%
- >8% and <80%

N W E S

100 50 0 100 Metres

IMPERVIOUS SURFACES - McKEAN

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Impervious Surfaces proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

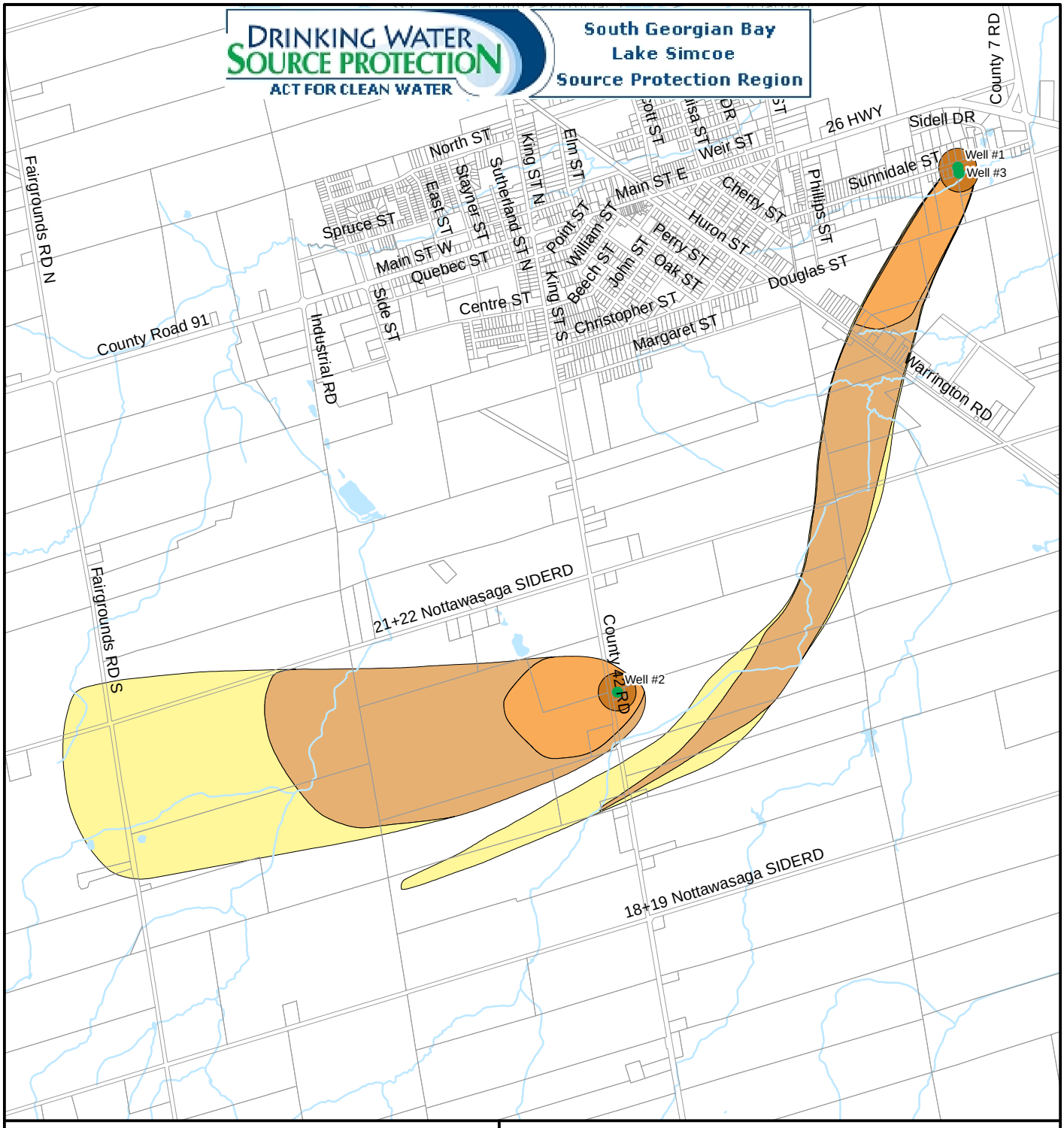
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PROJECT: 0-071948.01 | FILE. NO.:0-07194801F6.5-11

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GENIVAR Ontario

FIGURE **10e-9**



Legend

- MUNICIPAL WELL LOCATION
- WHPA-A: 100 m RADIUS
- WHPA-B: 2-YEAR TIME-OF-TRAVEL
- WHPA-C1: 10-YEAR TIME-OF-TRAVEL
- WHPA-D: 25-YEAR TIME-OF-TRAVEL

