Chapter 10: Township of Clearview

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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, which has also been reviewed by South Georgian Bay-Lake Simcoe Source Water Protection staff and members of the Technical Work Group or the Source Protection Committee~~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 Figure 10-1 all of the groundwater supplies are within the South Georgian Bay-Lake Simcoe (SGBLS) Source Protection Region (SPR). The list below also indicates the Source Protection Region and corresponding lead Source Protection Authority (SPA) for the municipal water supplies.

Municipal Groundwater Supplies in the Township of Clearview within the Nottawasaga Valley SPA included in this report:

- Buckingham Woods (Drinking Water Information System Number 250001420) with 3 wells screened in a confined overburden aquifer
- Colling-Woodlands (Drinking Water Information System Number 260005398) with 5 wells screened in a confined overburden aquifer
- Creemore (Drinking Water Information System Number 220001101) with 2 wells screened in a confined overburden aquifer
- New Lowell (Drinking Water Information System Number 220003706) with 3 wells screened in a confined overburden aquifer
- McKean Subdivision (Drinking Water Information System Number 260005411) with 4 wells screened in a confined overburden aquifer
- Stayner (Drinking Water Information System Number 220001138) with 8 wells screened in a confined overburden aquifer

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
- 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, Conservation and Parks local offices pertaining to licenses, and records of spills in the area of the delineated WHPA
- records available from the Ministry of the Environment, Conservation and Parks 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 combined with the ~~table of Drinking Water Threats~~Technical Rules threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores.

~~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 circumstances~~tables~~ can be found at ~~the~~ https://threats.swpip.ca/~~https://swpip.ca/~~. ~~Government of Ontario's Drinking Water Threats and Circumstances.~~

10.3.3.3.1 Pathogen Parameters

The ~~MECP table of Drinking Water Threats~~Technical Rules ~~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 (Figure 10a- 4). 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 ~~MECP table of Drinking Water Threats~~Technical Rules ~~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 (Figure 10a- 5).~~,~~ 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 MECP table of Drinking Water Threats~~Technical Rules ~~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

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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 10-1 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 10-1: Number of Significant Drinking Water Threats for the Buckingham Woods Wells 1 and 2 Drinking Water Supply, Enumeration of Significant Threats (Wellhead Protected Area)

Threat Number	Threat	Significant Threat Counts Number of Threats
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act	0
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	5
3	The application of agricultural source material to land	0
4	The storage of agricultural source material to land	0
5	The management of agricultural source material	0
6	The application of non-agricultural source material to land	0
7	The handling and storage of non-agricultural source material	0
8	The application of commercial fertilizer to land	0
9	The handling and storage of commercial fertilizer to land	0
10	The application of pesticide to land	0
11	The handling and storage of pesticide	0
12	The application of road salt	0
13	The handling and storage of road salt	0

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Threat Number	Threat	Significant Threat Counts Number of Threats
14	The storage of snow	0
15	The handling and storage of fuel	1
16	The handling and storage of dense non-aqueous phase liquid	0
17	The handling and storage of an organic solvent	0
18	The management of runoff that contains chemicals used in the de-icing of aircraft	0
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard	0
22	The establishment and operation of a liquid hydrocarbon pipeline. O. Reg. 385/08, s. 3; O. Reg. 206/18, s. 1.	0
-	**Total Number**	**6** significant threats (on **6** properties)

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Notes for the table above:

1. 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~~ ~~Part XII of~~ the Technical Rules ~~(December 2021)~~.~~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 ~~Part XII of~~ the Technical Rules ~~(December 2021)~~.~~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 ~~Part XII of~~ the Technical Rules ~~(December 2021)~~. ~~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). Methodology in Technical Memorandum A5.1 (Appendix MO) was used in 2023 to update the proportion of Impervious Surfaces within the delineated WHPA zones using the 2021 Technical Rules. 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 2773-AEQLV6issued on November 15, 2016. 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.

Well 2 had a history of producing silt following routine maintenance and in 2024 started producing abnormally high quantities of silt during normal operation. Well 2 was taken out of service and replacement of Well 2 with Well 2R was planned. Well 2R was drilled to a depth of 10.5 m below ground surface (m bgs) and was sited 2.2 m south of the original Well 2.

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, 2R, 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, 2R, 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
- 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, Conservation and Parks local offices pertaining to licenses, and records of spills in the area of the delineated WHPA
- records available from the Ministry of the Environment, Conservation and Parks 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 combined with the ~~table of Drinking Water Threats~~Technical Rules threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. ~~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 circumstances ~~tables~~ can be found at ~~the~~ https://threats.swpip.ca/~~https://swpip.ca/~~. ~~Government of Ontario's Drinking Water Threats and Circumstances.~~

10.4.3.3.1 Pathogen Parameters

The ~~MECP table of Drinking Water Threats~~Technical Rules ~~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 (Figure 10b- 4). 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 ~~MECP table of Drinking Water Threats~~Technical Rules 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 (Figure 10b- 5).~~,~~ 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 ~~MECP table of Drinking Water Threats~~Technical Rules ~~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 Threa~~ts~~

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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 10-2 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 10-2: Number of Significant Drinking Water Threats for the Colling-woodlands Drinking Water Supply, Enumeration of Significant Threats (Wellhead Protected Area)

Threat Number	Threat	Significant Threat Counts Number of Threats
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act	0
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	14
3	The application of agricultural source material to land	0
4	The storage of agricultural source material to land	0
5	The management of agricultural source material	0
6	The application of non-agricultural source material to land	0
7	The handling and storage of non-agricultural source material	0
8	The application of commercial fertilizer to land	0
9	The handling and storage of commercial fertilizer to land	0
10	The application of pesticide to land	0
11	The handling and storage of pesticide	0
12	The application of road salt	0
13	The handling and storage of road salt	0

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Threat Number	Threat	Significant Threat Counts Number of Threats
14	The storage of snow	0
15	The handling and storage of fuel	1
16	The handling and storage of dense non-aqueous phase liquid	0
17	The handling and storage of an organic solvent	0
18	The management of runoff that contains chemicals used in the de-icing of aircraft	0
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard	0
22	The establishment and operation of a liquid hydrocarbon pipeline. O. Reg. 385/08, s. 3; O. Reg. 206/18, s. 1.	0
-	**Total Number**	**15** significant threats (on **15** properties)

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Notes for the table above:

1. 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 ~~Part XII of~~ the Technical Rules ~~(December 2021).~~ ~~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 ~~Part XII of~~ the Technical Rules ~~(December 2021).~~ ~~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 ~~Part XII of~~ the Technical Rules ~~(December 2021)~~.~~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). Methodology in Technical Memorandum A5.1 (Appendix MO) was used in 2023 to update the proportion of Impervious Surfaces within the delineated WHPA zones using the 2021 Technical Rules. 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
- 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, Conservation and Parks local offices pertaining to licenses, and records of spills in the area of the delineated WHPA
- records available from the Ministry of the Environment, Conservation and Parks 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 combined with the ~~table of Drinking Water Threats~~Technical Rules threat circumstances can be used to

correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. ~~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 circumstances~~tables~~ can be found at ~~the~~ https://threats.swpip.ca/~~https://swpip.ca/~~. ~~Government of Ontario's Drinking Water Threats and Circumstances.~~

10.5.3.3.1 Pathogen Parameters

The ~~MECP table of Drinking Water Threats~~Technical Rules ~~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 (Figure 10c- 4). 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 ~~MECP table of Drinking Water Threats~~Technical Rules ~~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 (Figure 10c- 5). 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 MECP table of Drinking Water Threats~~Technical Rules ~~Key Table on Figure 10c-6~~ can be used to can be used to identify the circumstances in which these Activates associated with DNAPL threat 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

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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 10-3 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 10-3: Number of Significant Drinking Water Threats for the Creemore Drinking Water Supply, Enumeration of Significant Threats (Wellhead Protected Area)

Threat Number	Threat	Significant Threat Counts Number of Threats
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act	0
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	9
3	The application of agricultural source material to land	1
4	The storage of agricultural source material to land	0
5	The management of agricultural source material	0
6	The application of non-agricultural source material to land	0
7	The handling and storage of non-agricultural source material	0
8	The application of commercial fertilizer to land	10
9	The handling and storage of commercial fertilizer to land	0
10	The application of pesticide to land	1
11	The handling and storage of pesticide	0
12	The application of road salt	0
13	The handling and storage of road salt	0
14	The storage of snow	0

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Threat Number	Threat	Significant Threat Counts Number of Threats
15	The handling and storage of fuel	1
16	The handling and storage of dense non-aqueous phase liquid	2
17	The handling and storage of an organic solvent	0
18	The management of runoff that contains chemicals used in the de-icing of aircraft	0
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard	0
22	The establishment and operation of a liquid hydrocarbon pipeline. O. Reg. 385/08, s. 3; O. Reg. 206/18, s. 1.	0
-	**Total Number**	**24** significant threats (on **13** properties)

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Notes for the table above:

1. 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 ~~Part XII of~~ the Technical Rules ~~(December 2021).~~ ~~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 calculation of Managed Lands was updated to reflect the methodology in the most recent technical bulletin (November, 2009). 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 ~~Part XII of~~ the Technical Rules ~~(December 2021).~~ ~~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 ~~Part XII of~~ the Technical Rules ~~(December 2021).~~ ~~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). Methodology in Technical Memorandum A5.1 (Appendix MO) was used in 2023 to update the proportion of Impervious Surfaces within the delineated WHPA zones using the 2021 Technical Rules. 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
- 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, Conservation and Parks local offices pertaining to licenses, and records of spills in the area of the delineated WHPA
- records available from the Ministry of the Environment, Conservation and Parks 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 combined with the ~~table of Drinking Water Threats~~Technical Rules threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. ~~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 circumstances~~tables~~ can be found at ~~the~~ https://threats.swpip.ca/~~https://swpip.ca/~~. ~~Government of Ontario's Drinking Water Threats and Circumstances~~.

Field Code Changed

10.6.3.3.1 Pathogen Parameters

The ~~MECP table of Drinking Water Threats~~Technical Rules ~~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 (Figure 10d- 4). 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 ~~MECP table of Drinking Water Threats~~Technical Rules ~~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 (Figure 10d- 5).~~,~~ 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 ~~MECP table of Drinking Water Threats~~ Technical Rules ~~Key Table on Figure 10d-6~~ can be used to identify the circumstances in which these Activities associated with DNAPL threat 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

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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 10-4 and Table 10-5 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 10-4: Number of Significant Drinking Water Threats for the New Lowell Wells 1 and 2 Drinking Water Supply, Enumeration of Significant Threats (Wellhead Protected Area)

Threat Number	Threat	Significant Threat Counts Number of Threats
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act	0
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	9
3	The application of agricultural source material to land	1
4	The storage of agricultural source material to land	0
5	The management of agricultural source material	0
6	The application of non-agricultural source material to land	0
7	The handling and storage of non-agricultural source material	0
8	The application of commercial fertilizer to land	10
9	The handling and storage of commercial fertilizer to land	0
10	The application of pesticide to land	1
11	The handling and storage of pesticide	0
12	The application of road salt	0
13	The handling and storage of road salt	0
14	The storage of snow	0

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Threat Number	Threat	Significant Threat Counts Number of Threats
15	The handling and storage of fuel	1
16	The handling and storage of dense non-aqueous phase liquid	0
17	The handling and storage of an organic solvent	0
18	The management of runoff that contains chemicals used in the de-icing of aircraft	0
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard	0
22	The establishment and operation of a liquid hydrocarbon pipeline. O. Reg. 385/08, s. 3; O. Reg. 206/18, s. 1.	0
-	**Total Number**	**22** significant threats (on **11** properties)

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Notes for the table above:

1. The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel

Table 10-5: Number of Significant Drinking Water Threats for the New Lowell Well 6 Drinking Water Supply, Enumeration of Significant Threats (Wellhead Protected Area)

Threat Number	Threat	Significant Threat Counts Number of Threats
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act	0
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	25
3	The application of agricultural source material to land	0
4	The storage of agricultural source material to land	0
5	The management of agricultural source material	0
6	The application of non-agricultural source material to land	0
7	The handling and storage of non-agricultural source material	0
8	The application of commercial fertilizer to land	0
9	The handling and storage of commercial fertilizer to land	0
10	The application of pesticide to land	0
11	The handling and storage of pesticide	0
12	The application of road salt	0
13	The handling and storage of road salt	0
14	The storage of snow	0

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Threat Number	Threat	Significant Threat Counts Number of Threats
15	The handling and storage of fuel	1
16	The handling and storage of dense non-aqueous phase liquid	0
17	The handling and storage of an organic solvent	0
18	The management of runoff that contains chemicals used in the de-icing of aircraft	0
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard	0
22	The establishment and operation of a liquid hydrocarbon pipeline. O. Reg. 385/08, s. 3; O. Reg. 206/18, s. 1.	0
-	**Total Number**	**26** significant threats (on **26** properties)

Notes for the table above:

1. The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel

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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 ~~Part XII of~~ the Technical Rules ~~(December 2021).~~ ~~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 calculation of Managed Lands was updated to reflect the methodology in the most recent technical bulletin (November, 2009). 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 ~~Part XII of~~ the Technical Rules ~~(December 2021).~~ ~~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 ~~Part XII of~~ the Technical Rules ~~(December 2021)~~. ~~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). Methodology in Technical Memorandum A5.1 (Appendix MO) was used in 2023 to update the proportion of Impervious Surfaces within the delineated WHPA zones using the 2021 Technical Rules. 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 WPA-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
- 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, Conservation and Parks local offices pertaining to licenses, and records of spills in the area of the delineated WHPA
- records available from the Ministry of the Environment. Conservation and Parks 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 combined with the ~~table of Drinking Water Threats~~Technical Rules threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. ~~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 circumstances ~~tables~~ can be found at ~~the~~ https://threats.swpip.ca/~~https://swpip.ca/~~. ~~Government of Ontario's Drinking Water Threats and Circumstances~~.

10.7.3.3.1 Pathogen Parameters

The Technical Rules~~MECP table of Drinking Water Threats~~ ~~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 (Figure 10e- 4). 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. ~~See Figure 10e-4 for the McKean Water Supply.~~

10.7.3.3.2 Chemical Parameters

The ~~MECP table of Drinking Water Threats~~Technical Rules ~~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 (Figure 10e- 5).~~,~~ 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 MECP table of Drinking Water Threats~~ The Technical Rules~~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

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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 10-6 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 10-6: Number of Significant Drinking Water Threats for the McKean Drinking Water Supply, Enumeration of Significant Threats (Wellhead Protected Area)

Threat Number	Threat	Significant Threat Counts Number of Threats
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act	0
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	29
3	The application of agricultural source material to land	1
4	The storage of agricultural source material to land	0
5	The management of agricultural source material	0
6	The application of non-agricultural source material to land	0
7	The handling and storage of non-agricultural source material	0
8	The application of commercial fertilizer to land	10
9	The handling and storage of commercial fertilizer to land	0
10	The application of pesticide to land	1
11	The handling and storage of pesticide	0
12	The application of road salt	0
13	The handling and storage of road salt	0
14	The storage of snow	0

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Threat Number	Threat	Significant Threat Counts Number of Threats
15	The handling and storage of fuel	1
16	The handling and storage of dense non-aqueous phase liquid	0
17	The handling and storage of an organic solvent	0
18	The management of runoff that contains chemicals used in the de-icing of aircraft	0
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard	0
22	The establishment and operation of a liquid hydrocarbon pipeline. O. Reg. 385/08, s. 3; O. Reg. 206/18, s. 1.	0
-	**Total Number**	**42** significant threats (on **31** properties)

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Notes for the table above:

1. 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 ~~Part XII of~~ the Technical Rules ~~(December 2021).~~ ~~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 ~~Part XII of~~ the Technical Rules ~~(December 2021).~~ ~~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 ~~Part XII of~~ the Technical Rules ~~(December 2021)~~. ~~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). Methodology in Technical Memorandum A5.1 (Appendix MO) was used in 2023 to update the proportion of Impervious Surfaces within the delineated WHPA zones using the 2021 Technical Rules. 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 4,200 (1,810 units) in the Community of Stayner. The water supply consists of four existing wells: Well 1, Well 2, Well 3, and Well 4 in addition to 4 planned wells (3 production wells and 1 for stand-by redundancy/firm capacity). Positioned in three well fields, Well 3 is located beside Well 1. Well 2 is located beside Well 4, and the 4 planned wells in the Klondike Well field, as shown in Figure 10f- 1.

The Stayner Water Distribution System operates under the amended 10-year Permit to Take Water P-300-6059698529 that was issued on June 11, 2020. The water taking from wells 2 & 4 have a combined limited to 1818 L/min and 2618 m3/day. Due to mutual interference, Wells 2 and 4 cannot operate at their design rates simultaneously. Whereas, Well 1 is permitted to pump at a maximum rate of 909 L/min (1,309 m^3/day), and Well 3 is permitted to pump at a maximum rate of 1,818 L/min (2,618 m^3/day). The wells can operate up to a maximum combined taking of 6,545 m^3/day.

~~The four planned wells are located at 1585 Klondike Park Road, approximately 9 km northeast of Stayner. Water supply investigation concluded that four municipal wells at the Site (with one well as stand-by for firm capacity) could supply 60 L/s of average daily demand and 120 L/s of maximum daily demand.~~

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.

The construction of Well 4 was completed in October, 2009 by Northern Well Drilling of Unionville. The well has a Well Tag number of A 048988. The well was constructed approximately 6.3 m west of Well 2. Well 4 is a 254 x 508 mm diameter gravel wall well. A 762 mm diameter surface casing was installed in order to facilitate the grouting of the 508 mm diameter casing. Well 4 was constructed with 6.7 m of stainless steel screen set between 24 and 30.7 mbgl. Its 40-slot screen has a maximum transmitting capacity of 55 L/sec.

Three separate aquifers were observed. At the Well 2 and 4 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 and 4. 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 and 4.

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 3, and 4 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.

The four ~~planned~~ Klondike wellfield wells are located at 1585 Klondike Park Road, approximately 9 km northeast of Stayner. Water supply investigation concluded that four municipal wells at the Site (with one well as stand-by for firm capacity) could supply 60 L/s of average daily demand and 120 L/s of maximum daily demand.

The ~~planned~~ Klondike well field is targeted to be screened within the deep aquifer “A3” underlying the property at 1585 Klondike Park Road (the Site). The TW3 (water well record number A210653) well design was completed using a 7.93m of 200 mm diameter, 50 slot telescoping screen with an appropriately sized gravel pack. The transmitting capacity of the Johnson High Flo well screen is 53 L/sec. the screen depth is 47.5 to 55.1 mbgs in a brown sandy gravel unit. the overlying stratigraphy consists of several sand units interspersed with clayey sand units. The pump placement is at 42.70 mbgs.

~~The screen intervals for Wells 1, 2 3, and 4 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 (Wells 1,2,3,4) of this Chapter is based on Genivar 2010a report, whereas the Klondike wells is based on the Golder 2018, 2020 reports.

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 3in 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.

The water taking from the site is not increasing and the aquifer characteristics at Well 4 are similar to those at Well 2; therefore, the capture zone analysis conducted previously should not change. Due to mutual interference, Wells 2 and 4 cannot operate at their design rates simultaneously. They may be able to operate together at lower rates to provide 30.3 L/sec.

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 and 4 reflects groundwater flow from west to east. The groundwater flow patterns are reasonable based on available data describing regional groundwater flow patterns.

Regarding the four planned Klondike wells, numerical groundwater modelling was completed using the existing "Wasaga Beach" 3D MODFLOW model. The model was updated through the calibration to the pumping test results, MECP water levels and streamflow, and the estimated hydrogeological effects of future pumping. Using the best available science, the model was enhanced using the Ontario Geological Survey Central Simcoe 3D block model project findings, based on deep borehole evaluations.

Backward tracked particles in MODPATH are used to delineate the 2-year (WHPA-B), 5-year (WHPA-C) and 25-year (WHPA-D) time of travel capture zones (Figure 10f- 10). WHPA-A added as 100 m radius. The Klondike Park Rd wellfield was modelled at average daily demand of 60 L/s or 20 L/s per well. The average daily demand rates are considered most realistic portrayal of long-term water use and avoid unnecessarily large vulnerable area delineations which may occur if the ~~the~~ maximum daily demand was used. Klondike Park Rd wellfield WHPAs reach a width of 2.3 km and upgradient length of 2.8 km.

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, the AVI for Regional Aquifer A4 is used for the WHPA for Well 2 and the AVI for the Regional Aquifer A3 for the Klondike Wells (Figure 10f- 11). 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 and Figure 10f- 10 the Groundwater Vulnerability, as shown in Figure 10f- 2 for well 1-4 and Figure 10f- 11 for the planned Klondike wells, 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 for wells 1-4 and Figure 10f- 12 for the planned Klondike wells 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. Area with a vulnerability score of 10 is limited to the WHPA-A for all Stayner municipal drinking water supply wells.

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, excluding the Klondike wells, 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.

The factors considered in the delineation of the Klondike well uncertainty analysis included:

- the distribution, variability, quality, and relevance of data used in the assessment
- the ability of the methods and models used to accurately reflect the flow processes in the hydrogeological system
- the quality assurance and quality control procedures applied; and the extent and level of calibration and validation achieved for models used or calculations or general assessments completed

The vulnerability assessment for the Klondike Park Rd wellfield is based on the AVI method using the numerical model layers for the calculations. The WHPA delineation was also based on the numerical flow model and therefore the uncertainty associated with both items are similar as they both are linked with the ability of the numerical flow model to satisfactorily represent actual conditions.

The level of uncertainty is considered low in the area of the site and increases to the outer reaches of the WHPA-D area. However, the final WHPA -D incorporates a conservative 'uncertainty envelope' which, in effect, reduces overall uncertainty in the capture zone results. As such, the overall uncertainty and WHPA uncertainty is characterized as Low.

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). 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 in wells 1-4. 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
- 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, Conservation and Parks local offices pertaining to licenses, and records of spills in the area of the delineated WHPA
- records available from the Ministry of the Environment, Conservation and Parks 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.

It is noted that conditions can also be identified as significant risks if they are associated in issues contributing areas and may contribute to the issue associated with these areas.

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 combined with the ~~table of Drinking Water Threats~~Technical Rules threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. ~~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 circumstances~~tables~~ can be found at ~~the~~ https://threats.swpip.ca/~~https://swpip.ca/~~. ~~Government of Ontario's Drinking Water Threats and Circumstances~~.

10.8.3.3.1 Pathogen Parameters

The ~~MECP table of Drinking Water Threats~~Technical Rules ~~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 (Wells 1-4) and for the planned Klondike Wells. (Figure 10f- 4 and Figure 10f- 13)~~.~~ 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 ~~MECP table of Drinking Water Threats~~Technical Rules ~~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 (wells 1-4) and ~~Figure 10f-14~~ for the planned Klondike wells (Figure 10f- 5 and Figure 10f- 14) . 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 (wells 1-4) and Figure 10f-15 for the planned Klondike wells. The ~~MECP table of Drinking Water Threats~~Technical Rules ~~Key Table on Figure 10f-6 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 (wells 1-4) and Figure 10f- 12 for the planned Klondike wells 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

~~10.8.3.5~~

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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 10-7, 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 10-7 documents the enumeration for the WHPA for Wells 1 and 3. Table 10-8 documents the enumeration for the WHPA for Well 2 and 4. Table 10-9 documents the enumeration for the Klondike Park Rd WHPA. 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 and 4 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.

One significant drinking water threat is found within the Klondike Park Rd WHPAs related to fuel storage. No other significant drinking water threats were identified based on: 1) South Simcoe Groundwater Study Contaminant Source Inventory (Golder, 2004); 2) examination of satellite imagery; 3) windshield survey (October 20, 2020), which notably did not identify any obvious locations for DNAPL handling or storage; and 4) circumstances mapping. In addition, the aquifer A3 test well TW3 meets ODWS for all parameters tested except for turbidity and aesthetic parameters iron and hardness (Golder, 2018).

The land use within the WHPAs is almost entirely agricultural fields or forest, with the exception of residential properties and a few small commercial businesses along Highway 26 and the Peace Natural facility along Sunnidale Road. The WHPA does not underlie the landfills along Sideroad 12/13.

Table 10-7: Number of Significant Drinking Water Threats for the Stayner Wells 1 and 3 Drinking Water Supply, Enumeration of Significant Threats (Wellhead Protected Area)

Threat Number	Threat	Significant Threat Counts Number of Threats
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act	0
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	8
3	The application of agricultural source material to land	0
4	The storage of agricultural source material to land	0
5	The management of agricultural source material	0
6	The application of non-agricultural source material to land	0
7	The handling and storage of non-agricultural source material	0
8	The application of commercial fertilizer to land	0
9	The handling and storage of commercial fertilizer to land	0
10	The application of pesticide to land	0
11	The handling and storage of pesticide	0
12	The application of road salt	0
13	The handling and storage of road salt	0
14	The storage of snow	0

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Threat Number	Threat	Significant Threat Counts Number of Threats
15	The handling and storage of fuel	2
16	The handling and storage of dense non-aqueous phase liquid	1
17	The handling and storage of an organic solvent	0
18	The management of runoff that contains chemicals used in the de-icing of aircraft	0
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard	0
22	The establishment and operation of a liquid hydrocarbon pipeline. O. Reg. 385/08, s. 3; O. Reg. 206/18, s. 1.	0
-	**Total Number**	**11** significant threats (on **11** properties)

Notes for the table above:

1. The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel

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Table 10-8: Number of Significant Drinking Water Threats for the Stayner Wells 2 and 4 Drinking Water Supply, Enumeration of Significant Threats (Wellhead Protected Area)

Threat Number	Threat	Significant Threat Counts Number of Threats
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act	0
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	1
3	The application of agricultural source material to land	2
4	The storage of agricultural source material to land	0
5	The management of agricultural source material	0
6	The application of non-agricultural source material to land	0
7	The handling and storage of non-agricultural source material	0
8	The application of commercial fertilizer to land	0
9	The handling and storage of commercial fertilizer to land	0
10	The application of pesticide to land	2
11	The handling and storage of pesticide	0
12	The application of road salt	0
13	The handling and storage of road salt	0

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Formatted Table

Threat Number	Threat	Significant Threat Counts Number of Threats
14	The storage of snow	0
15	The handling and storage of fuel	1
16	The handling and storage of dense non-aqueous phase liquid	0
17	The handling and storage of an organic solvent	0
18	The management of runoff that contains chemicals used in the de-icing of aircraft	0
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard	0
22	The establishment and operation of a liquid hydrocarbon pipeline. O. Reg. 385/08, s. 3; O. Reg. 206/18, s. 1.	0
-	**Total Number**	**6** significant threats (on **3** properties)

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Notes for the table above:

1. 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 ~~planned~~ Klondike Wellfield Drinking Water Supply, Enumeration of Significant Threats (Wellhead Protected Area)

Threat Number	Threat	Significant Threat Counts Number of Threats
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.	0
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	0
3	The application of agricultural source material to land.	0
4	The storage of agricultural source material to land.	0
5	The management of agricultural source material.	0
6	The application of non-agricultural source material to land.	0
7	The handling and storage of non-agricultural source material.	0
8	The application of commercial fertilizer to land.	0
9	The handling and storage of commercial fertilizer to land.	0
10	The application of pesticide to land.	1~~0~~
11	The handling and storage of pesticide.	0
12	The application of road salt.	0
13	The handling and storage of road salt.	0

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Threat Number	Threat	Significant Threat Counts Number of Threats
14	The storage of snow.	0
15	The handling and storage of fuel.	1
16	The handling and storage of dense non-aqueous phase liquid.	0
17	The handling and storage of an organic solvent.	0
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	0
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	0
22	The establishment and operation of a liquid hydrocarbon pipeline. O. Reg. 385/08, s. 3; O. Reg. 206/18, s. 1.	0
-	**Total Number**	~~1~~2 significant threat (on **2** property)

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Notes for the table above:

1. 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 ~~Part XII of~~ the Technical Rules ~~(December 2021)~~. ~~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 (wells 1-4) and Figure 10f- 16 for the planned Klondike wells 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 ~~Part XII of~~ the Technical Rules ~~(December 2021)~~. ~~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.

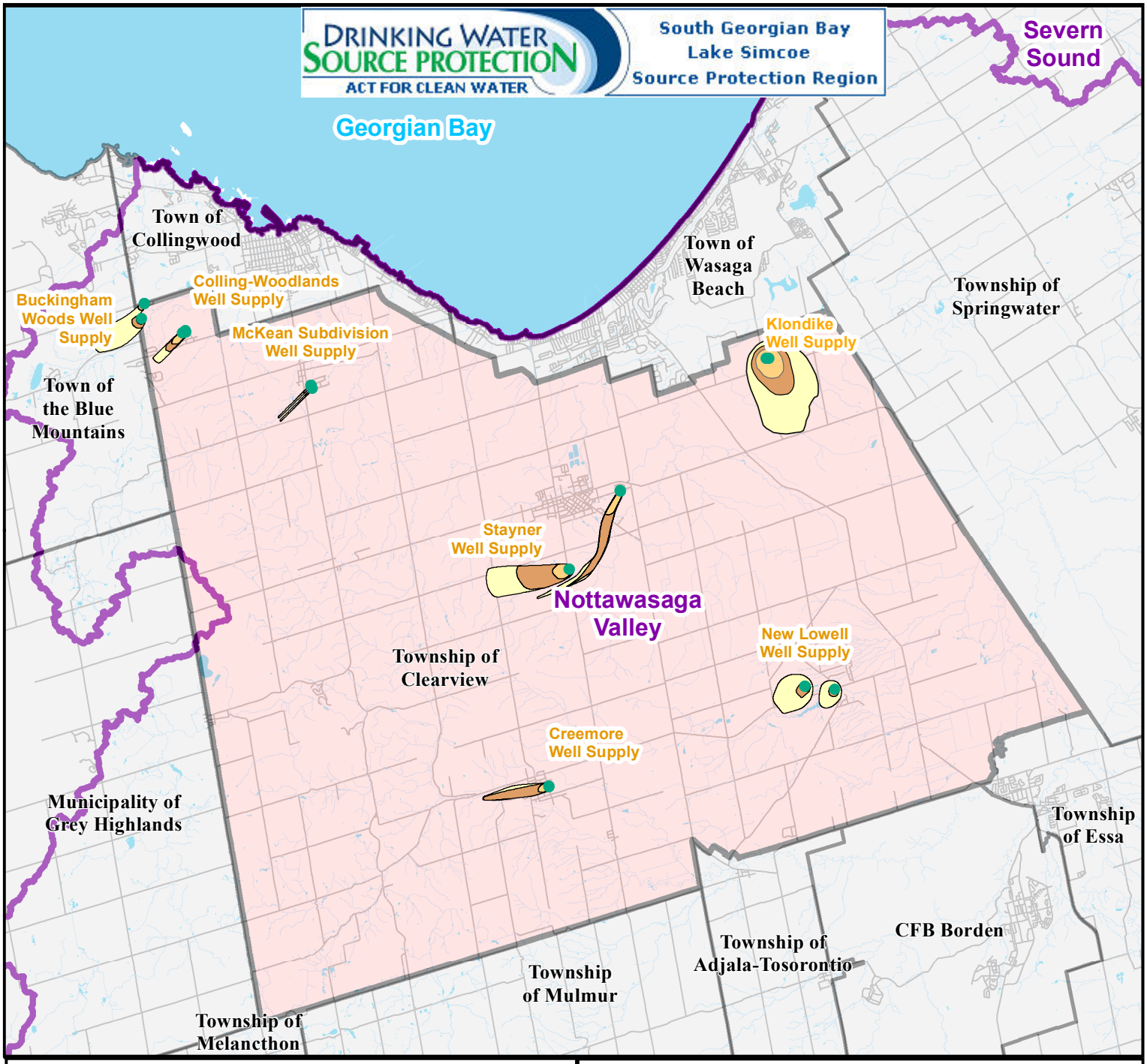
Figure 10f- 8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Stayner Water Supply (wells 1-4) and Figure 10f- 17 for the planned Klondike wells where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D. The Livestock Density figure reflects the distribution 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 ~~Part XII of~~ the Technical Rules ~~(December 2021)~~. ~~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). Methodology in Technical Memorandum A5.1 (Appendix MO) was used in 2023 to update the proportion of Impervious Surfaces within the delineated WHPA zones using the 2021 Technical Rules. 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 (wells 1-4) and Figure 10f- 18 for the planned Klondike wells where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.



Legend

- Municipal Supply Well in Township of Clearview
- WHPA-A (100 m RADIUS)
- WHPA-B (2-YEAR TIME-OF-TRAVEL)
- WHPA-C (5-YEAR TIME-OF-TRAVEL)
- WHPA-C1 (10-YEAR TIME-OF-TRAVEL)
- WHPA-D (25-YEAR TIME-OF-TRAVEL)
- Municipality Boundary
- SWP Watershed Area

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have benn compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

Drinking Water System Vulnerable Areas in Township of Clearview

N W E S

2,100 1,050 0 2,100 Meters

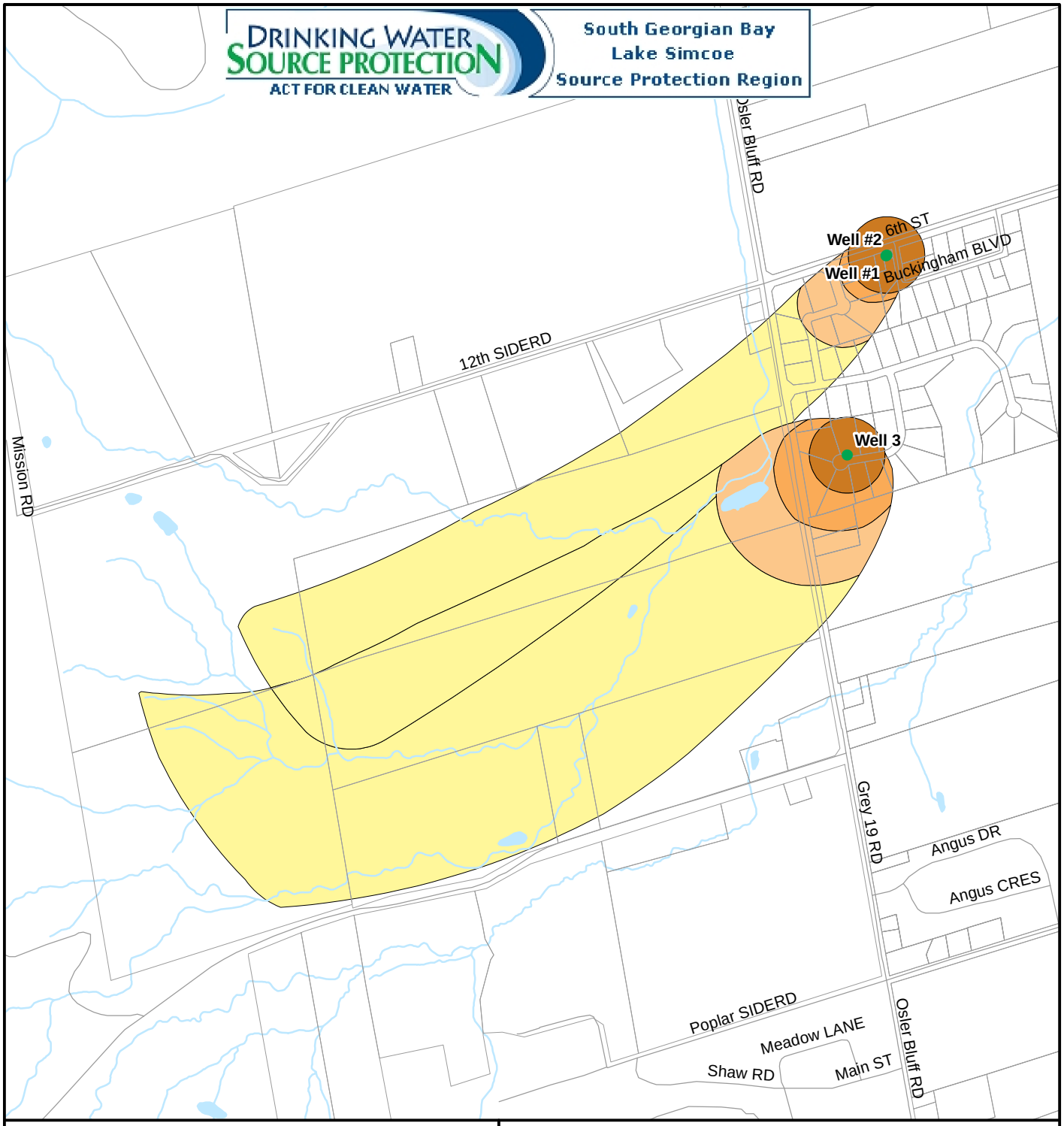
Created by: NVCA
Date: 2021-09

Scale: 1:200,000

UTM Zone 17N, NAD83

Ontario

Figure 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

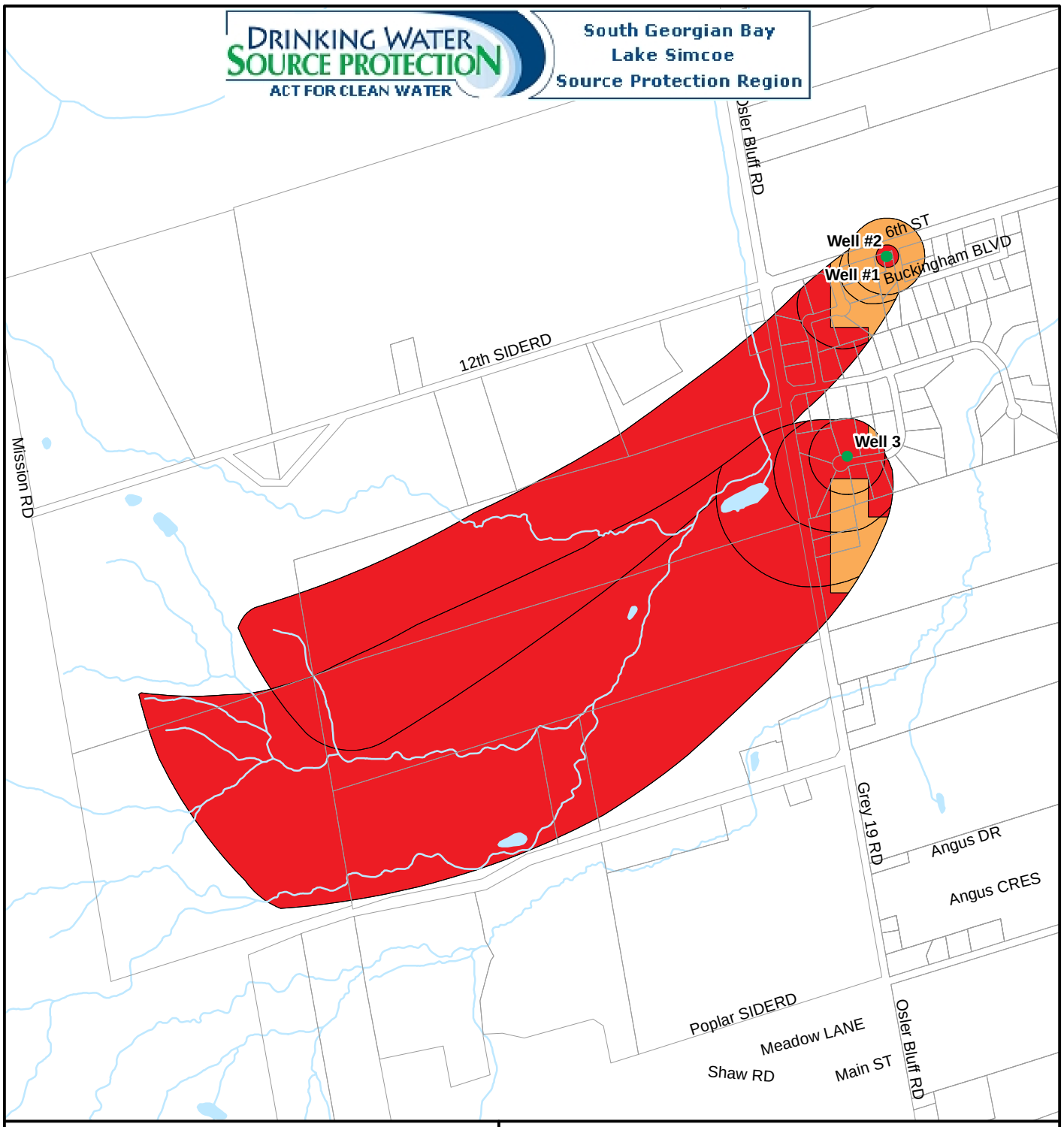
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.1-1

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-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

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.1-2

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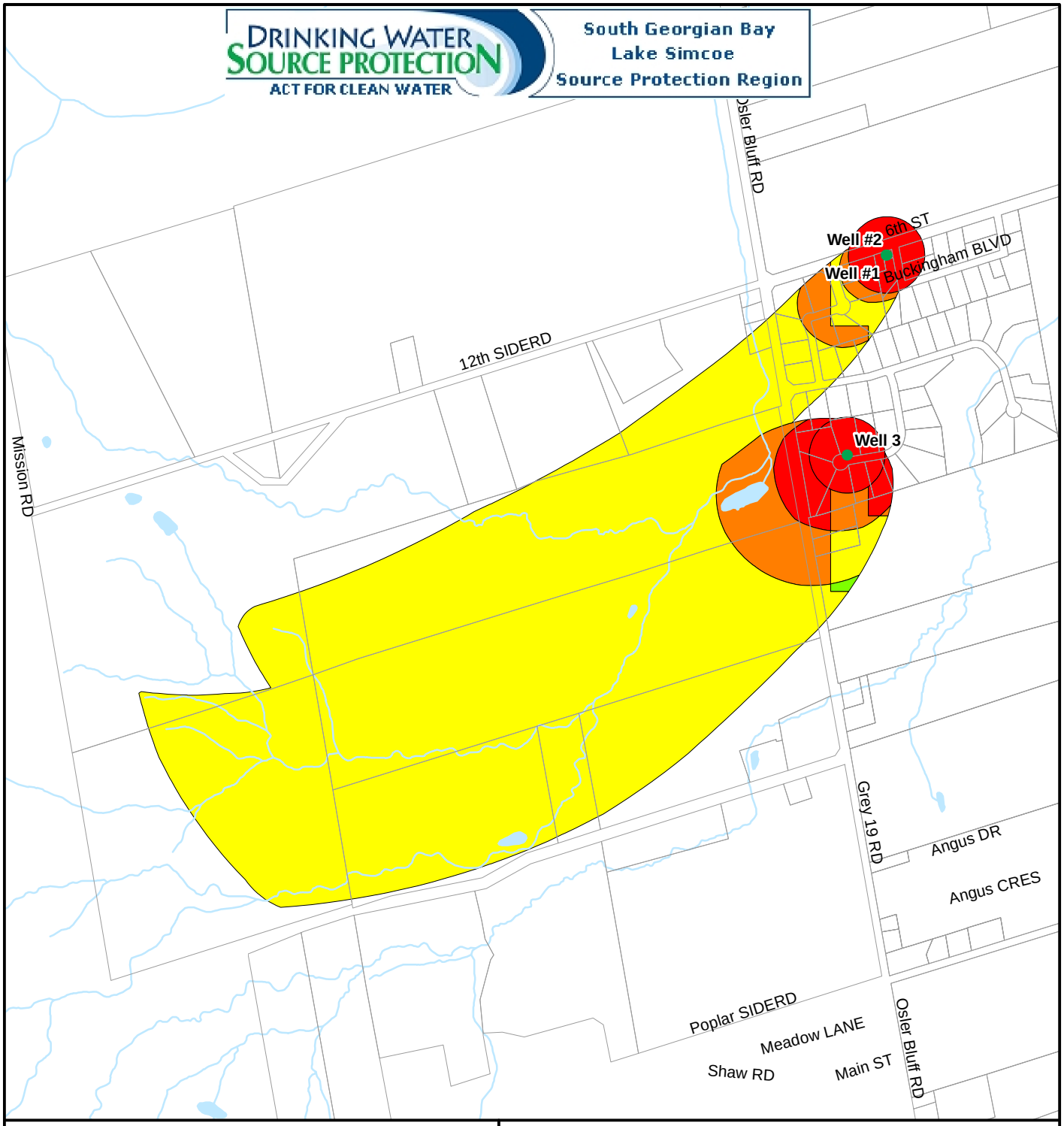
GENIVAR Ontario

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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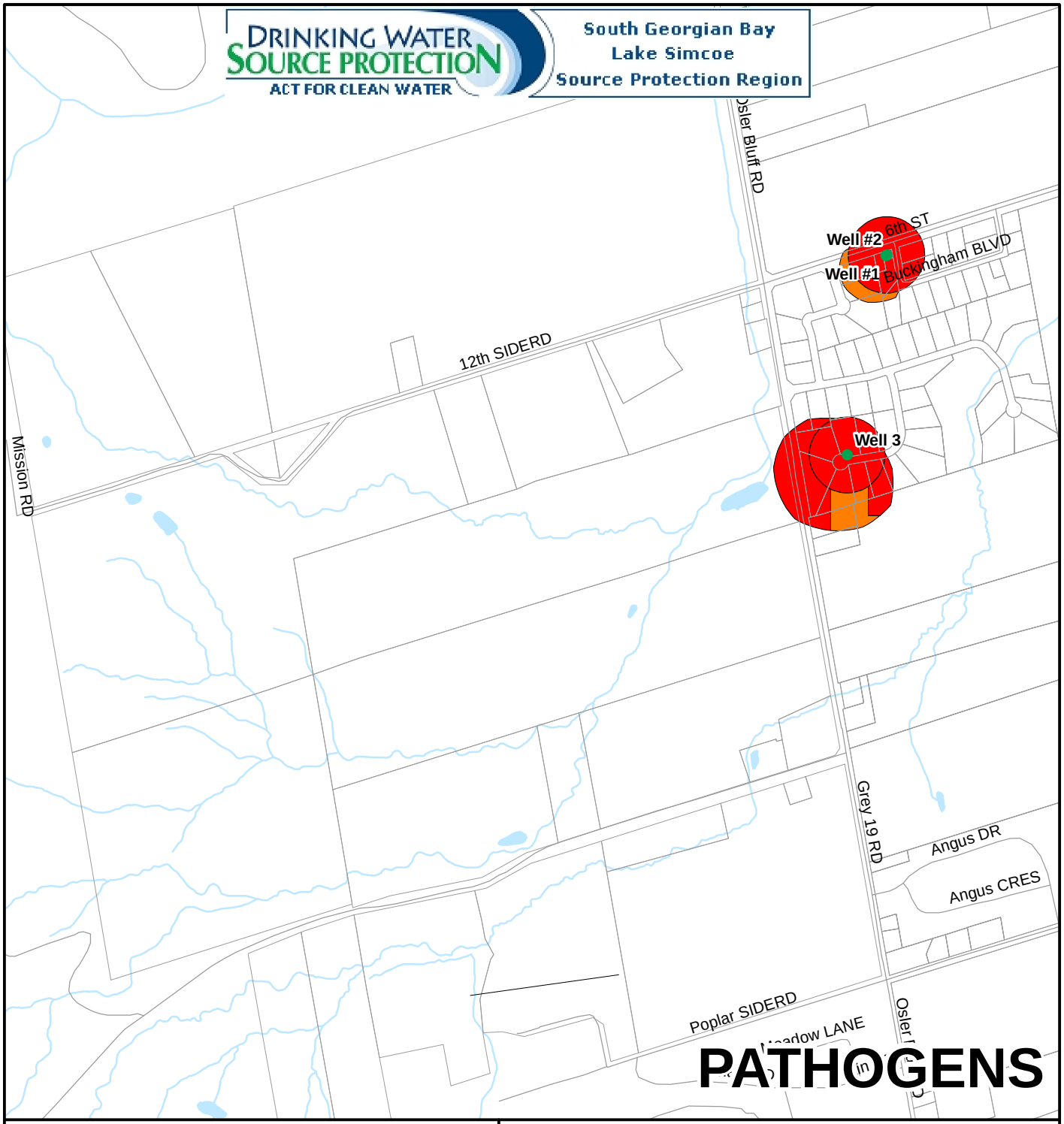
GENIVAR Ontario

FIGURE 10a-3



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
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.1-4

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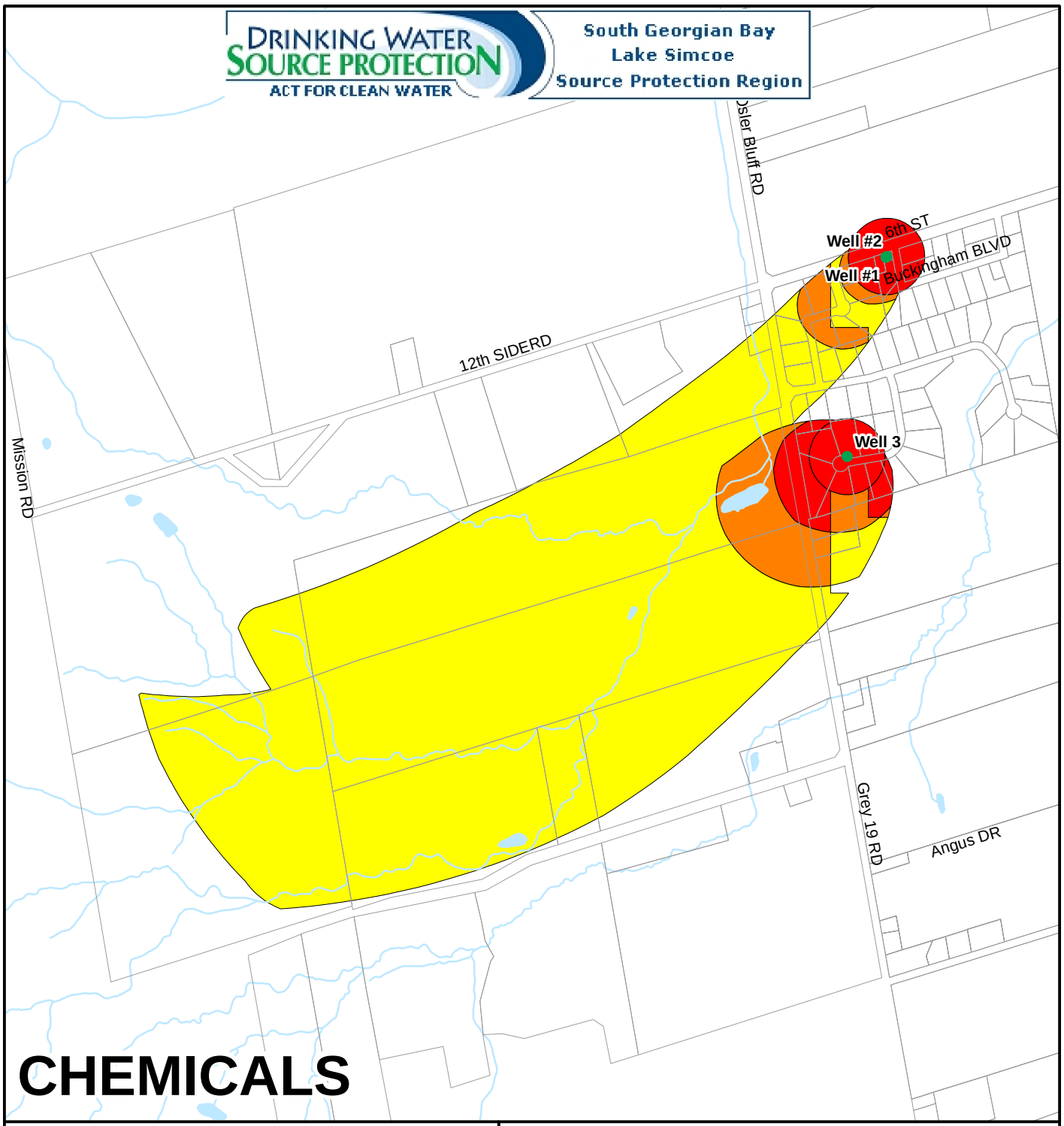
GENIVAR Ontario