N W E S

290 145 0 290 Metres

WELLHEAD PROTECTION AREAS - STAYNER, CLEARVIEW

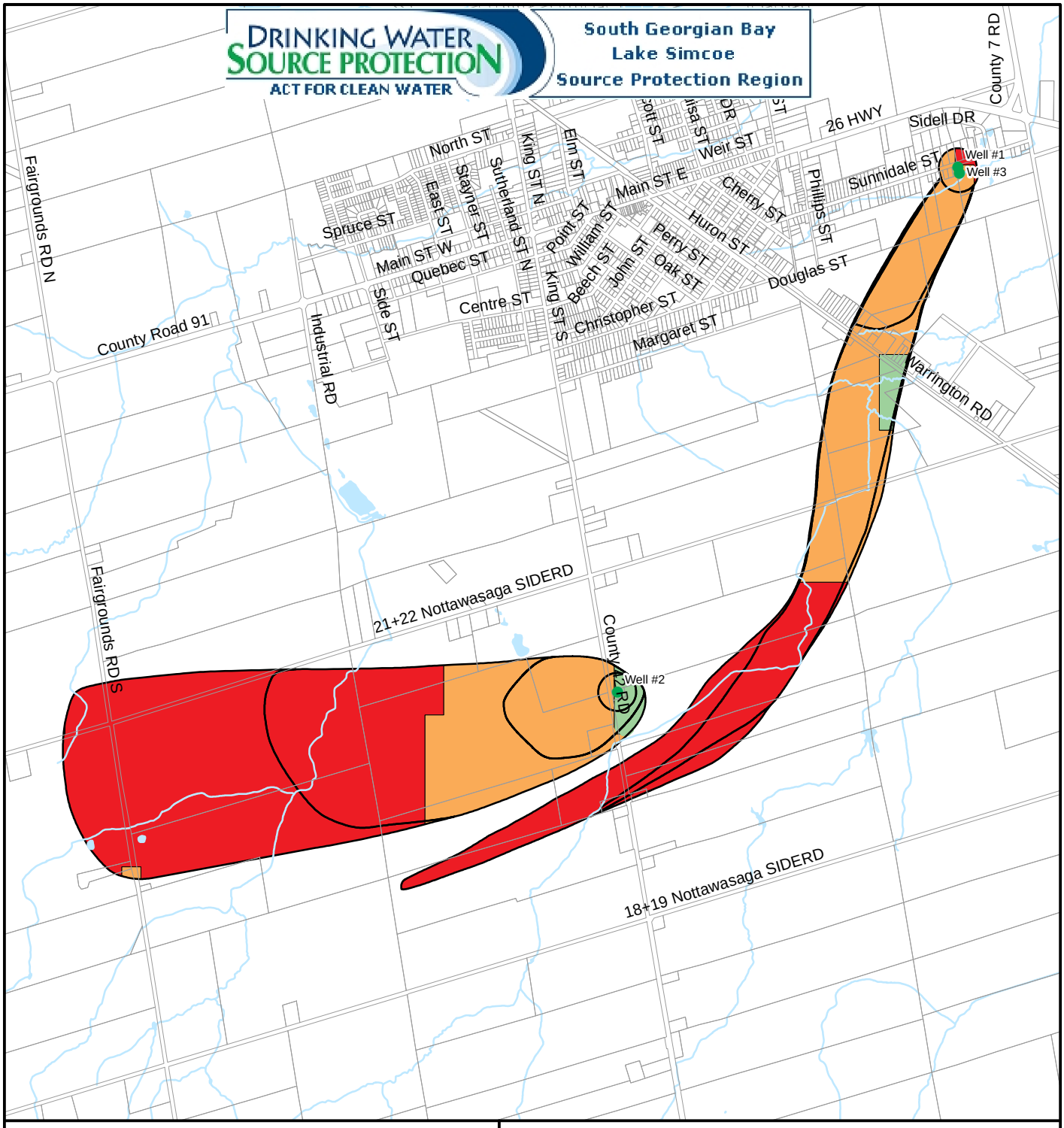
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:30000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.6-1