FIGURE **10a-4**



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

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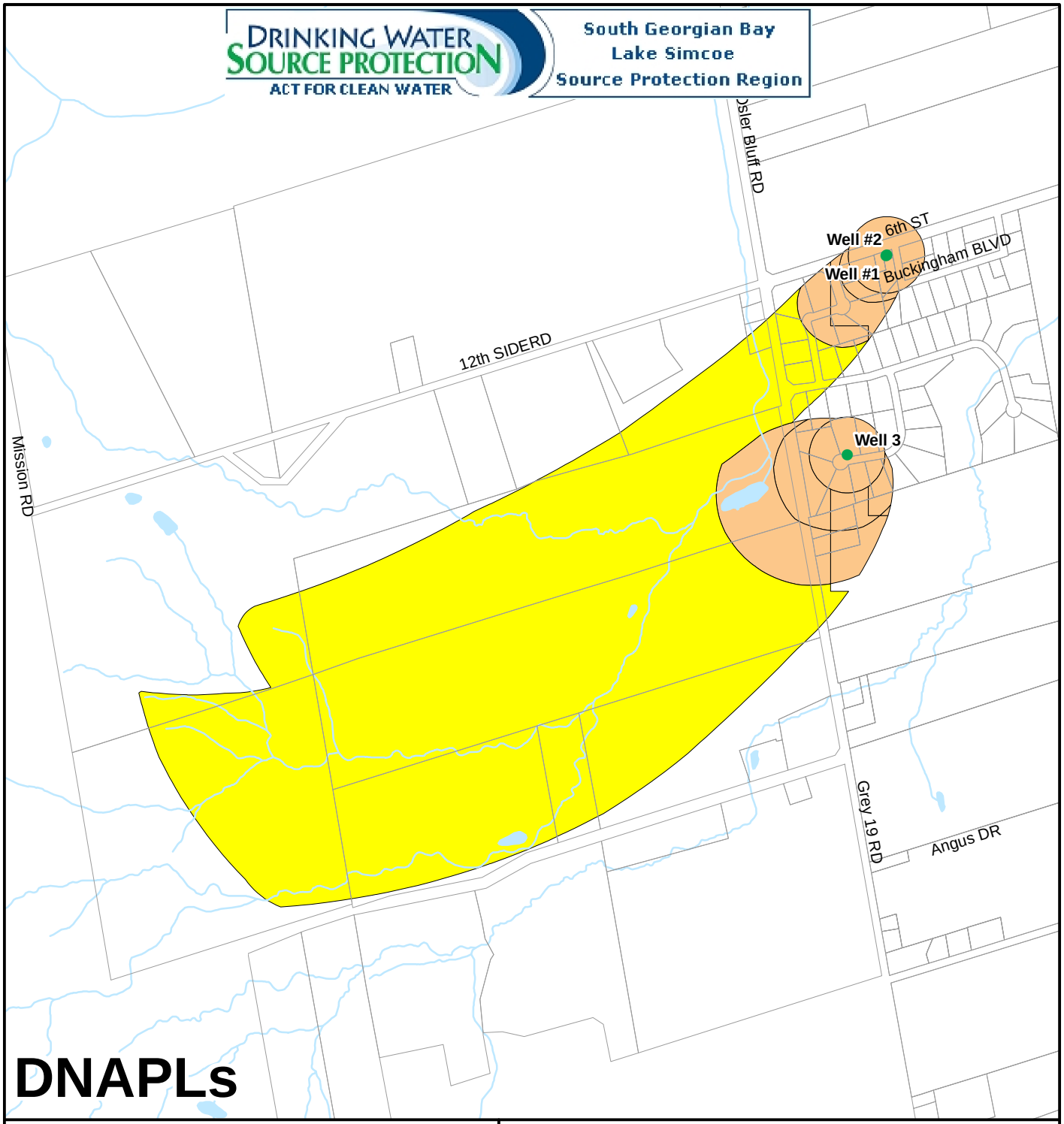
GENIVAR Ontario

FIGURE **10a-5**



DNAPLs

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

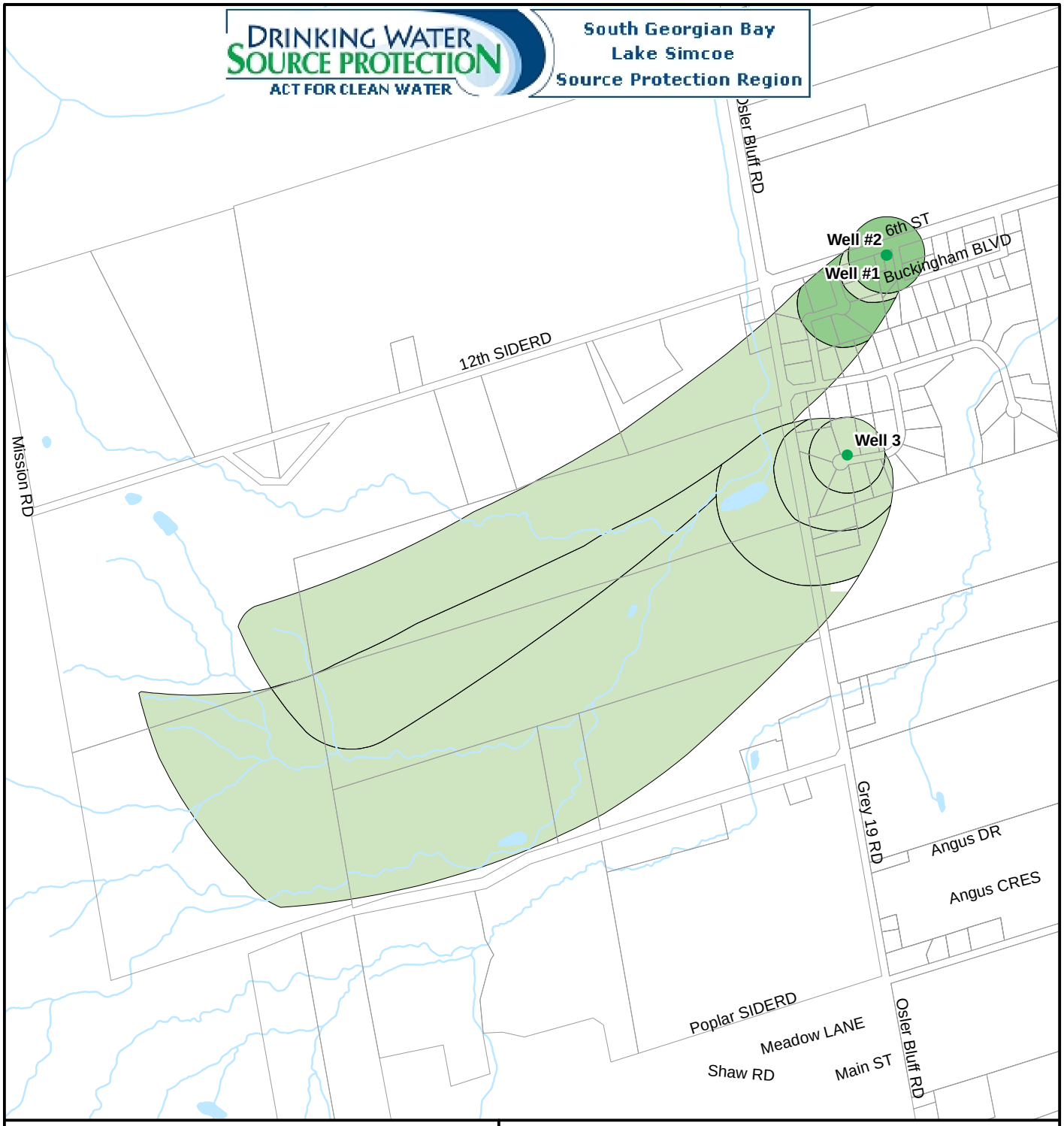
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.1-6

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-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

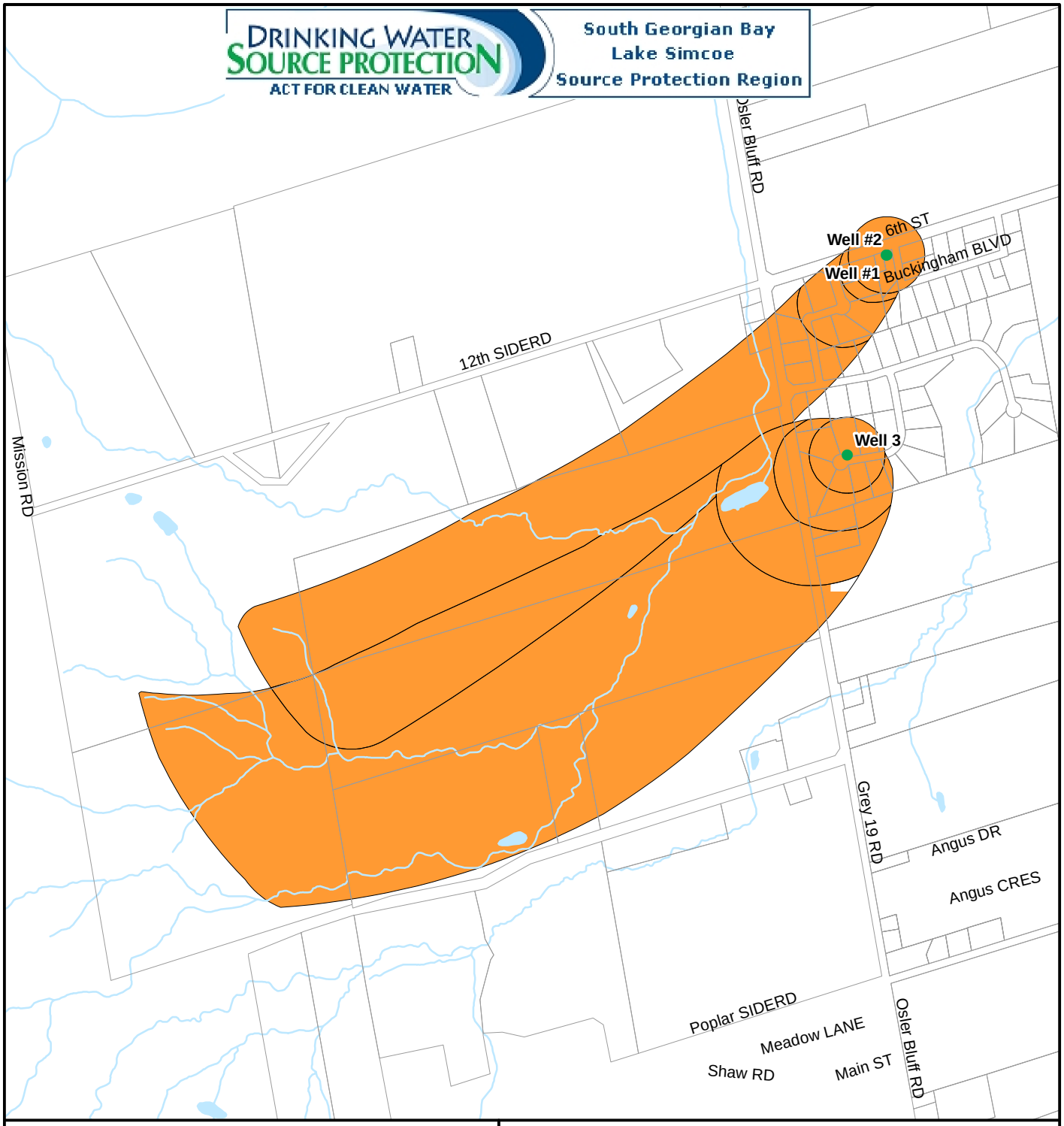
The Managed Land proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

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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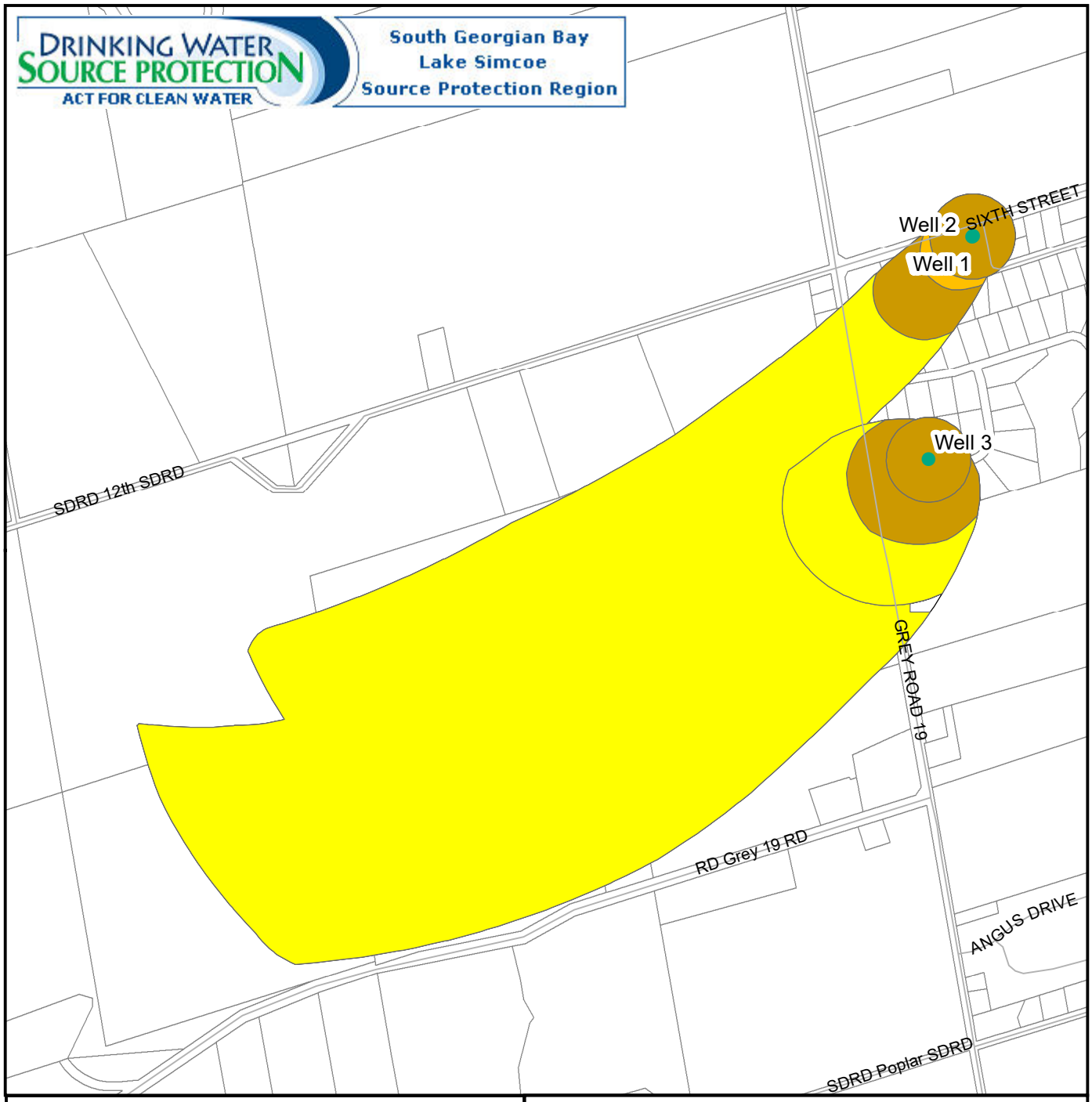
GENIVAR Ontario

FIGURE **10a-8**



Legend

- Municipal Well Location
- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- =>30%

N W E S

200 100 0 200 Meters

The Impervious Surfaces proportion is illustrated where the vulnerability score is greater than 6.

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IMPERVIOUS SURFACES - BUCKINGHAM WOODS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

Created by: NVCA
Date: 2025-09

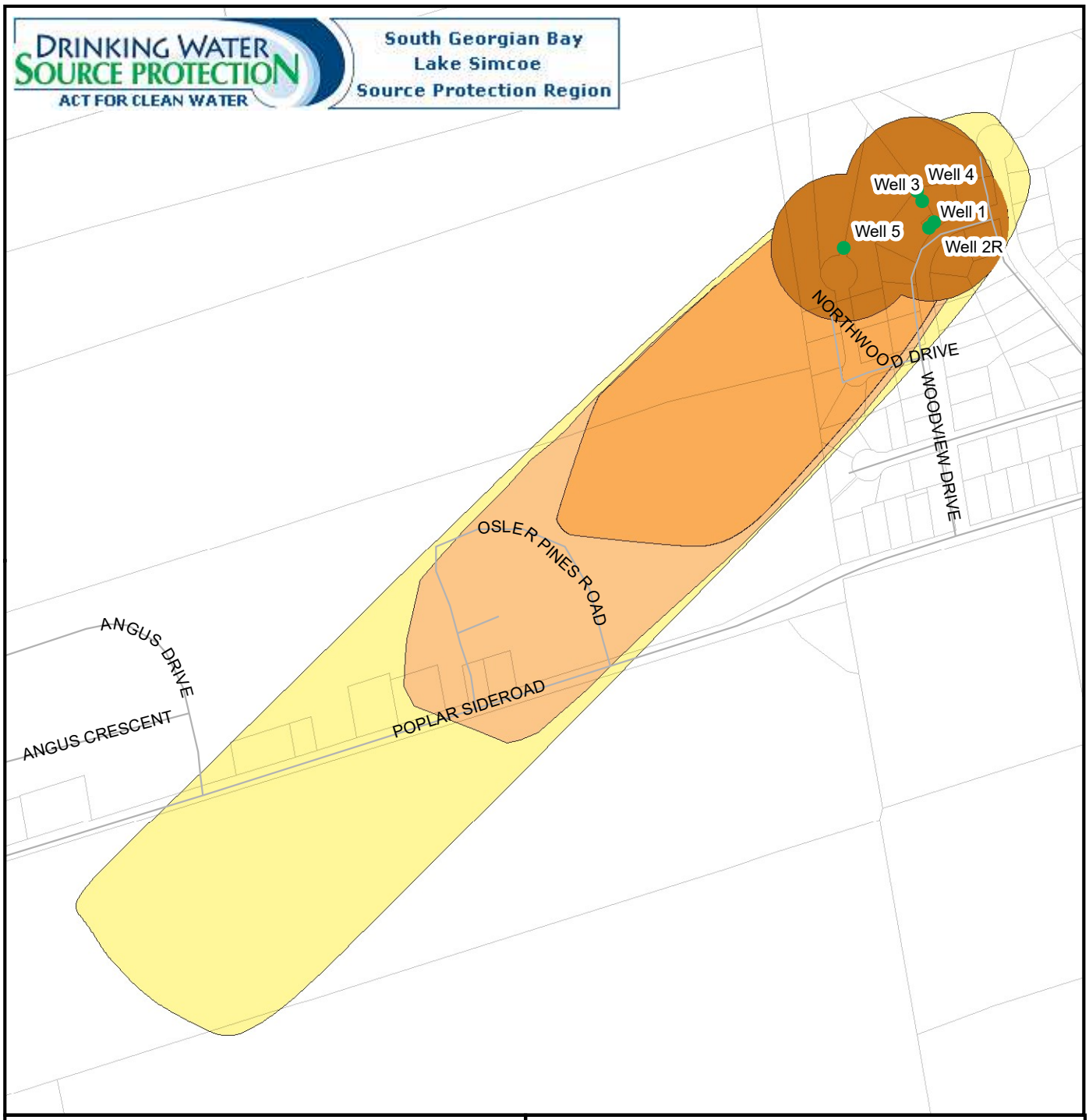
Scale: 1:14,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

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

90 45 0 90 Meters

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.

WELLHEAD PROTECTION AREAS-COLLING-WOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

Created by: NVCA
Date: 2025-04

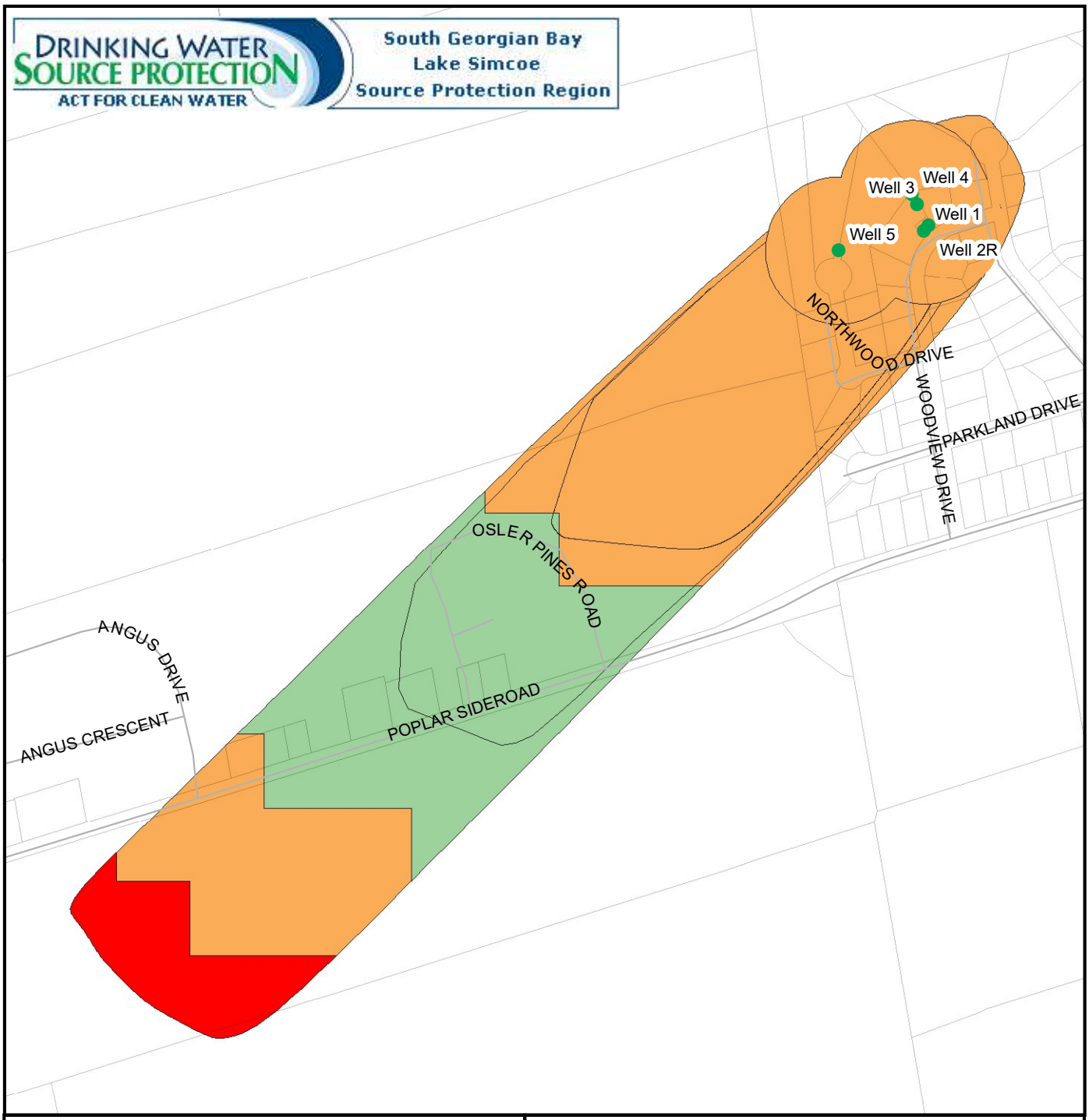
Scale: 1:7,997

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10b-1



Legend

- MUNICIPAL WELL LOCATION

Aquifer Vulnerabiity Index

- HIGH
- MEDIUM
- LOW

N W E S

90 45 0 90 Meters

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.

GROUNDWATER VULNERABILITY-COLLING-WOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

Created by: NVCA
Date: 2025-04

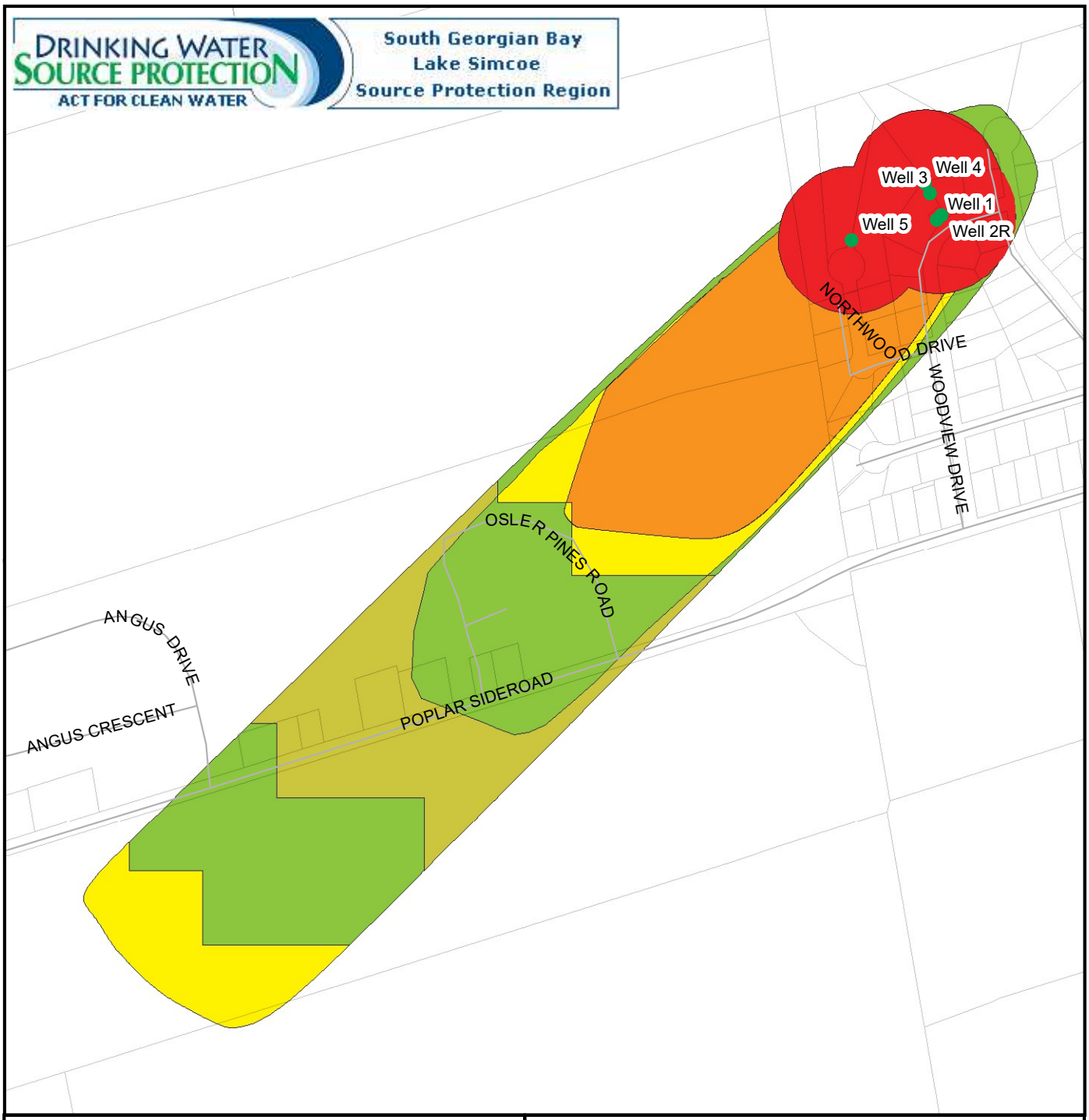
Scale: 1:7,997

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10b-2



Legend

- MUNICIPAL WELL LOCATION

Vulnerability Scores

- 10
- 8
- 6
- 4
- 2

N W E S

90 45 0 90 Meters

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.

VULNERABILITY SCORE-
COLLING-WOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

Created by: NVCA
Date: 2025-04

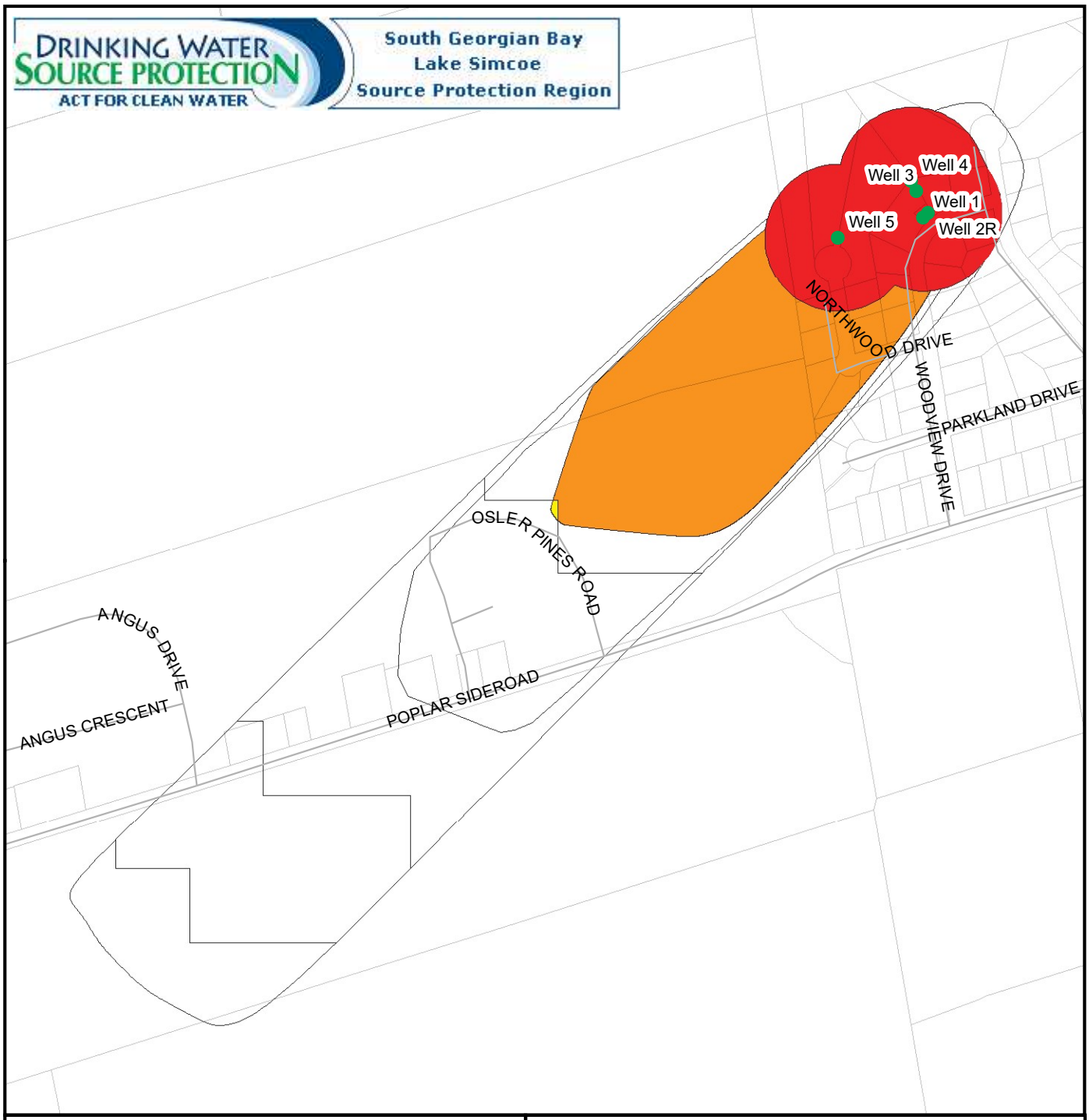
Scale: 1:7,997

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10b-3



Legend

- MUNICIPAL WELL LOCATION

Vulnerability

- 10
- 8
- 6

N W E S

90 45 0 90 Meters

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.

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.

AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE OR LOW THREATS-COLLING-WOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

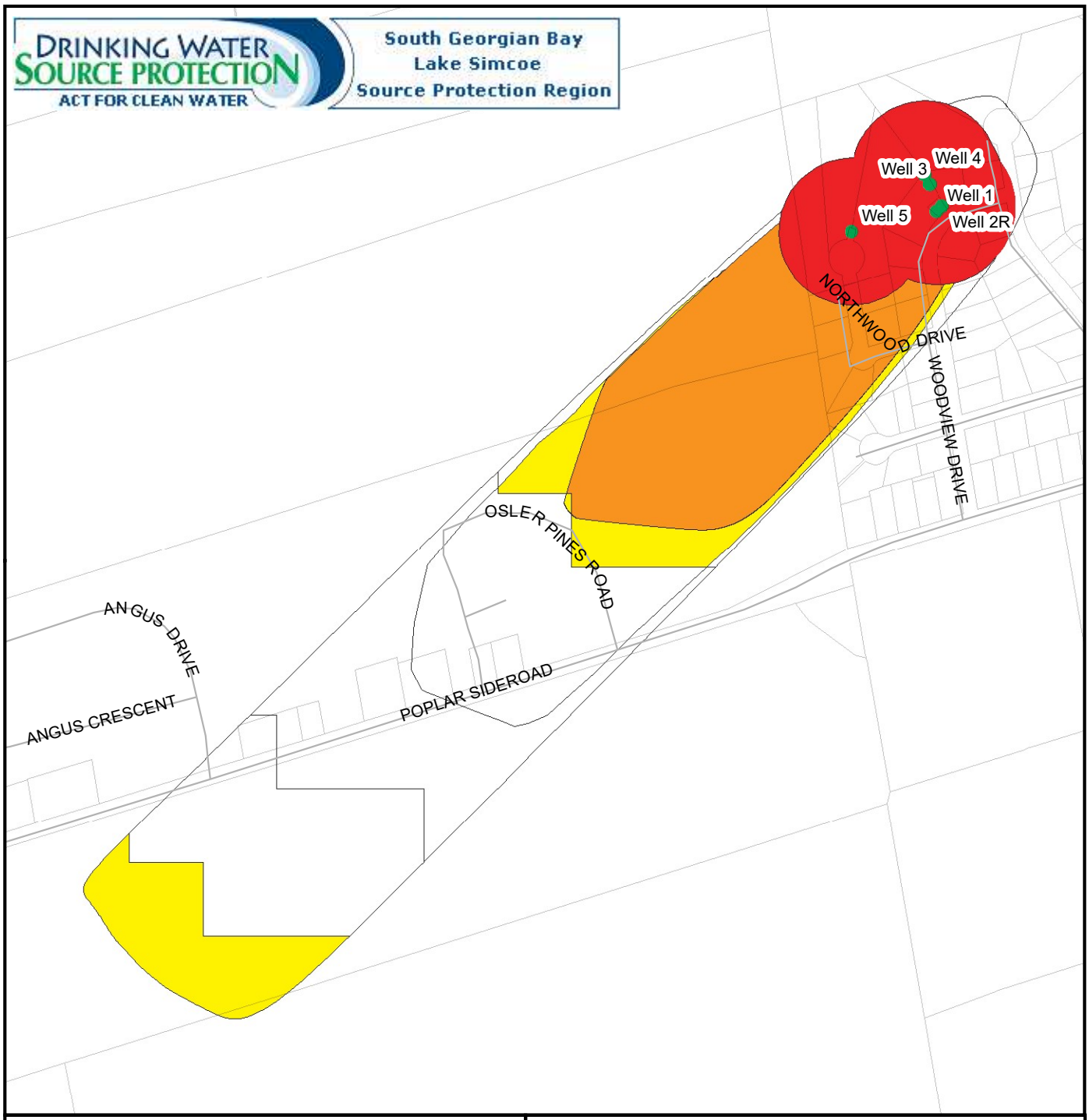
Created by: NVCA
Date: 2025-04

Scale: 1:7,997

UTM Zone 17N, NAD83

Ontario

Figure 10b-4



Legend

- MUNICIPAL WELL LOCATION

Vulnerability Score

- 10
- 8
- 6

N W E S

90 45 0 90 Meters

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.

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.

AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE OR LOW THREATS-COLLING-WOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

Created by: NVCA
Date: 2025-04

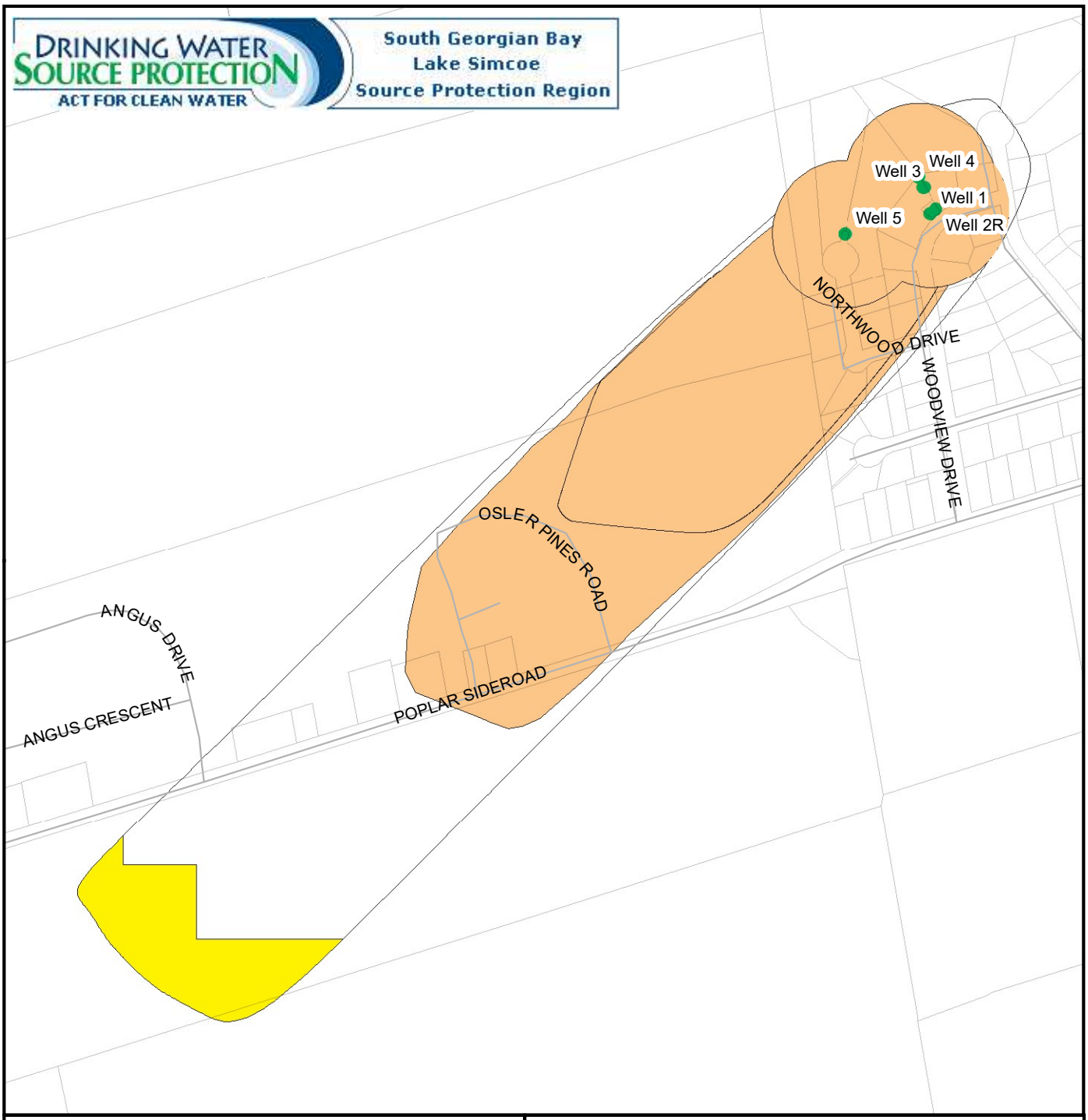
Scale: 1:7,997

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10b-5



Legend

- MUNICIPAL WELL LOCATION
- WHPA-C (5-YEAR TIME-OF-TRAVEL)

Vulnerability Score

- 6

N W E S

90 45 0 90 Meters

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.

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AREAS WHERE DNAPLS ARE OR WOULD BE SIGNIFICANT, MODERATE OR LOW THREATS-COLLING-WOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

Created by: NVCA
Date: 2025-04

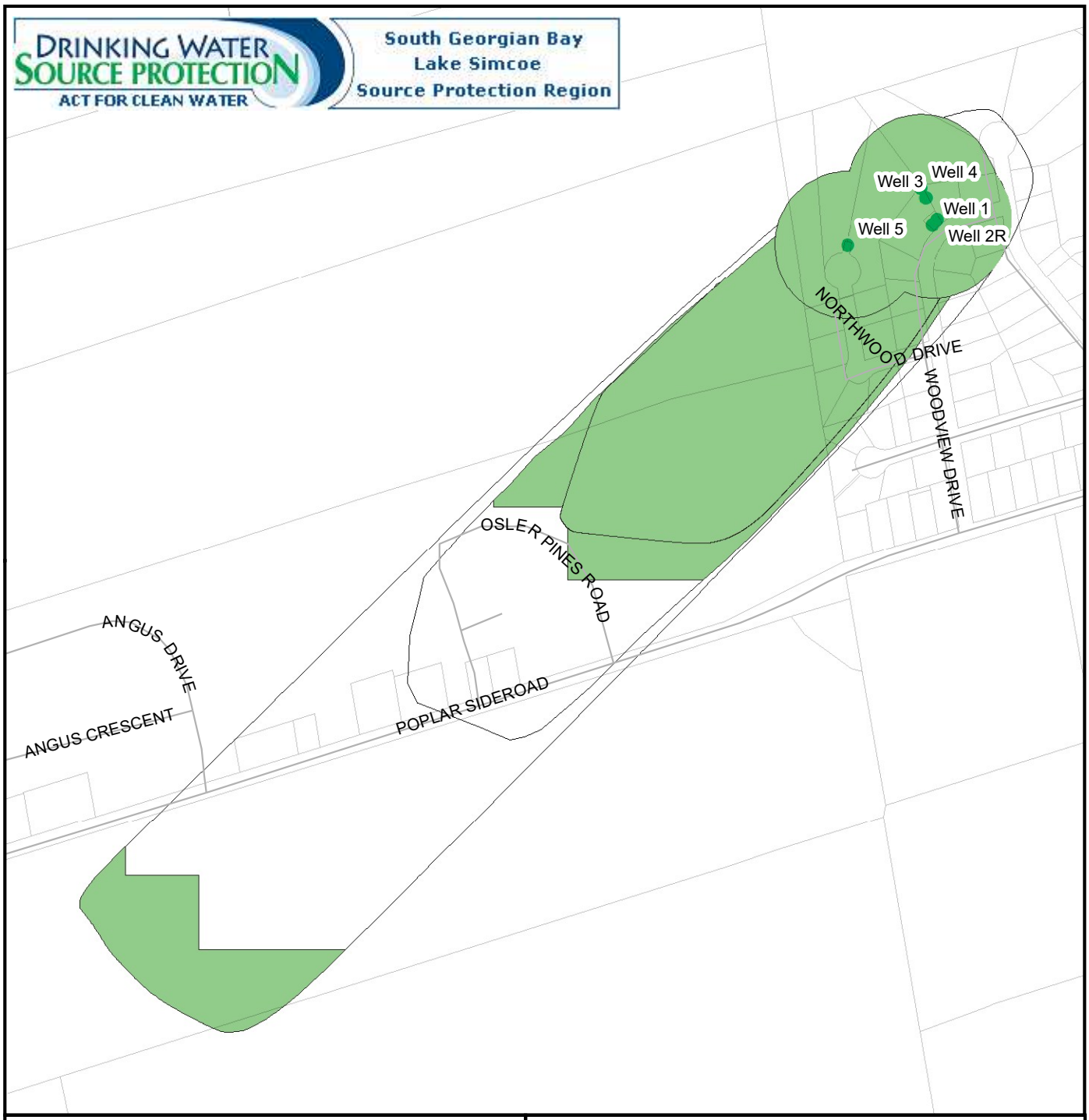
Scale: 1:7,997

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

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 Meters

The Managed Lands proportion is illustrated where the vulnerability score is greater than 6.

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MANAGED LANDS-COLLING-WOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

Created by: NVCA
Date: 2025-04

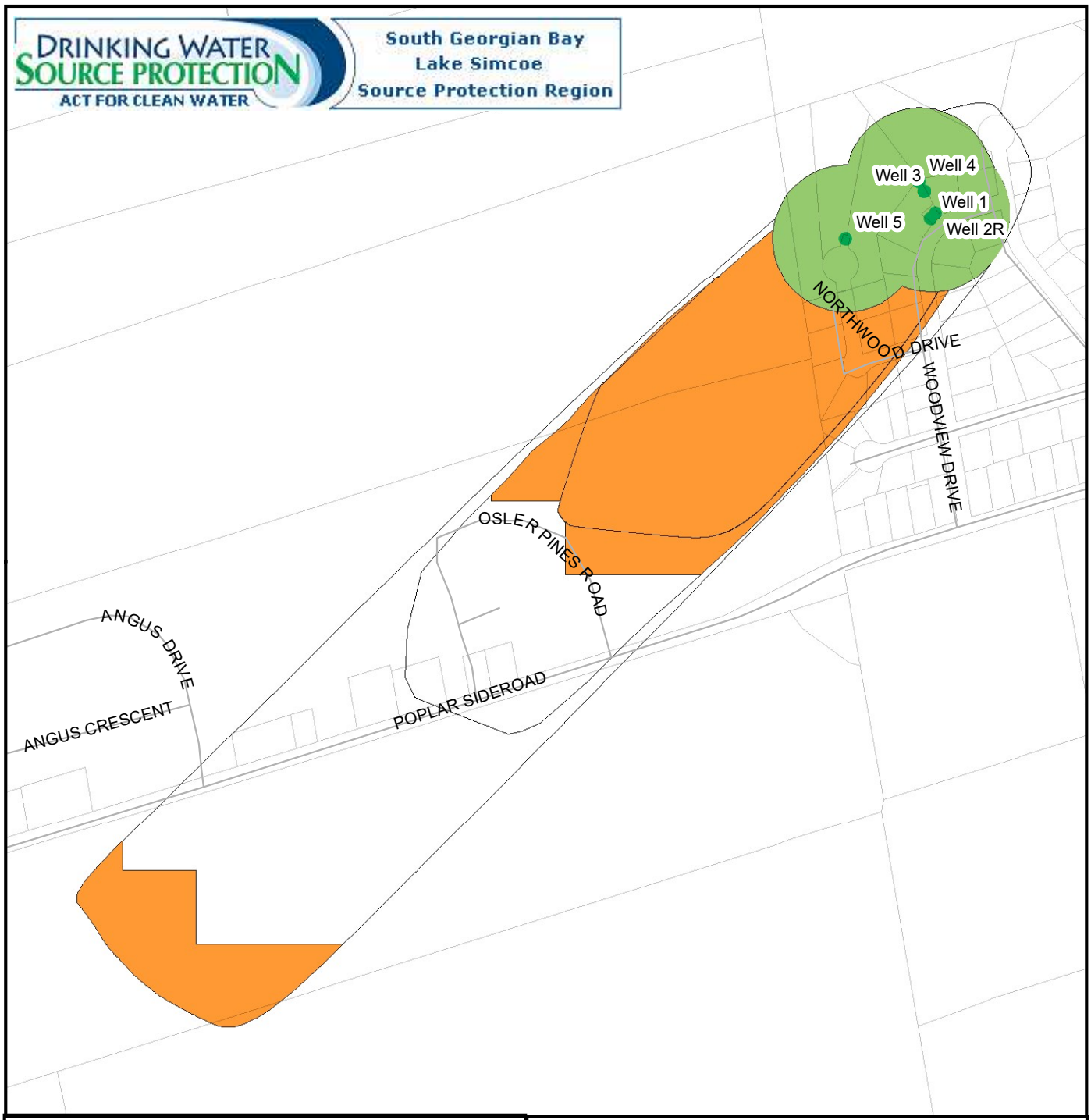
Scale: 1:7,997

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

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

90 45 0 90 Meters

The Livestock Density proportion is illustrated where the vulnerability score is greater than 6.