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GENIVAR Ontario

FIGURE 10f-1



LEGEND

- MUNICIPAL WELL LOCATION

AQUIFER VULNERABILITY INDEX

- HIGH
- MEDIUM
- LOW

N
W E
S

290 145 0 290 Metres

GROUNDWATER VULNERABILITY - STAYNER

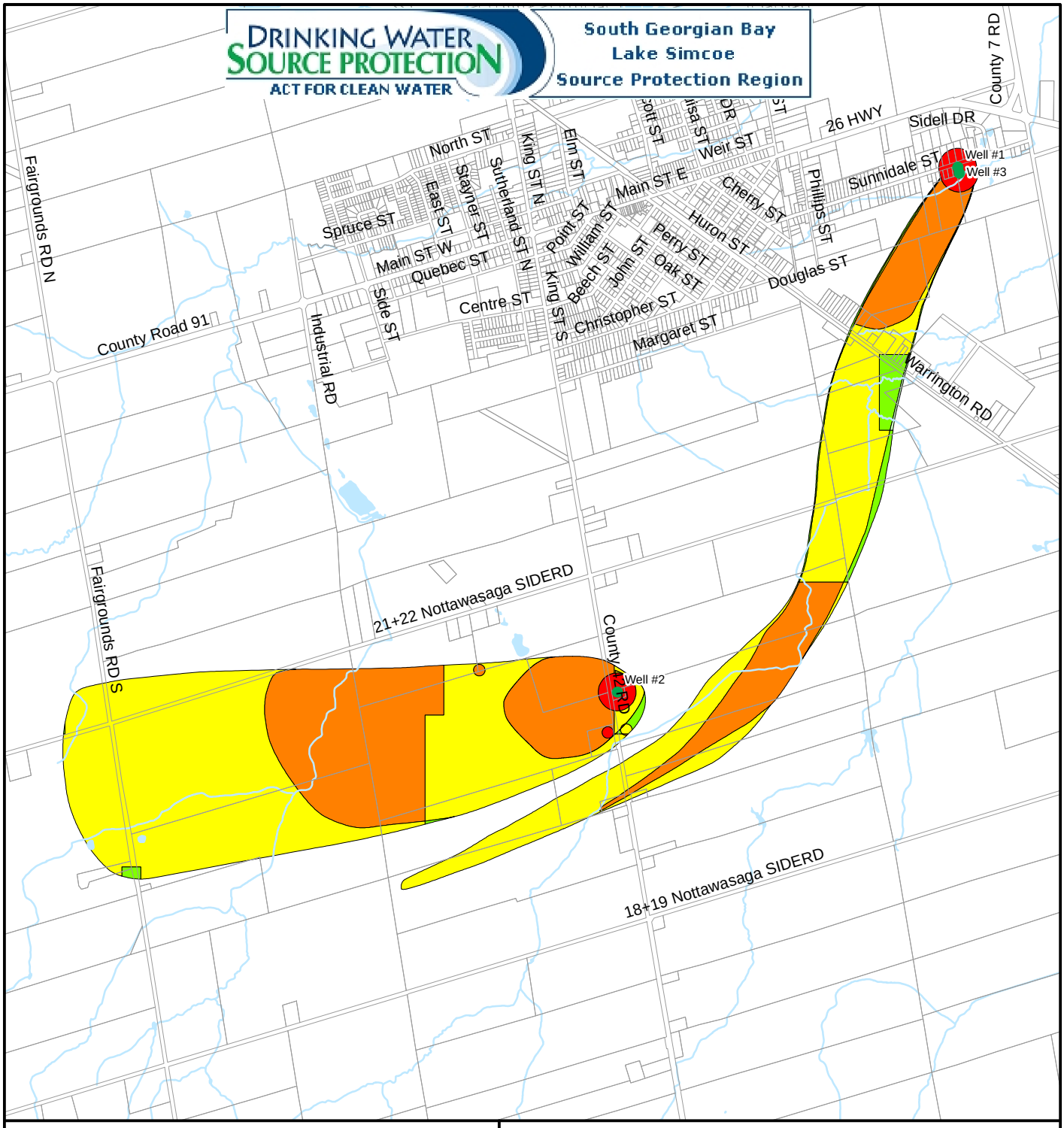
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:30000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.6-2

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GENIVAR Ontario

FIGURE 10f-2



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6
- 4
- 2

N
W E
S

300 150 0 300 Metres

VULNERABILITY SCORES - STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:30000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.6-5

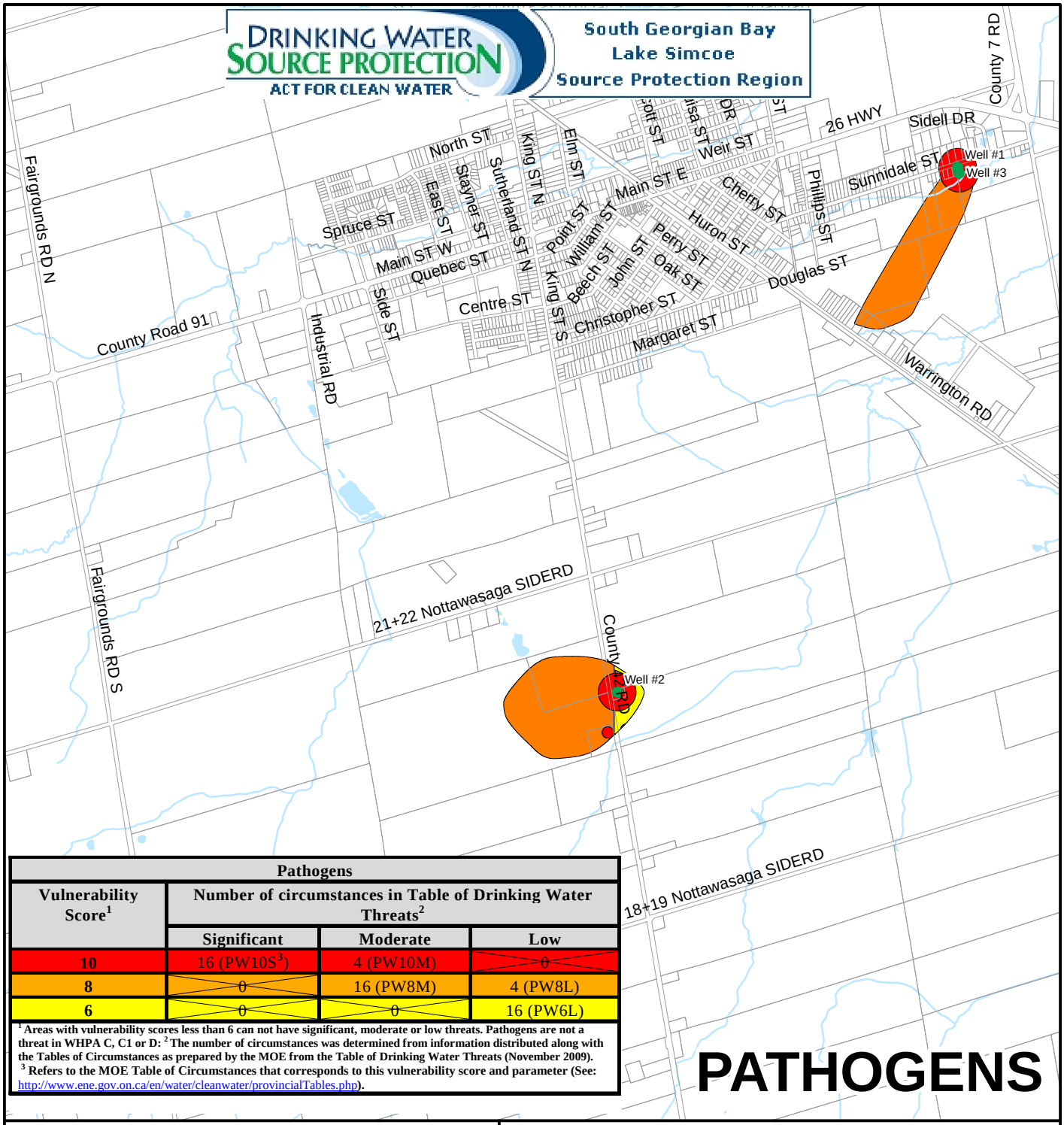
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GENIVAR Ontario