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LIVESTOCK DENSITY-COLLING-WOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

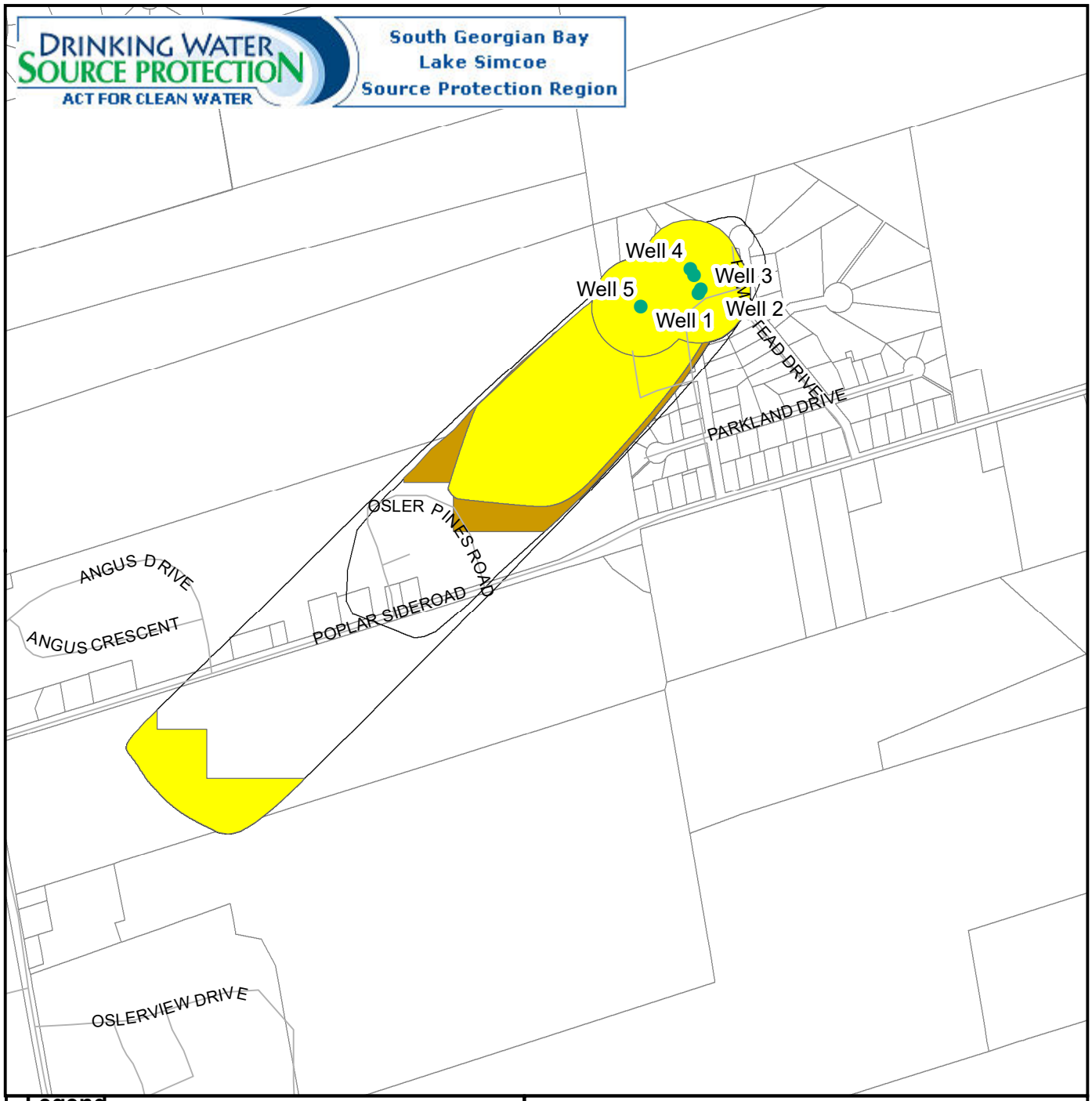
Created by: NVCA
Date: 2025-04

Scale: 1:7,997

UTM Zone 17N, NAD83

Ontario

Figure 10b-8



Legend

- Municipal Well Location
- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- =>30%

N W E S

100 50 0 100 Meters

The Impervious Surfaces proportion is illustrated where the vulnerability score is greater than 6.

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IMPERVIOUS SURFACES - COLLING-WOODLANDS

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

Created by: NVCA
Date: 2025-09

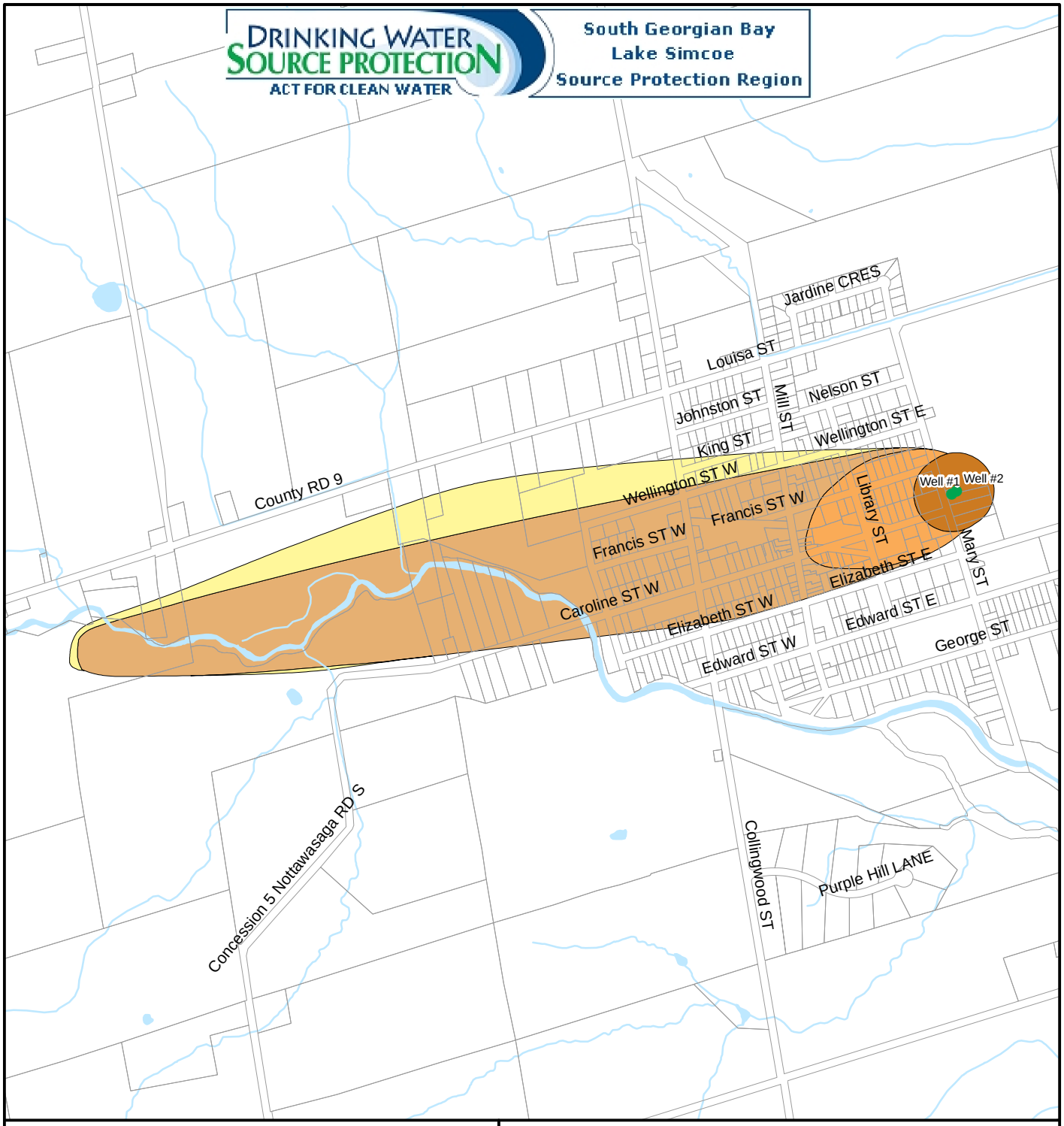
Scale: 1:12,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

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

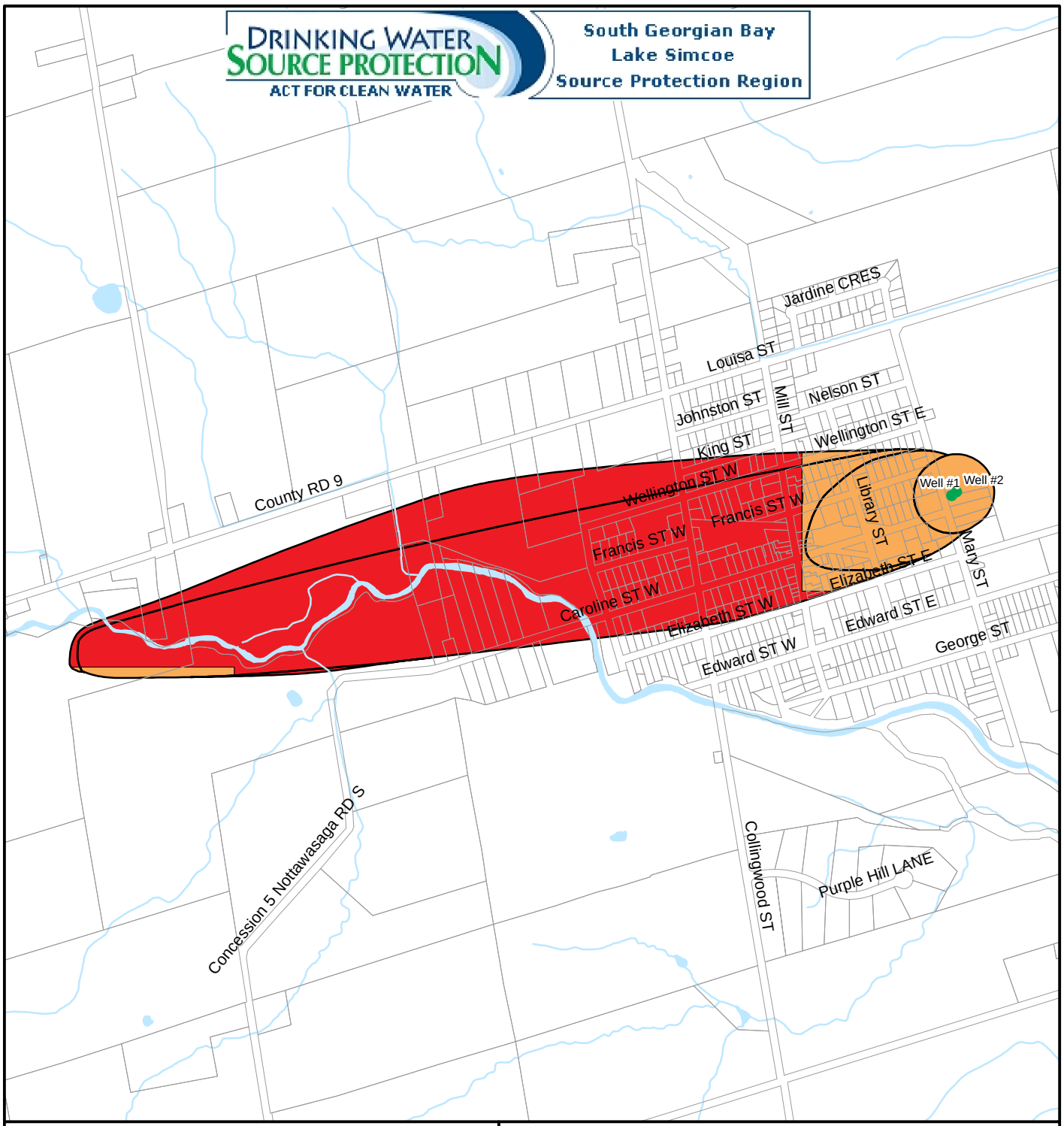
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.3-1

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-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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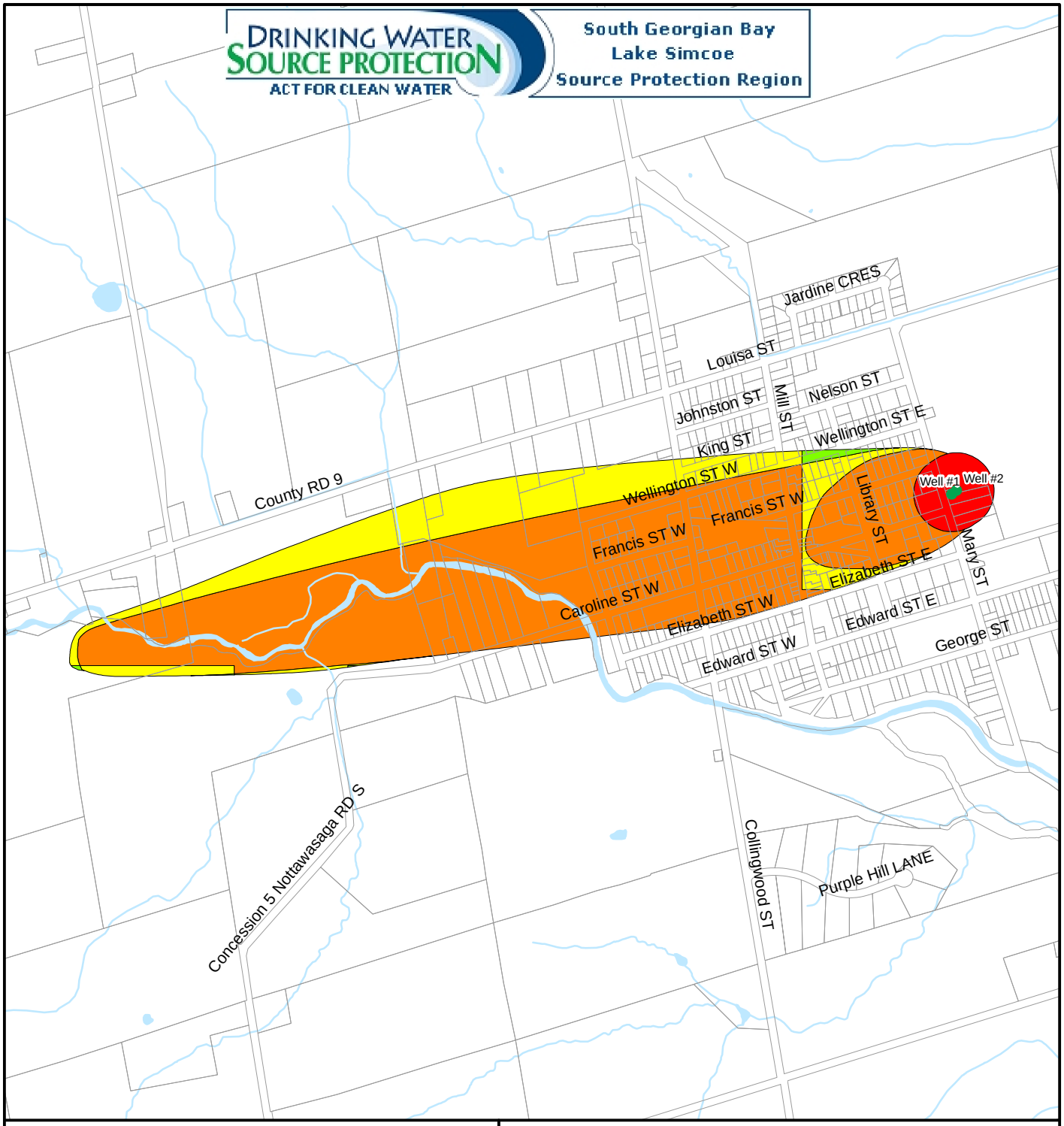
GENIVAR Ontario

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

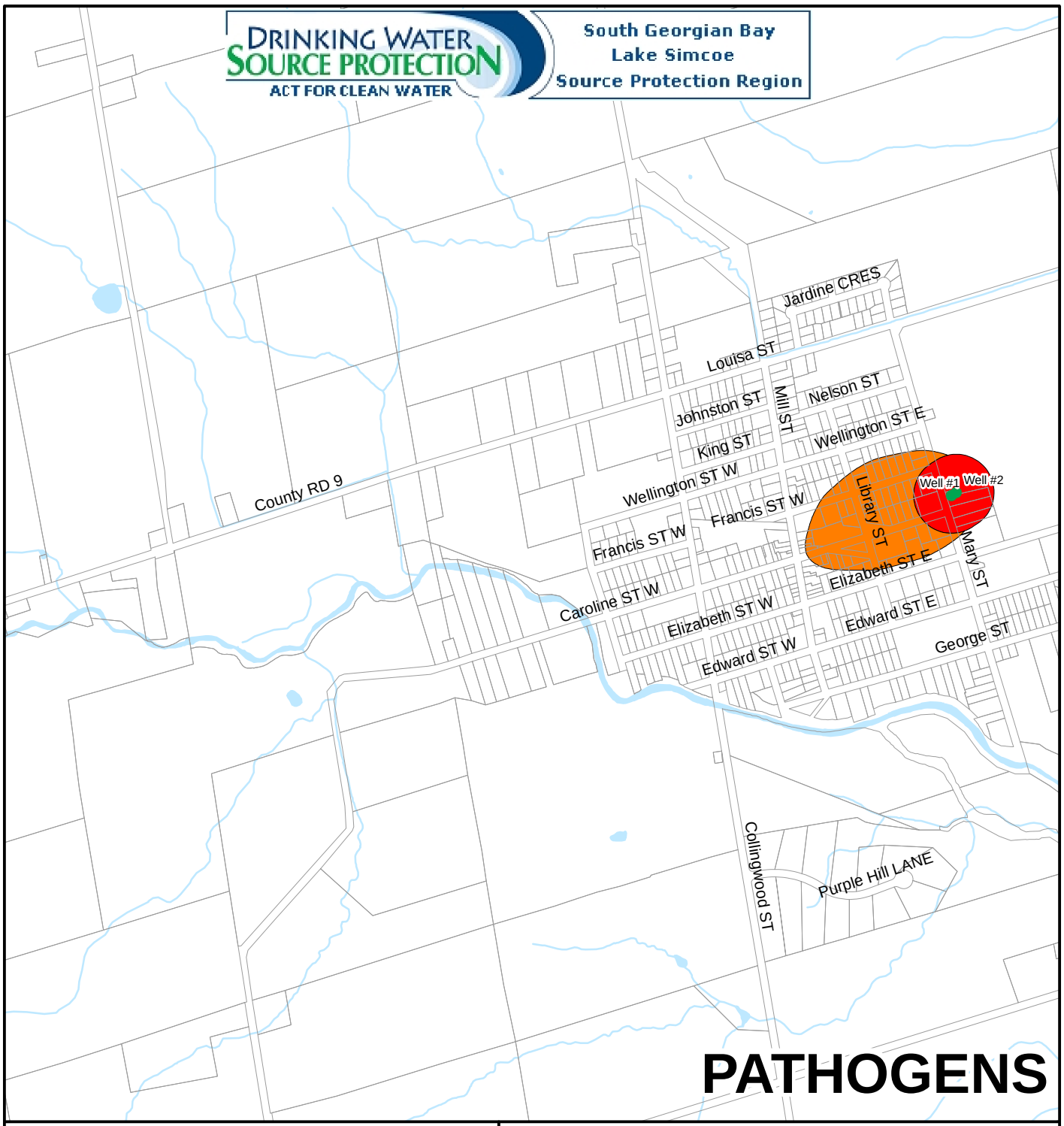
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

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



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

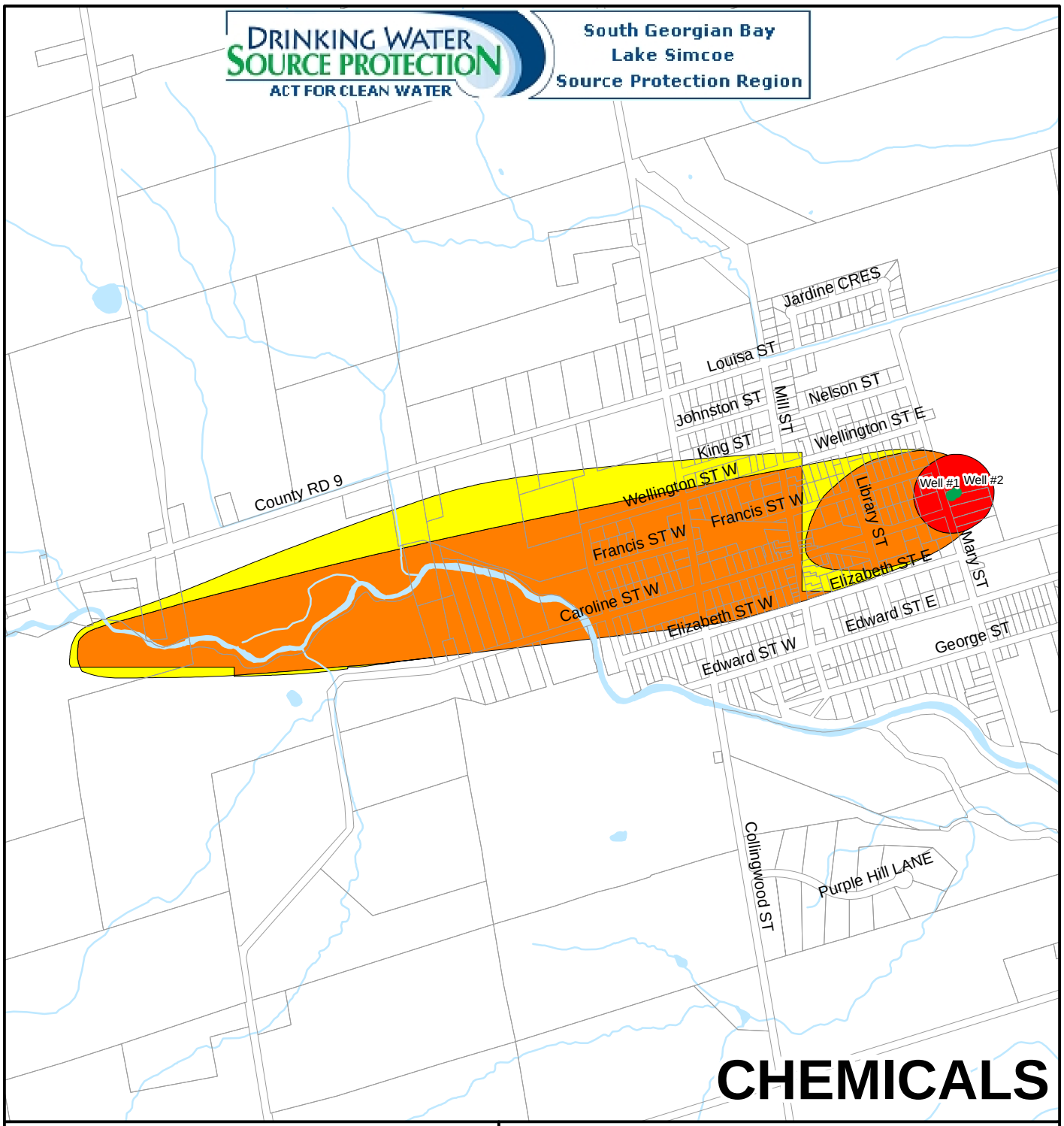
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

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



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

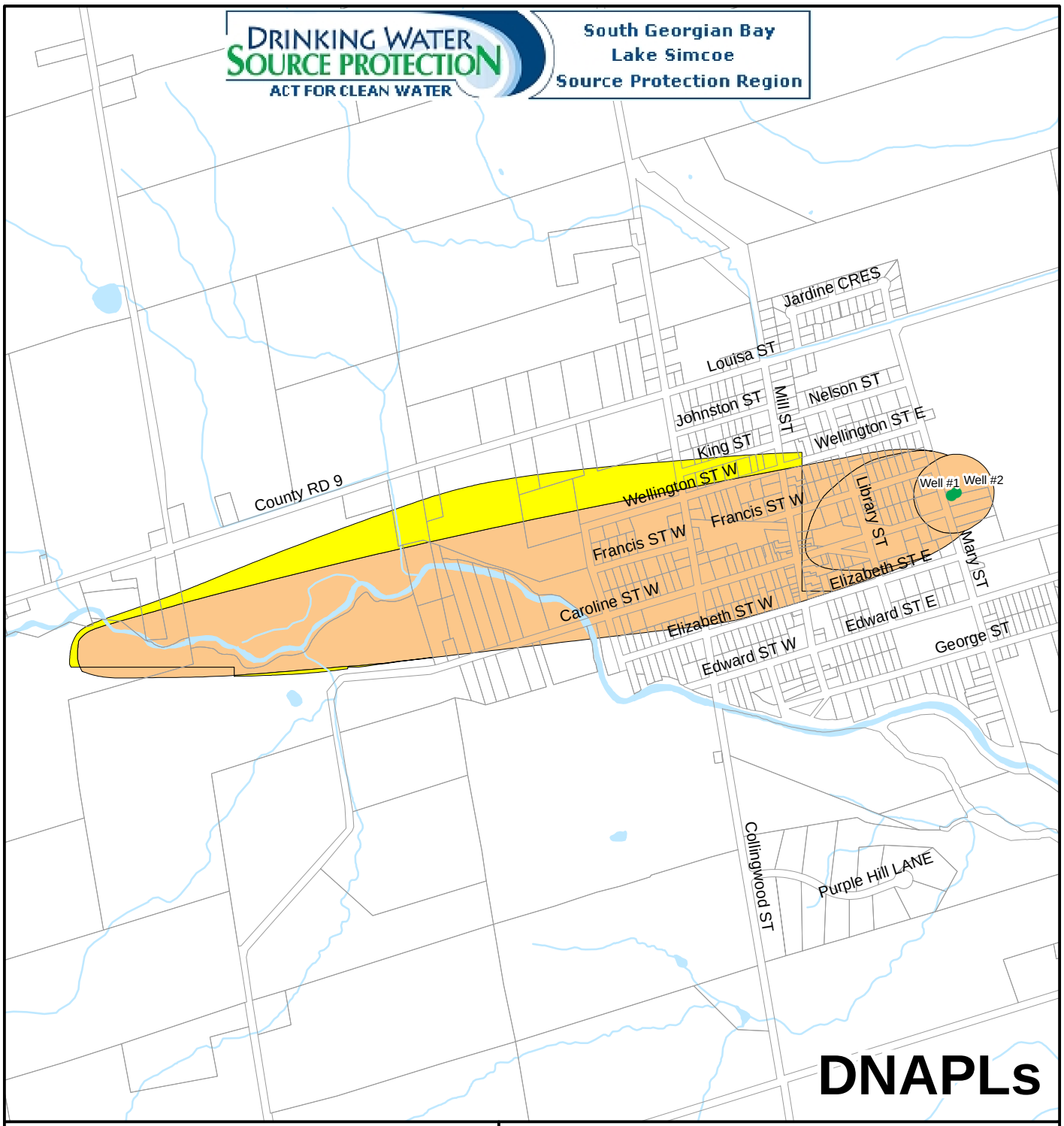
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

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



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

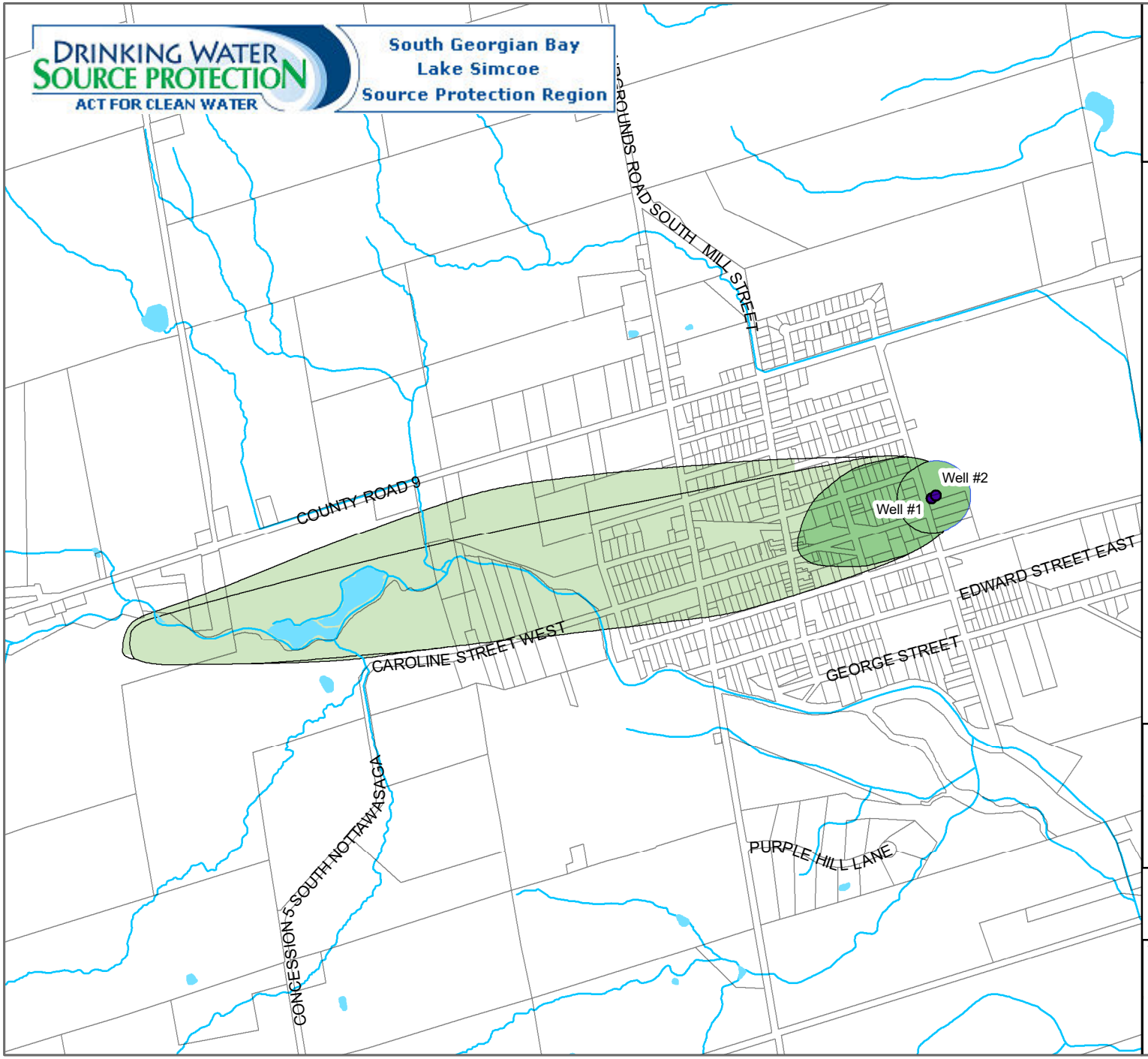
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.3-6

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-6**



Managed Lands - Township of Clearview Creemore Well Supply (Well 1&2)

N
W E
S

Legend

Well Locations

Percent Managed Lans

<40

40-80

>80

Meters
0 150 300 600

Created by: NVCA
Date: 2020-08-25

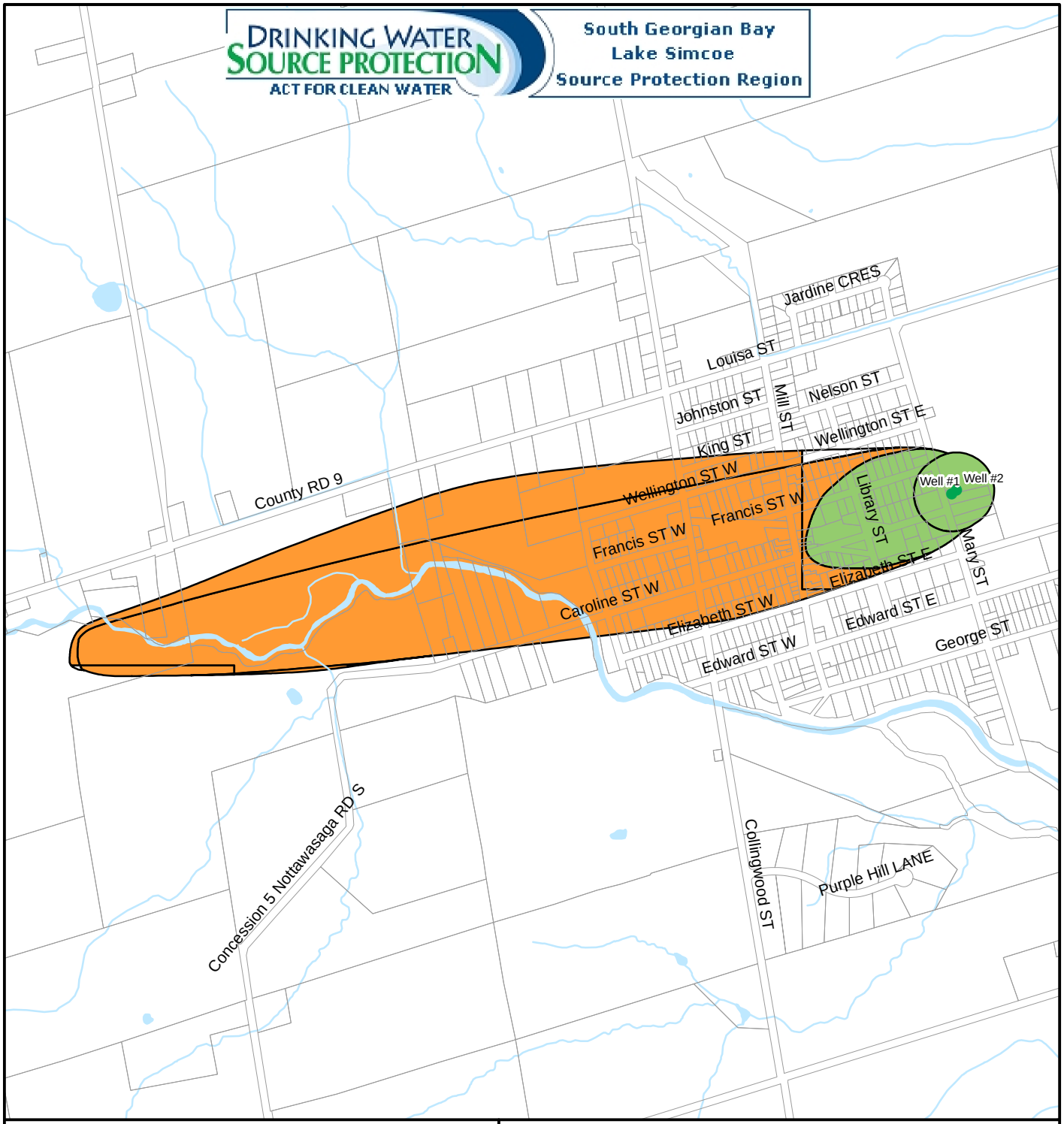
Scale: 1:16,346

UTM Zone 17N, NAD83

Ontario

Figure 10c-7

This map was originally created for the Nottawasaga Valley Conservation Authority Water Budget Model - Geological/Hydrostratigraphic Model Development June 2009, for the purposes of completing the South Georgian Bay Lake Simcoe Assessment reports. While every effort has been made to accurately depict the base data, errors may exist.



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

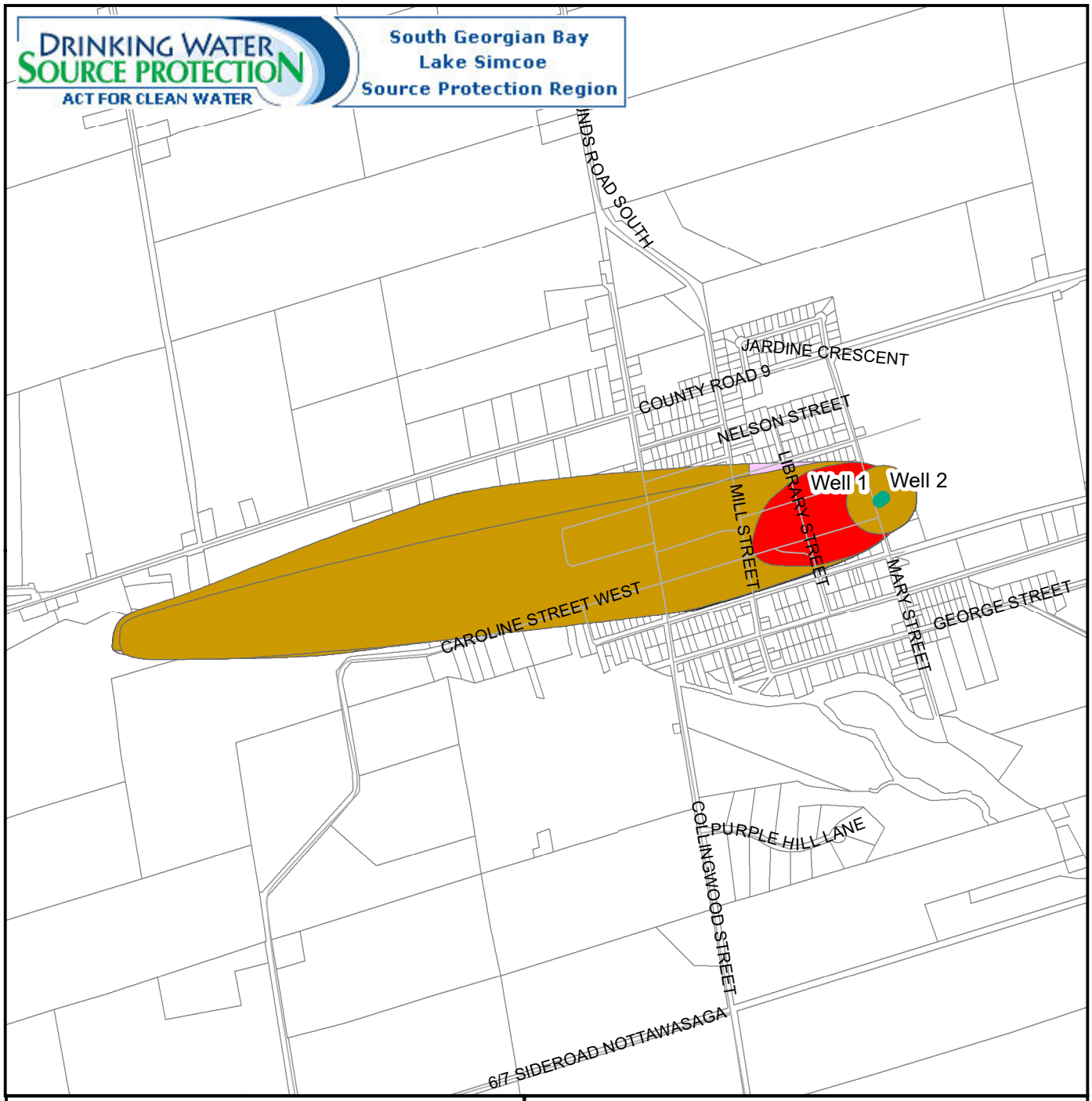
The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JULY 2010	SCALE: 1:15000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.3-8

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-8**



Legend

- Municipal Well Location
- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- =>30%

N W E S

200 100 0 200 Meters

The Impervious Surfaces proportion is illustrated where the vulnerability score is greater than 6.

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.

IMPERVIOUS SURFACES - CREEMORE

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

Created by: NVCA
Date: 2025-09

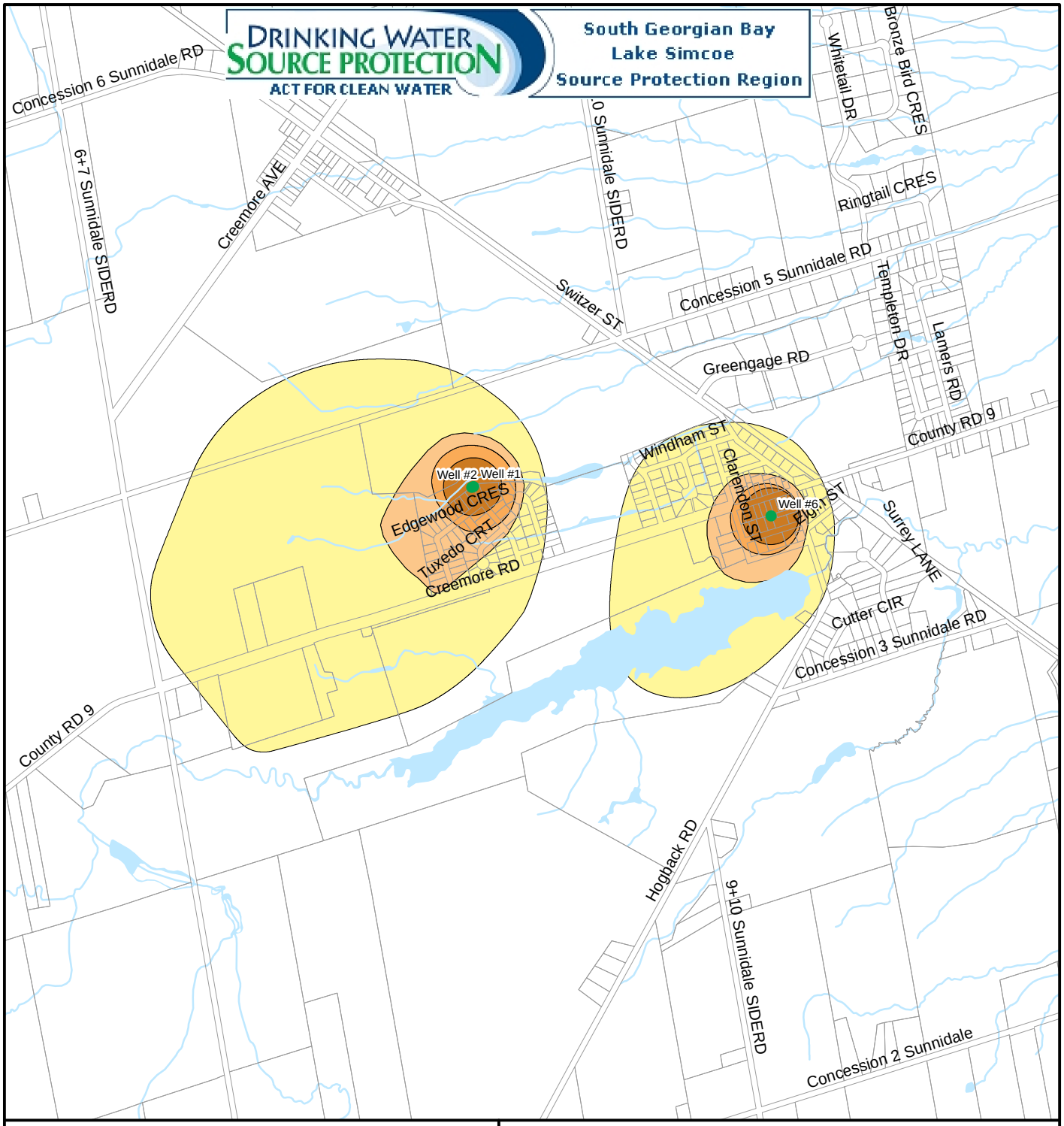
Scale: 1:18,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

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

N W E S

190 95 0 190 Metres

WELLHEAD PROTECTION AREAS - NEW LOWELL, CLEARVIEW

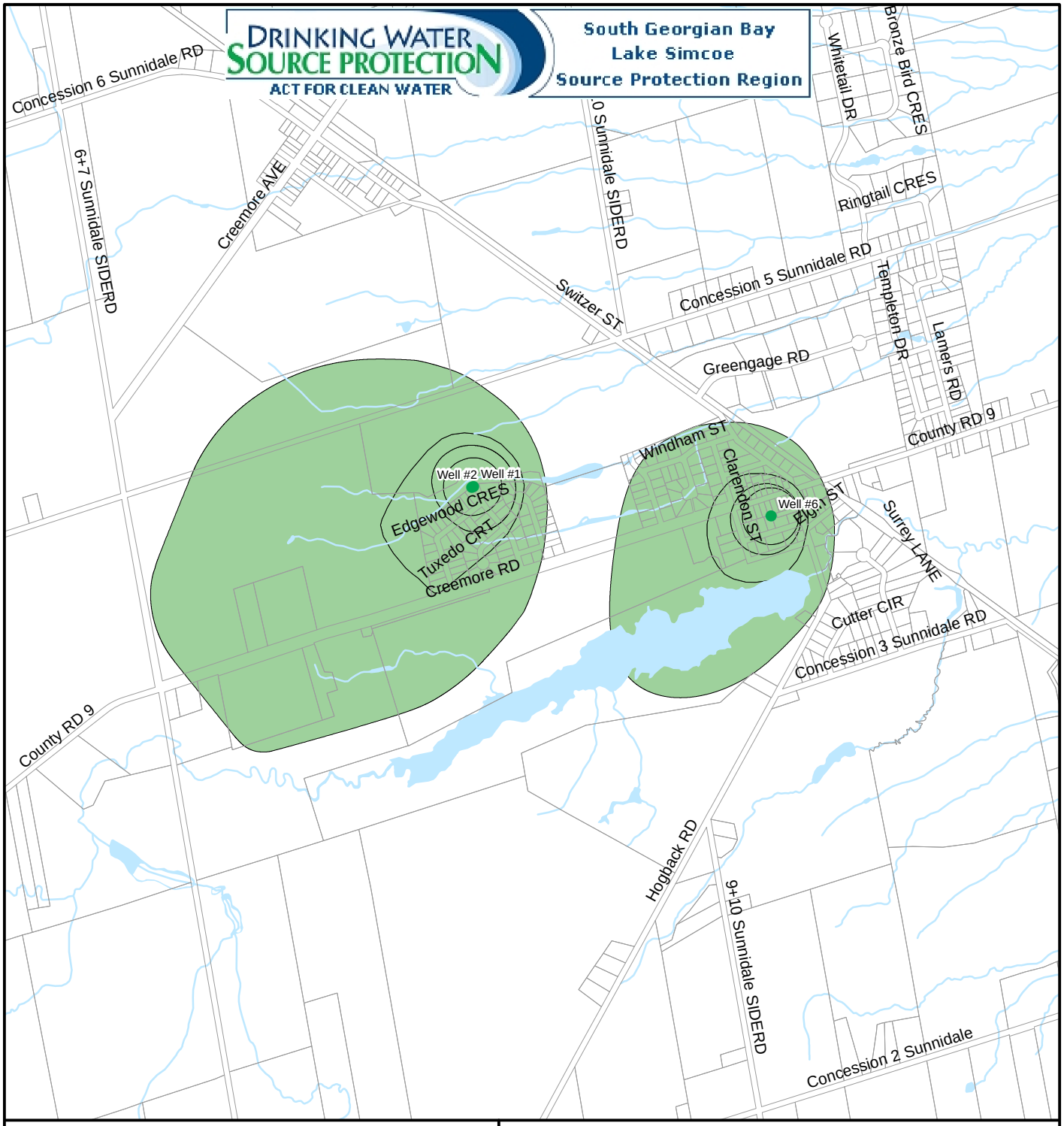
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:20000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.4-1

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 **10d-1**



LEGEND

- MUNICIPAL WELL LOCATION

AQUIFER VULNERABILITY INDEX

- HIGH
- MEDIUM
- LOW

N W E S

200 100 0 200 Metres

GROUNDWATER VULNERABILITY - NEW LOWELL

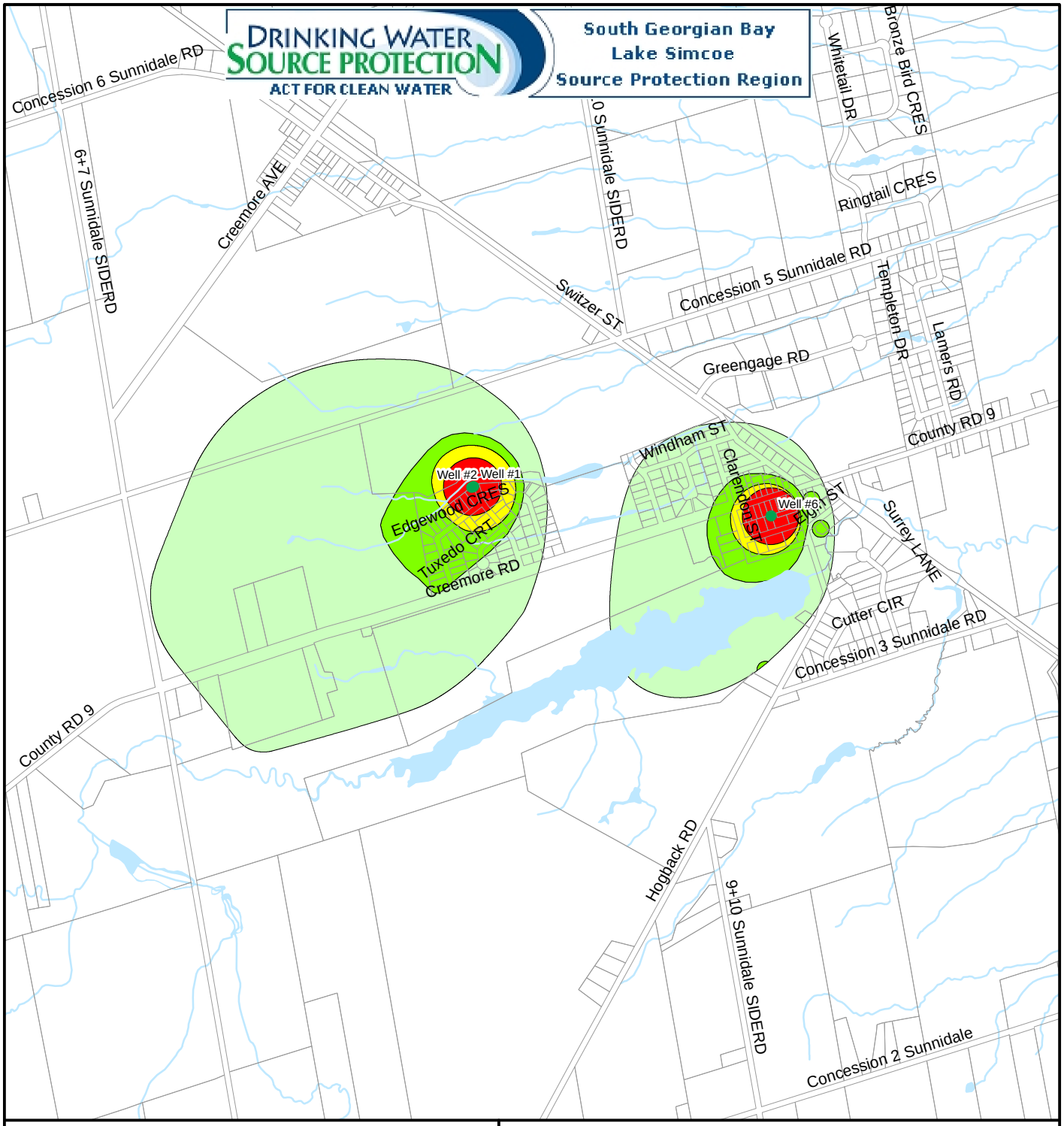
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:20000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.4-2