FIGURE **10f-3**

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Pathogens			
Vulnerability Score[1]	Number of circumstances in Table of Drinking Water Threats[2]		
	Significant	Moderate	Low
10	16 (PW10S[3])	4 (PW10M)	~~0~~
8	~~0~~	16 (PW8M)	4 (PW8L)
6	~~0~~	~~0~~	16 (PW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. Pathogens are not a threat in WHPA C, C1 or D: [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009).
[3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

PATHOGENS

LEGEND
- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING
- 10
- 8
- 6

N W E S

300 150 0 300 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:30000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.6-6

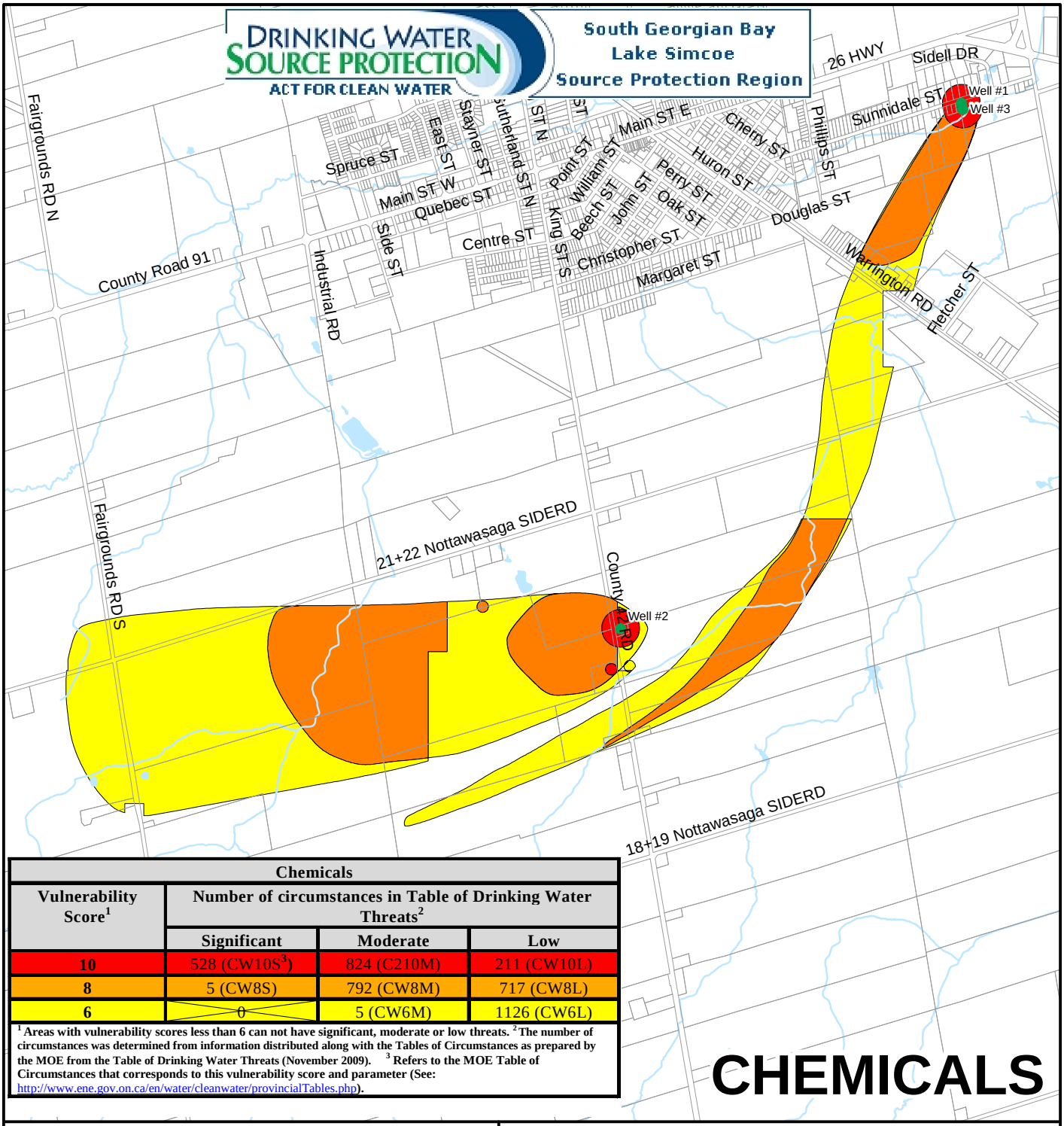
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GENIVAR Ontario

FIGURE 10f-4

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Chemicals			
Vulnerability Score[1]	Number of circumstances in Table of Drinking Water Threats[2]		
	Significant	Moderate	Low
10	528 (CW10S[3])	824 (C210M)	211 (CW10L)
8	5 (CW8S)	792 (CW8M)	717 (CW8L)
6	~~0~~	5 (CW6M)	1126 (CW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009). [3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

CHEMICALS

LEGEND
- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING
- 10
- 8
- 6

N W E S

300 150 0 300 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - STAYNER

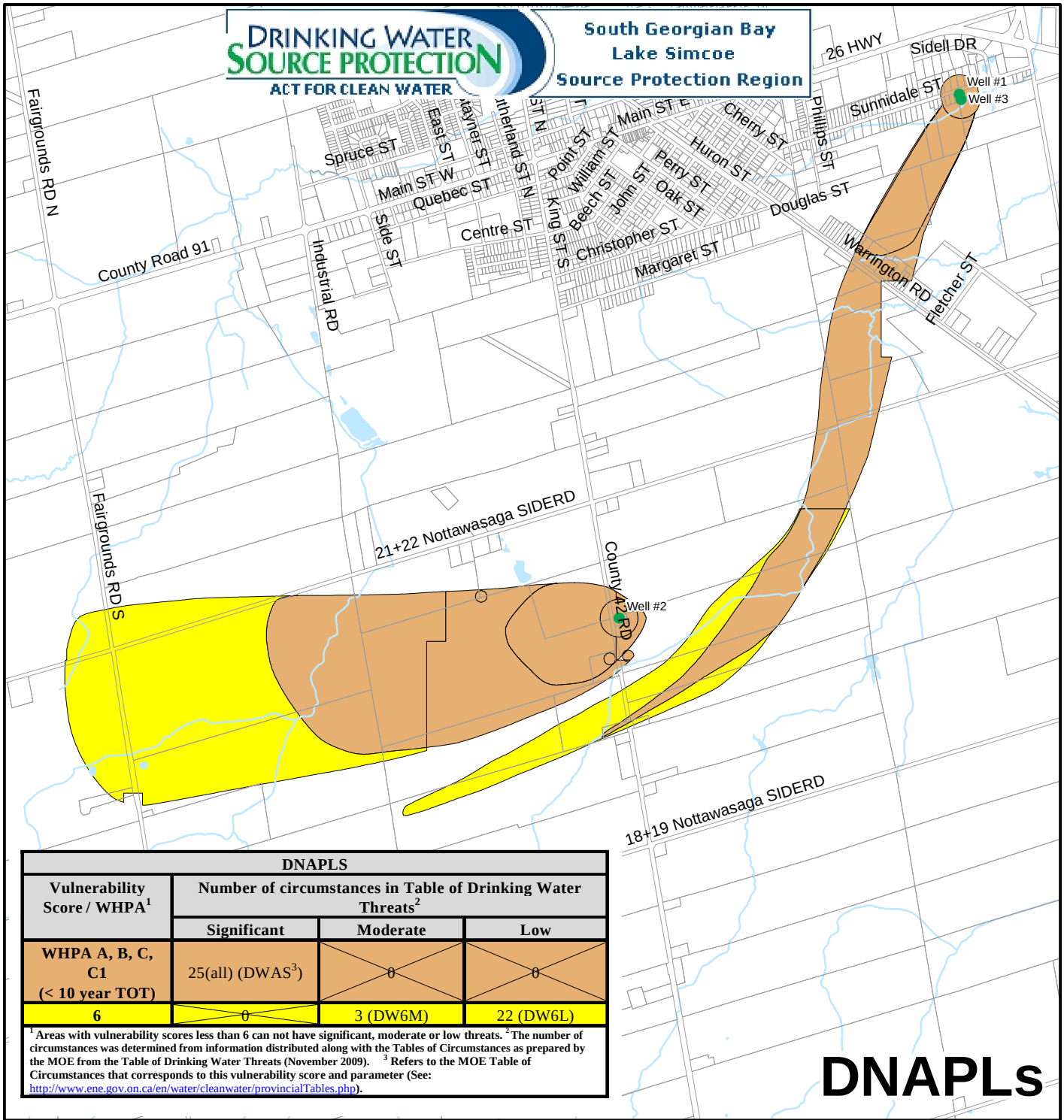
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:30000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.6-7

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GENIVAR Ontario

FIGURE 10f-5



DNAPLS			
Vulnerability Score / WHPA[1]	**Number of circumstances in Table of Drinking Water Threats[2]**		
	Significant	**Moderate**	**Low**
WHPA A, B, C, C1 (< 10 year TOT)	25(all) (DWAS[3])	~~0~~	~~0~~
6	~~0~~	3 (DW6M)	22 (DW6L)

[1] Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. [2] The number of circumstances was determined from information distributed along with the Tables of Circumstances as prepared by the MOE from the Table of Drinking Water Threats (November 2009). [3] Refers to the MOE Table of Circumstances that corresponds to this vulnerability score and parameter (See: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php).