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 10d-2



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6
- 4
- 2

N W E S

190 95 0 190 Metres

VULNERABILITY SCORES - NEW LOWELL

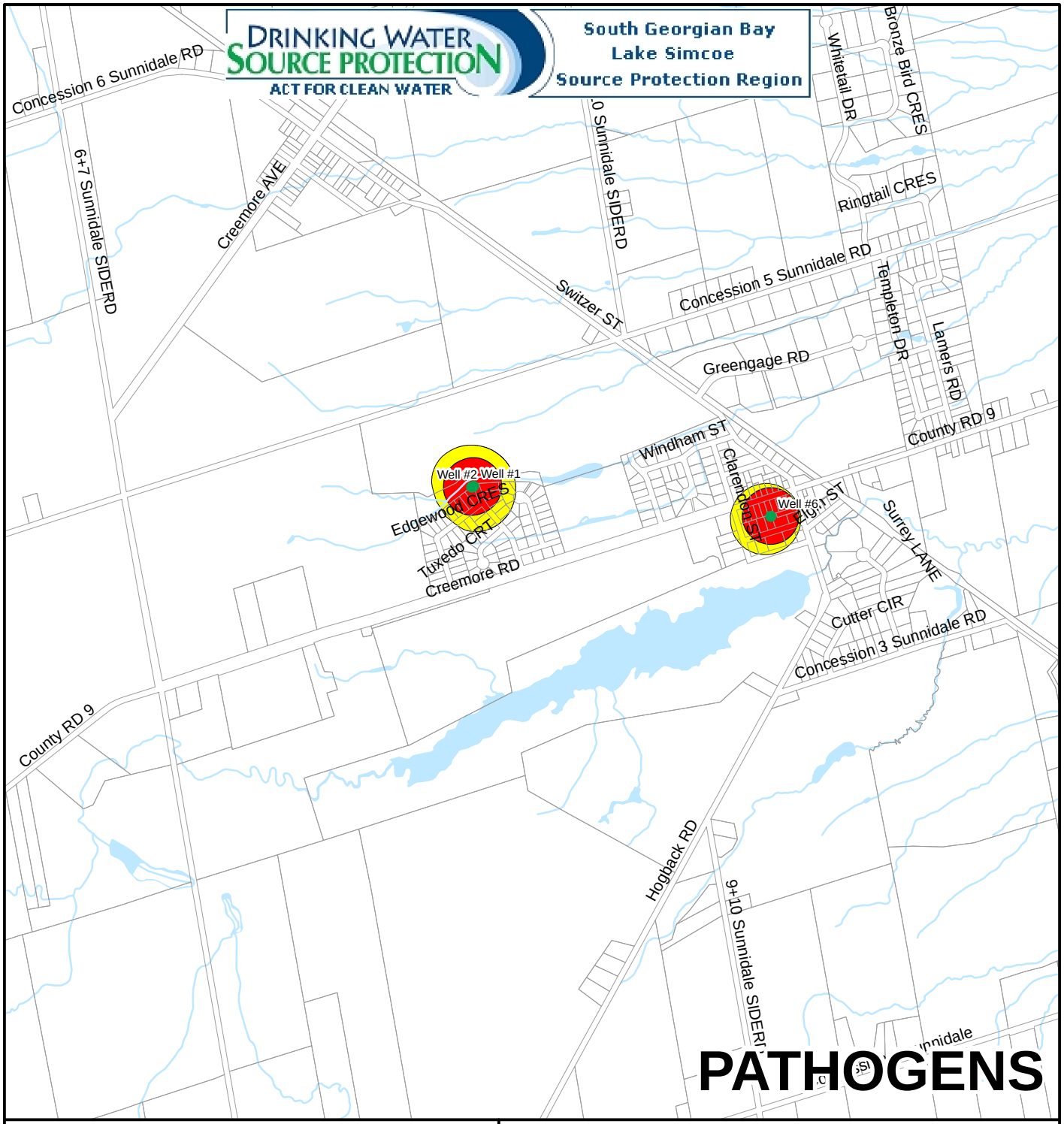
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:20000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.4-5

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 10d-3



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 - NEW LOWELL

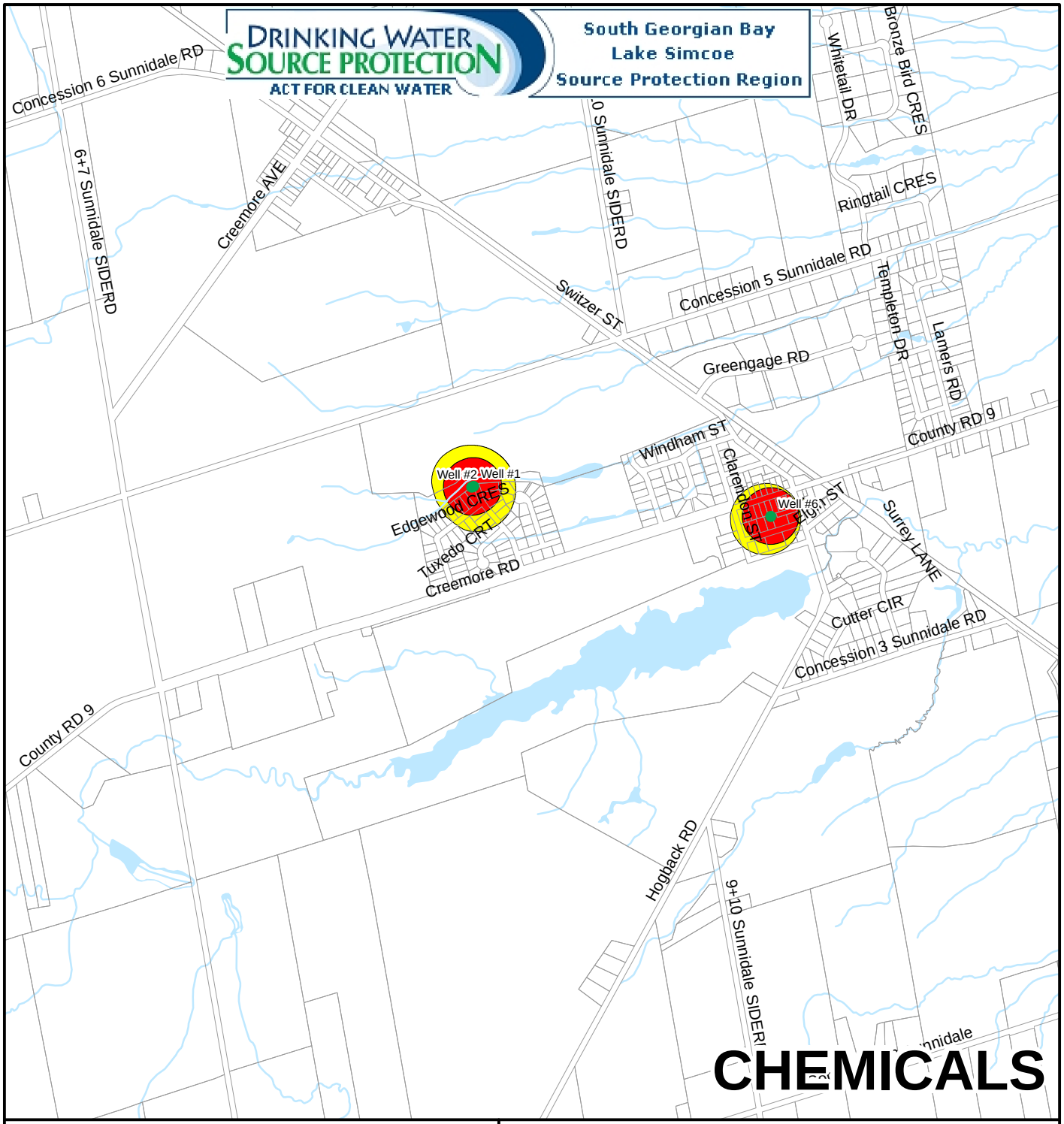
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:20000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.4-6

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 10d-4



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

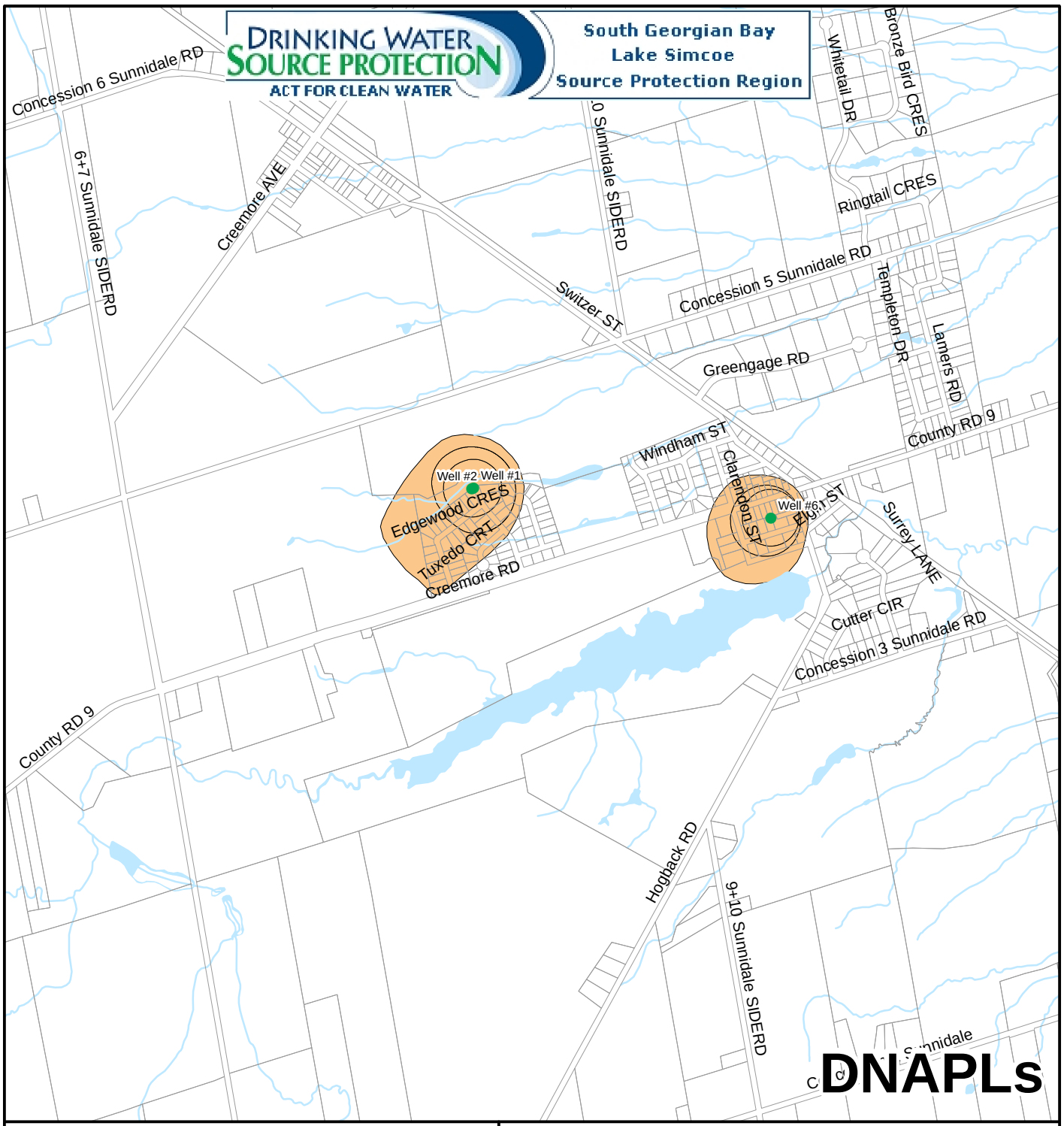
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:20000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.4-7

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 **10d-5**



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.

AREAS WHERE DNAPLS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - NEW LOWELL

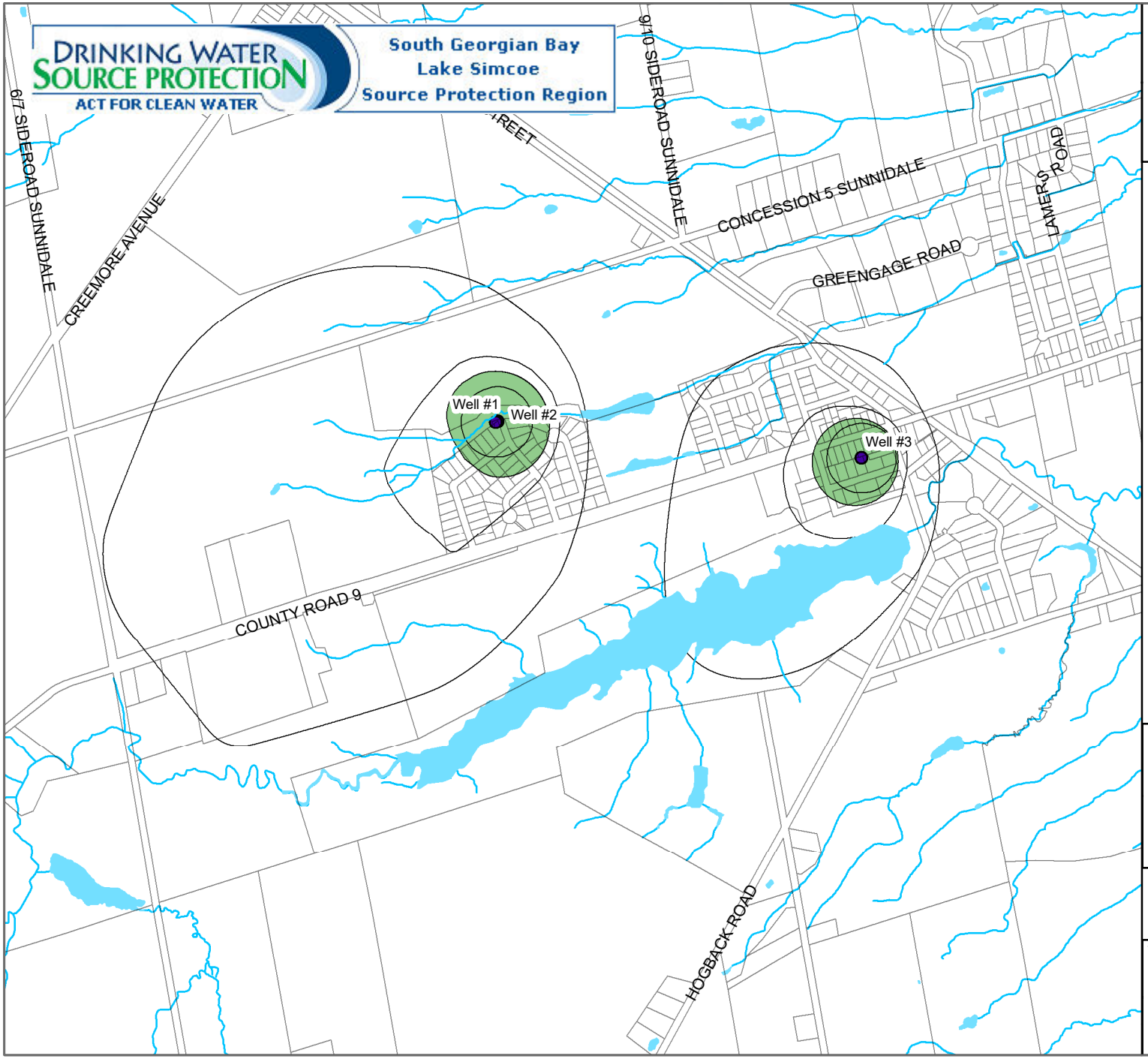
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:20000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.4-8

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 **10d-6**



Percent Managed Lands - New Lowell Wells 1/2/3, Township of Clearview

N
W E
S

Legend

Well Location

Percent Managed Lands

<40

40-80

>80

Meters
0 150 300 600

Created by: NVCA
Date: 2020-08-25

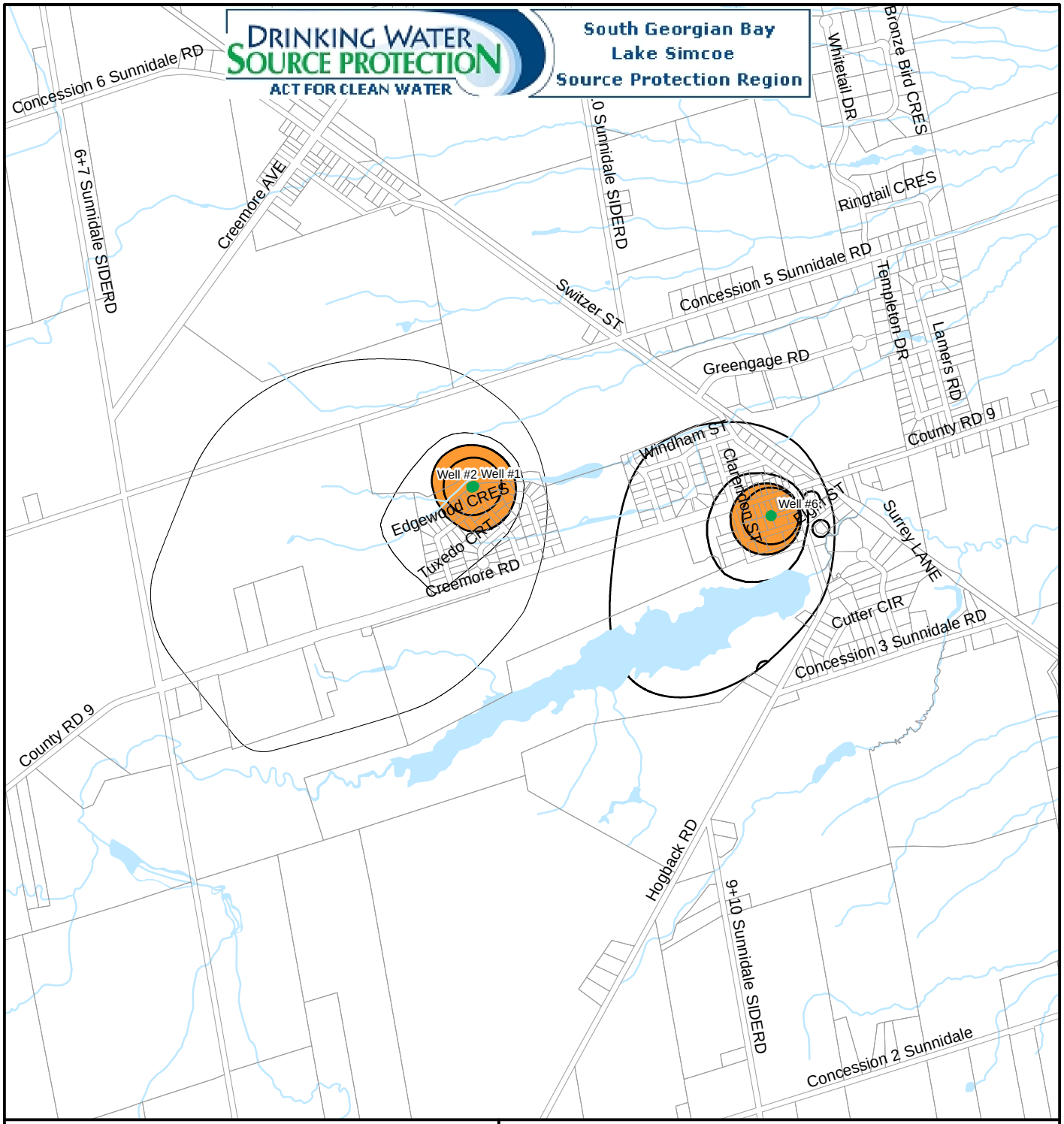
Scale: 1:16,346

UTM Zone 17N, NAD83

Ontario

Figure 10d-7

This map was originally created for the Nottawasaga Valley Conservation Authority Water Budget Model - Geological/Hydrostratigraphic Model Development June 2009, for the purposes of completing the South Georgian Bay Lake Simcoe Assessment reports. While every effort has been made to accurately depict the base data, errors may exist.



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 - NEW LOWELL

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

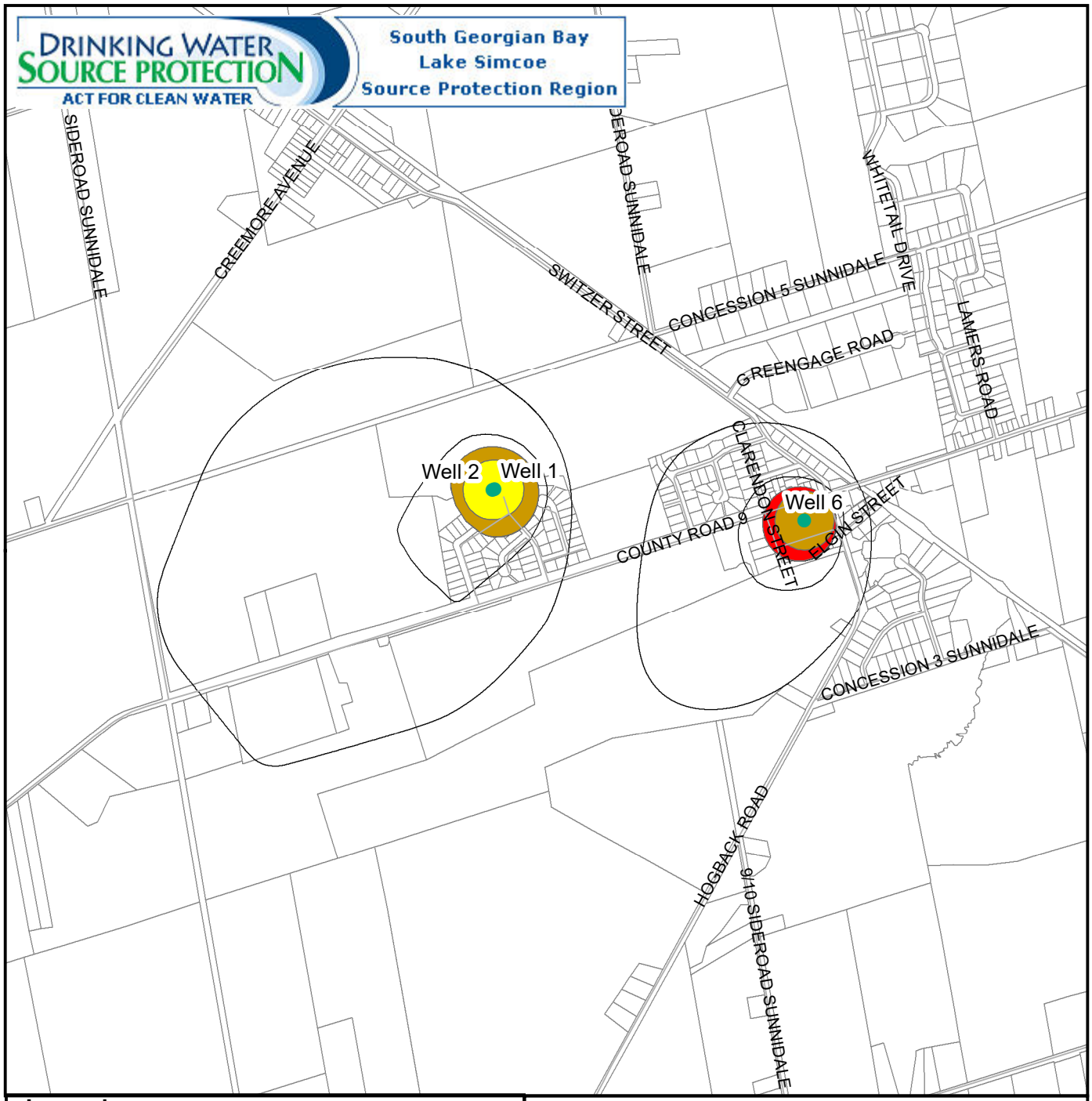
The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JULY 2010	SCALE: 1:20000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.4-10

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 **10d-8**



Legend

- Municipal Well Location
- <1%
- =1 - <6%
- =6 -<8%
- =8 - <30%
- =>30%

N W E S

190 95 0 190 Meters

The Impervious Surfaces proportion is illustrated where the vulnerability score is greater than 6.

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.