DNAPLs

LEGEND

- MUNICIPAL WELL LOCATION
- WHPA-C1: 10-YEAR TIME-OF-TRAVEL

VULNERABILITY SCORING

- 6

N W E S

300 150 0 300 Metres

AREAS WHERE DNAPLS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

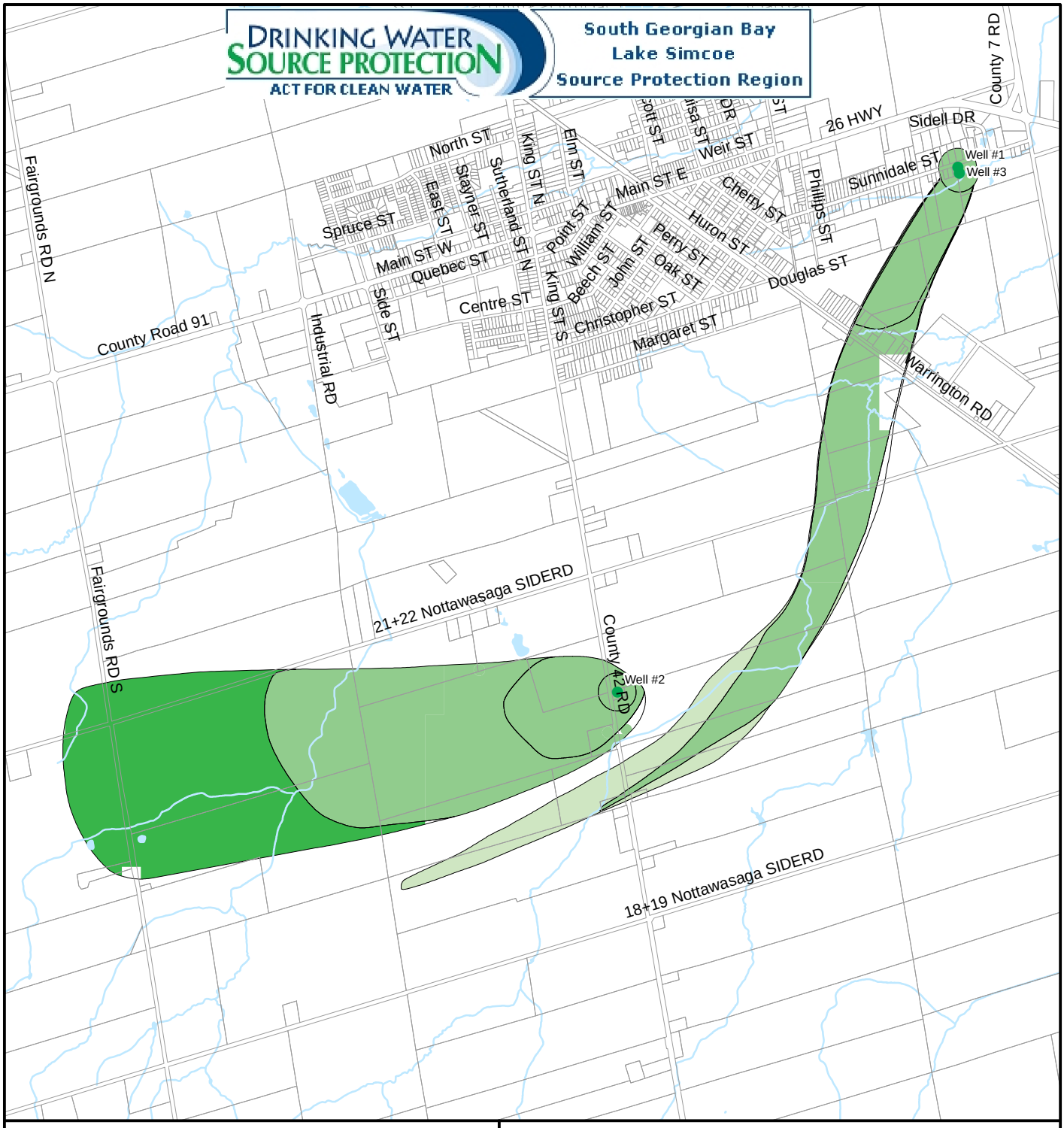
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

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PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.6-8

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GENIVAR Ontario

FIGURE **10f-6**



Legend

- MUNICIPAL WELL LOCATION
- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)

N W E S

300 150 0 300 Metres

MANAGED LANDS - STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Managed Land proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

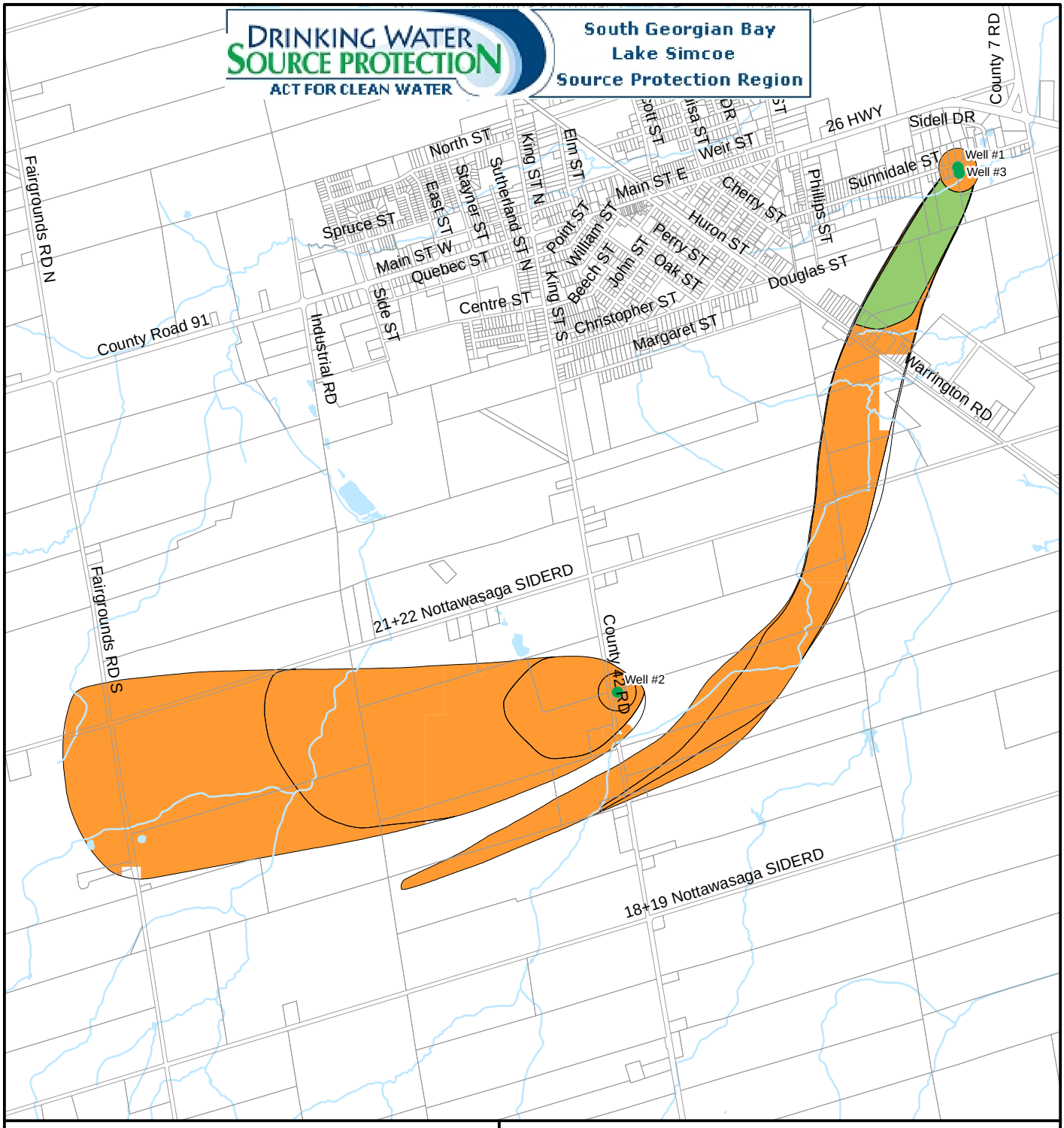
DATE: JULY 2010 | SCALE: 1:30000

PROJECT: 0-071948.01 | FILE. NO.:0-07194801F6.6-9

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GENIVAR Ontario

FIGURE **10f-7**



Legend

- MUNICIPAL WELL LOCATION
- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)

N W E S

310 155 0 310 Metres

LIVESTOCK DENSITY - STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

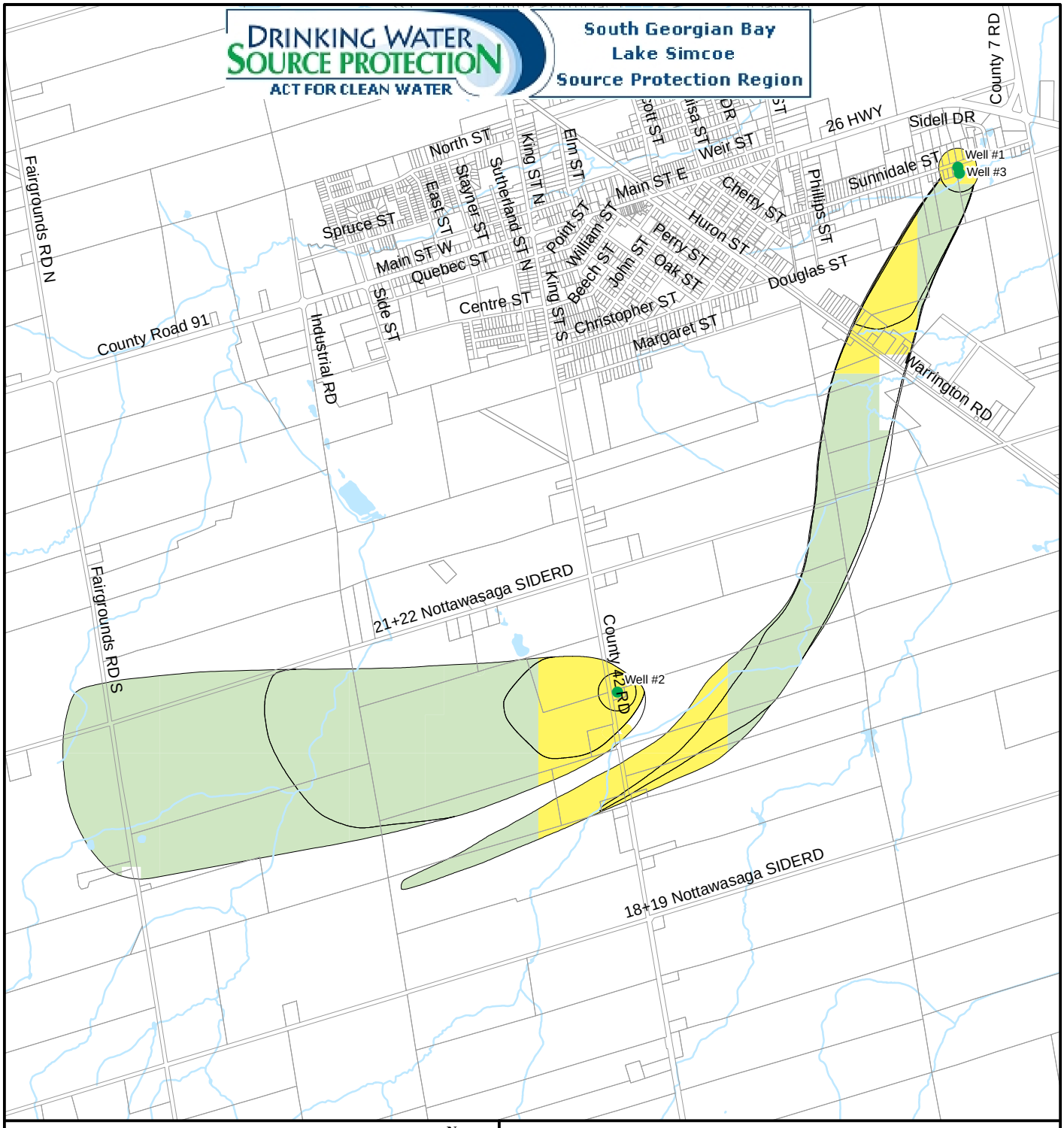
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GENIVAR Ontario

FIGURE **10f-8**



Legend

- MUNICIPAL WELL LOCATION

IMPERVIOUS SURFACE

- <1%
- >1% and <8%
- >8% and <80%

N W E S

280 140 0 280 Metres

IMPERVIOUS SURFACES - STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Impervious Surfaces proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JULY 2010	SCALE: 1:30000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.6-11

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GENIVAR Ontario

FIGURE **10f-9**

APPENDIX K



Water Balance - 163 - 164 Edward St E, Creemore, ON

1. Climate Information

Precipitation	996	mm/a	1.00	m/a *
Evapotranspiration	556	mm/a	0.56	m/a *
Water Surplus	388	mm/a	0.44	m/a

2. Infiltration Rates

Table 2

Table 2 Approach - Infiltration Factors

Topography - (Flat land, rolling land, hilly land)	0.3 *
Soil - (Tight impervious clay, etc...)	0.3 *
Cover - (Cultivated lands, woodland)	0.1 *
TOTAL:	0.7

Infiltration (Infil. Fac x Water Surplus)	271.6	mm/a	0.2716	m/a
Run-off (Water Surplus - Infiltration)	116	mm/a	0.1164	m/a

Table 3 Approach - Typical Recharge Rates

coarse sand and gravel	250+	mm/a *
fine to medium sand	200 - 250	mm/a *
silty sand to sandy silt	150 - 200	mm/a *
silt	125 - 150	mm/a *
clayey silt	100 - 125	mm/a *
clay	< 100	mm/a *

The site development area is underlain by sand and gravel.

Based on the above, the recharge rate is	250	mm/a	0.250 m/a
with runoff of	138	mm/a	0.138 m/a

3. Property Statistics - Pre-development

Area Covered by Existing Building	630	m^2	0.06 ha
Area Covered by Existing Hard Surface Paving	0	m^2	0.00 ha
Area Covered by Existing Landscaped area	371 370	m^2	37.14 ha
TOTAL	372 000	m^2	37.20 ha

4. Property Statistics - Post-development

Area Covered by Building with Additions	192 000	m^2	19.20 ha
Area Covered by Hard Surface Paving	133 000	m^2	13.30 ha
Area Covered by Landscaped Area	47 000	m^2	4.70 ha
TOTAL:	372 000	m^2	37.20 ha

*Based on published information

Water Balance - 163 - 164 Edward St E, Creemore, ON

5. Annual Water Balance Before Building Additions

Land Use	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Building (entire site)	630	627	-	-	-	627
Hard Surface Paving	0	0	-	-	-	0
Landscape Area (entire site)	371 370	369 885	206 482	-	100 864	43 227
TOTAL	**372 000**	**370 512**	**206 482**	**0**	**100 864**	**43 855**

6. Annual Water Balance After Building Additions

Land Use	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Building (entire site)	192 000	191 232	-	-	-	191 232
Hard Surface Paving	133 000	132 468	-	-	-	132 468
Landscape Area (entire site)	19 000	18 924	10 564	-	5 160	2 212
SMWP	28 000	27 888	15 568	-	7 605	3 259
TOTAL	**372 000**	**370 512**	**26 132**	**0**	**12 765**	**329 171**

7. Comparison of Pre-Development (before buidling additions) and Post-Development (after building additions)

	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Pre-Development	370 512	206 482	-	100 864	43 855
Post-Development	370 512	26 132	-	12 765	329 171

8. Requirement for Infiltration of Roof Runoff

Volume of roof (building additions) run-off captured (90%)	172 109 m^3
Volume of post-development infiltration without roof run-off	12 765 m^3
Volume of roof run-off required to match pre-development infiltration rates	88 099 m^3
Percentage of roof run-off (building additions roof) required to match pre-development infiltration	51%