IMPERVIOUS SURFACES - NEW LOWELL

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

Created by: NVCA
Date: 2025-09

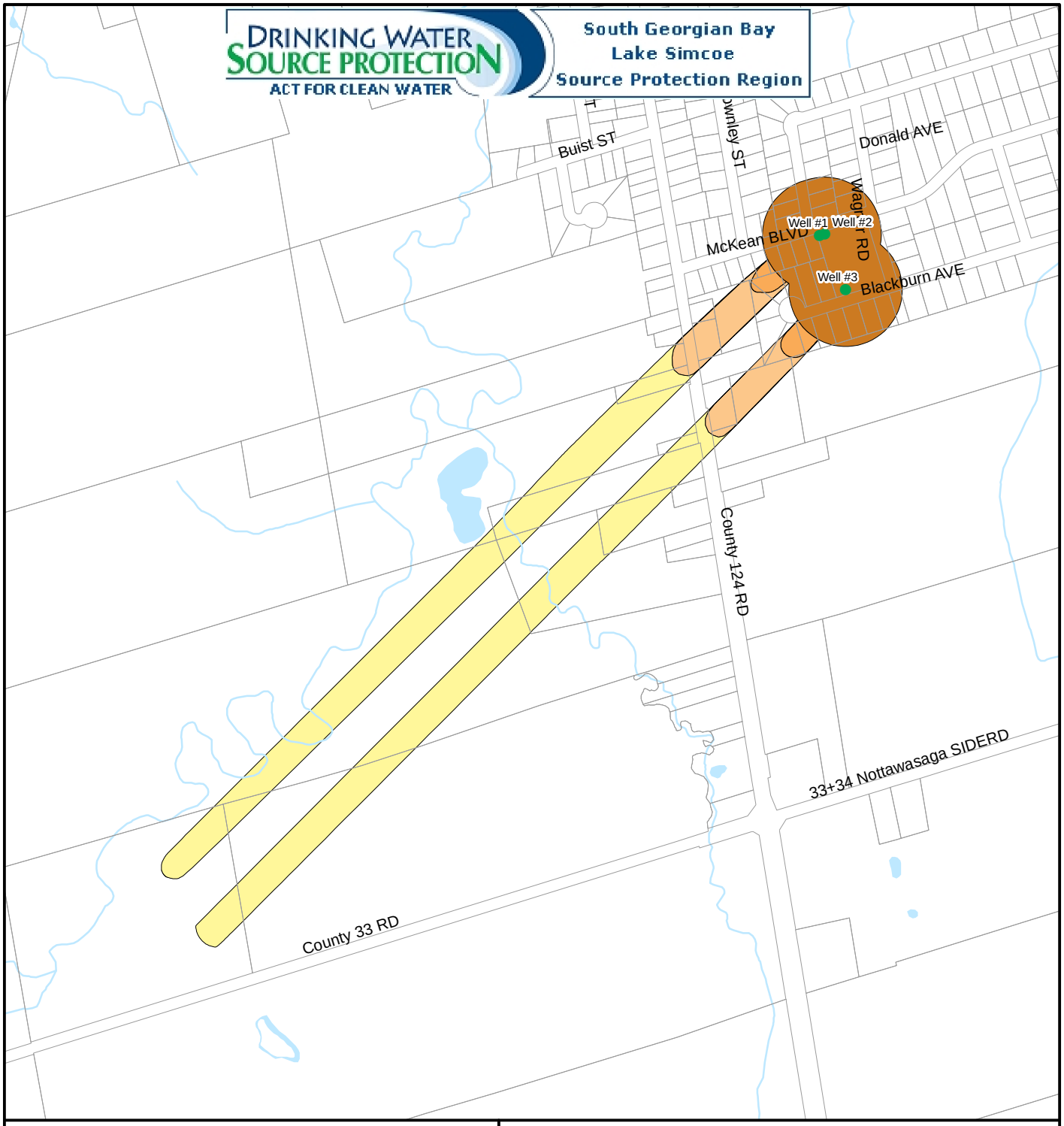
Scale: 1:20,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

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

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 **10e-1**

LEGEND

- MUNICIPAL WELL LOCATION

AQUIFER VULNERABILITY INDEX

- HIGH
- MEDIUM
- LOW

N W E S

90 45 0 90 Metres

GROUNDWATER VULNERABILITY - McKEAN

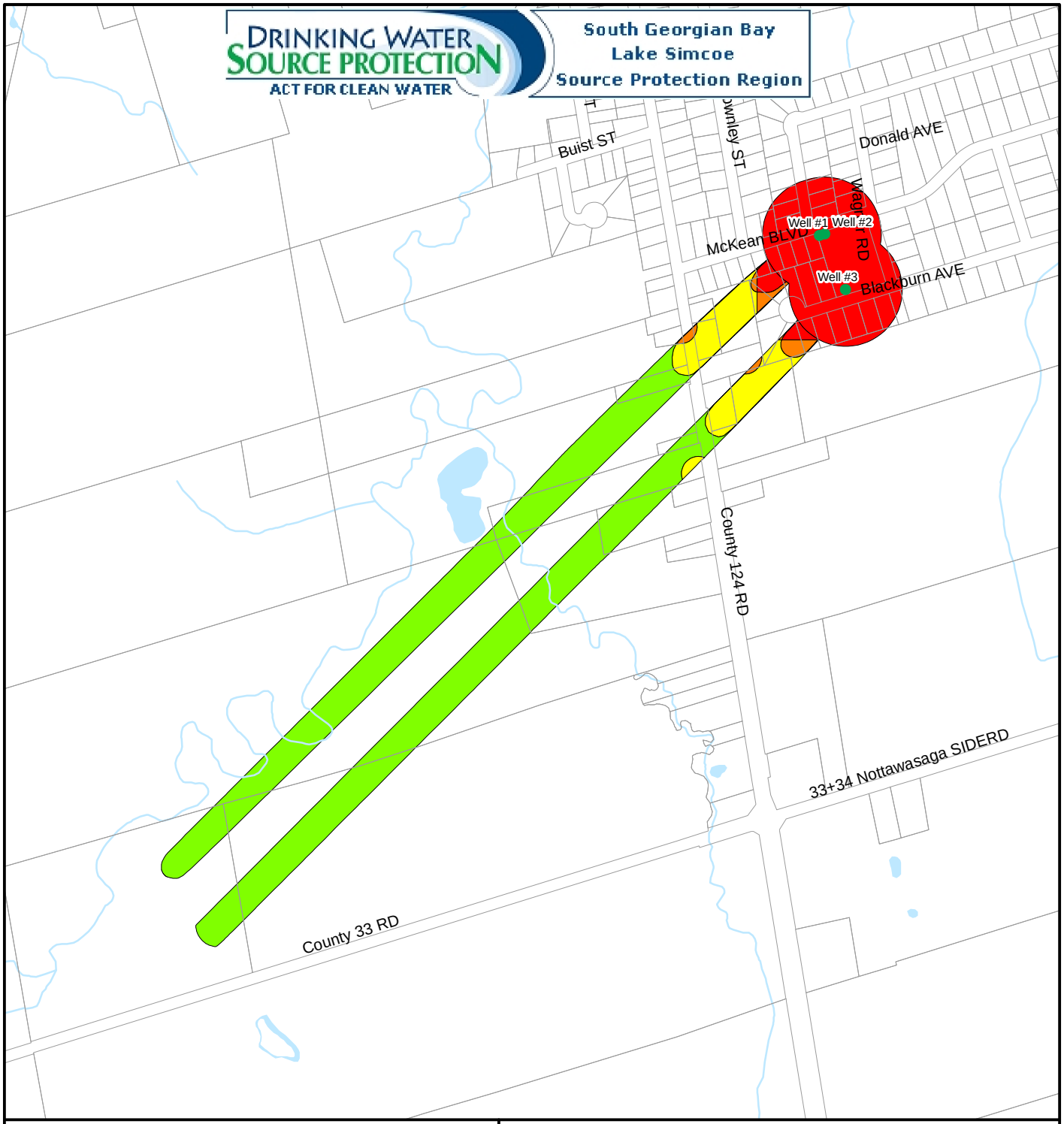
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.5-2

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 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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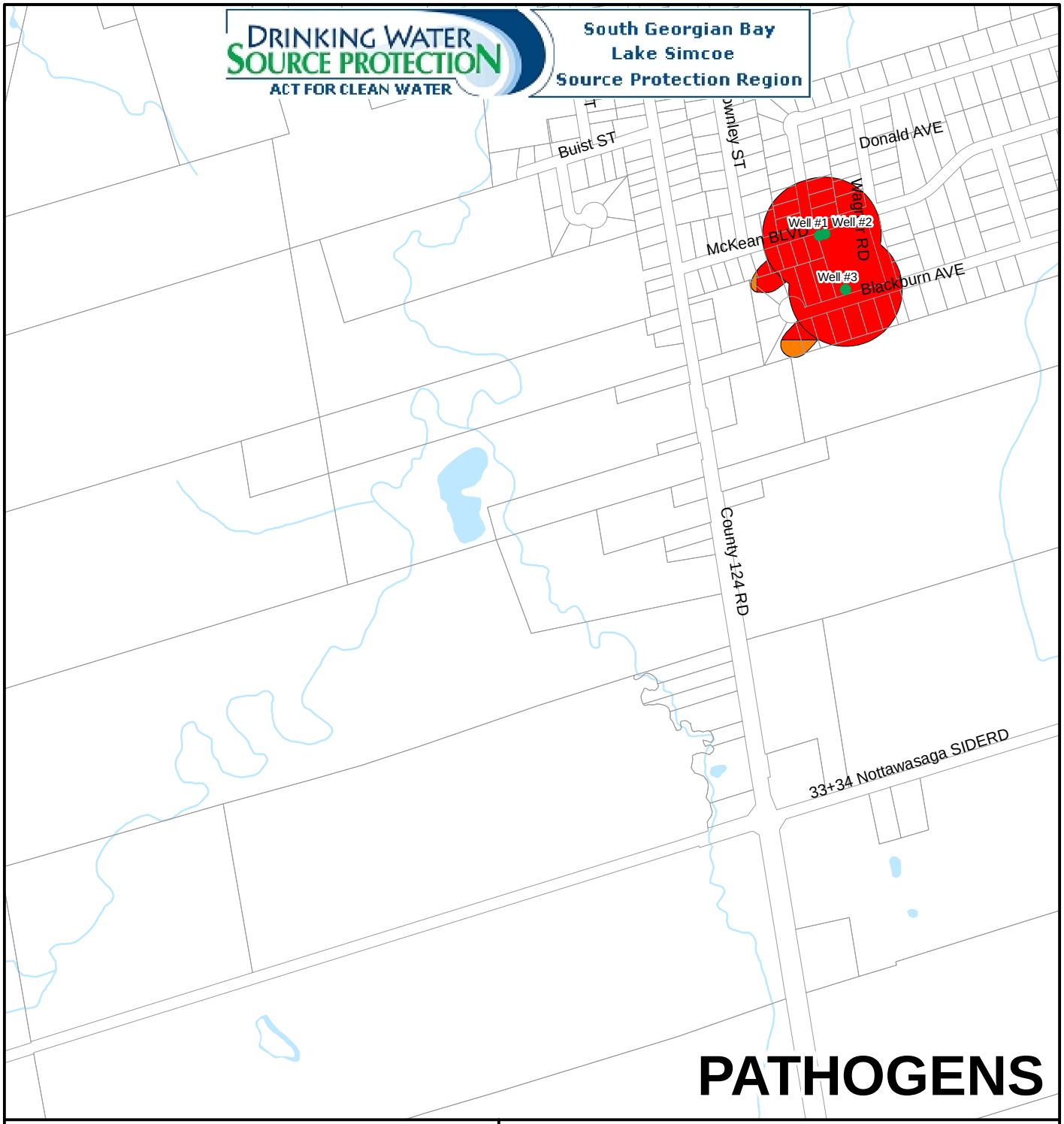
GENIVAR Ontario

FIGURE 10e-3



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 - NOTTAWA-McKEAN

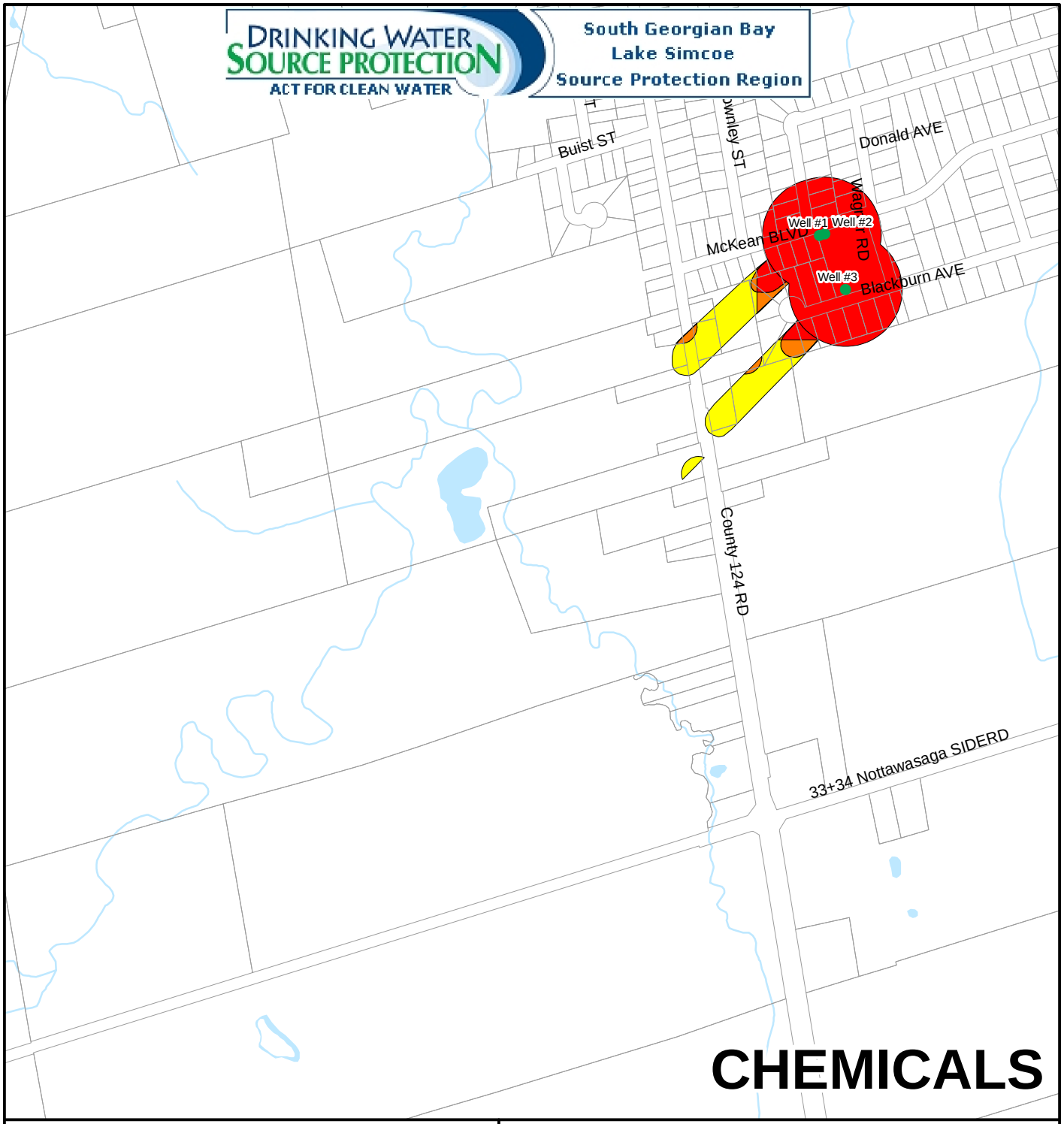
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.5-6

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 10e-4



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

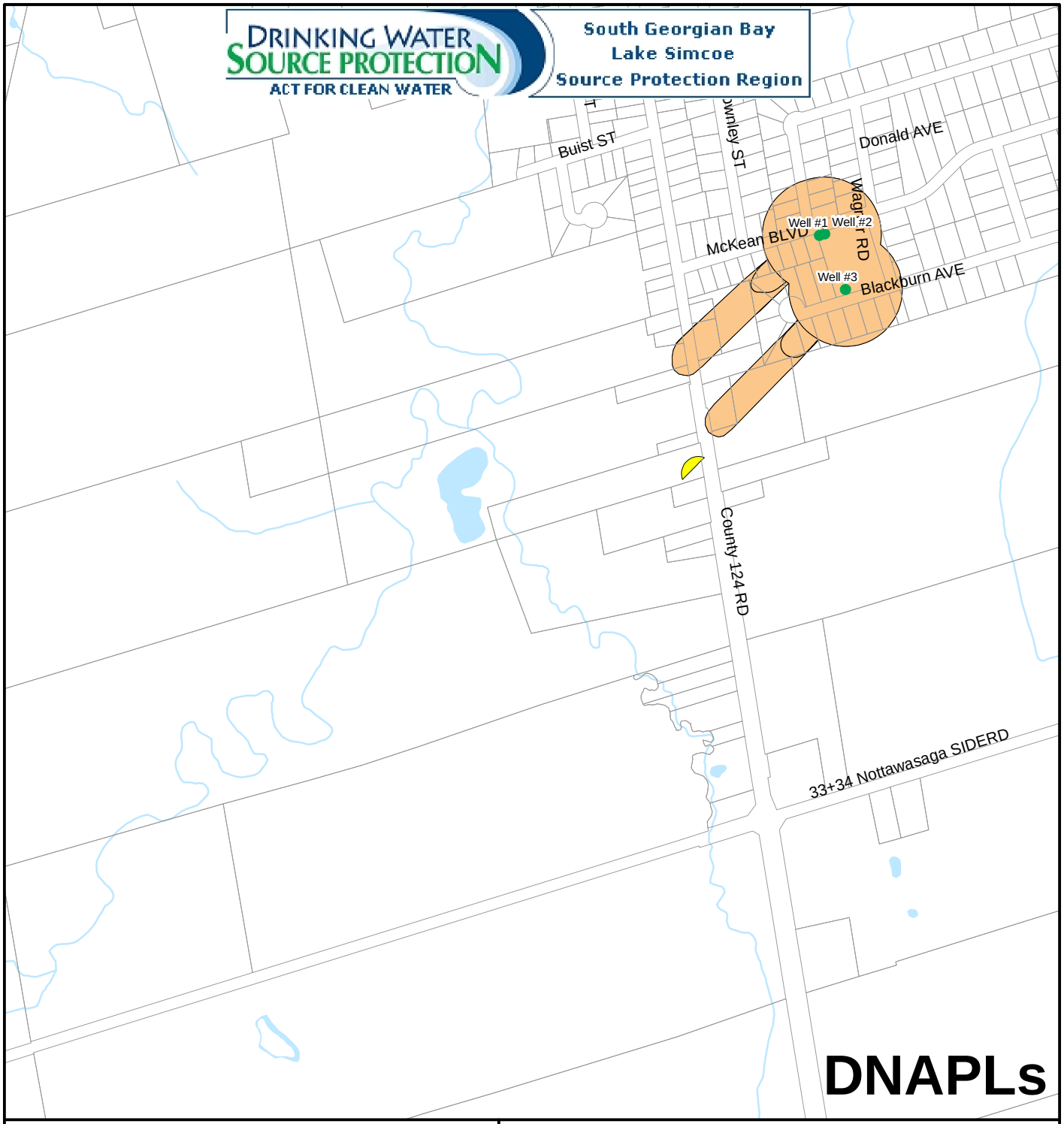
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.5-7

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 **10e-5**



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 - 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.:0-07194801F6.5-8

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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

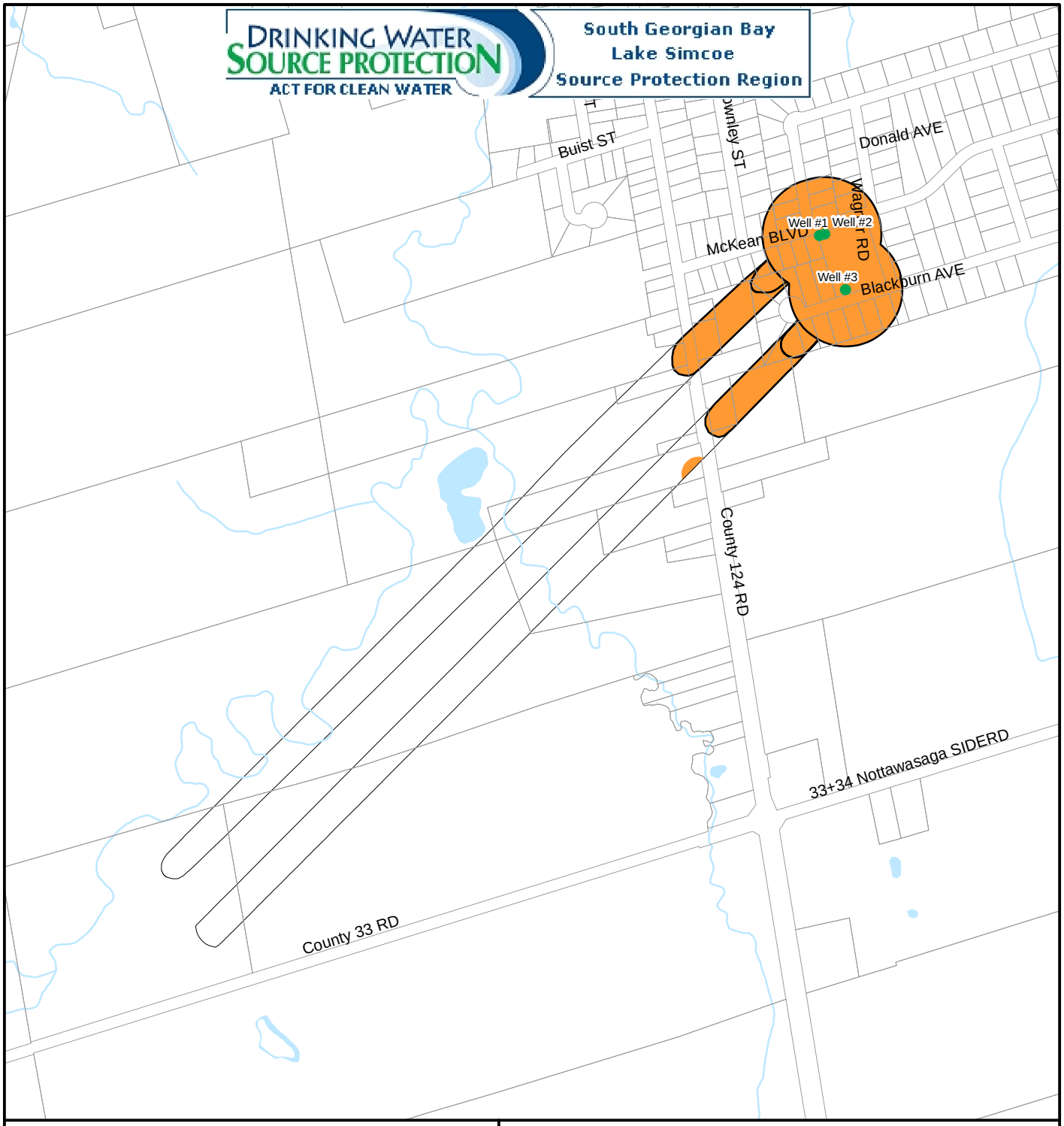
The Managed Land proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.5-9

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 **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

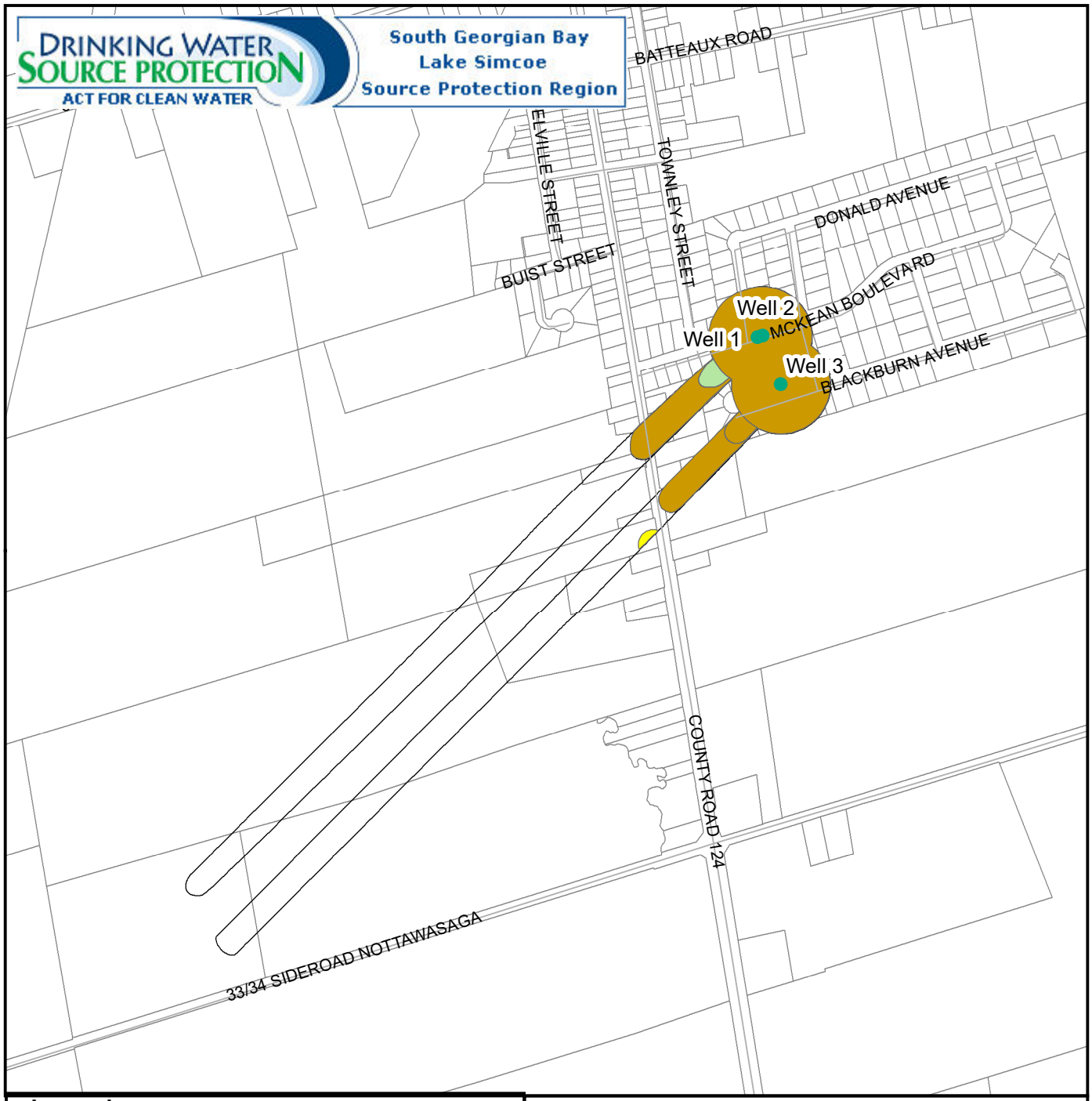
The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JULY 2010	SCALE: 1:10000
PROJECT: 0-071948.01	FILE. NO.:0-07194801F6.5-10

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 **10e-8**



Legend

- Municipal Well Location
- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- =>30%

N W E S

100 50 0 100 Meters

The Impervious Surfaces proportion is illustrated where the vulnerability score is greater than 6.

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IMPERVIOUS SURFACES - MCKEAN

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

Created by: NVCA
Date: 2025-09

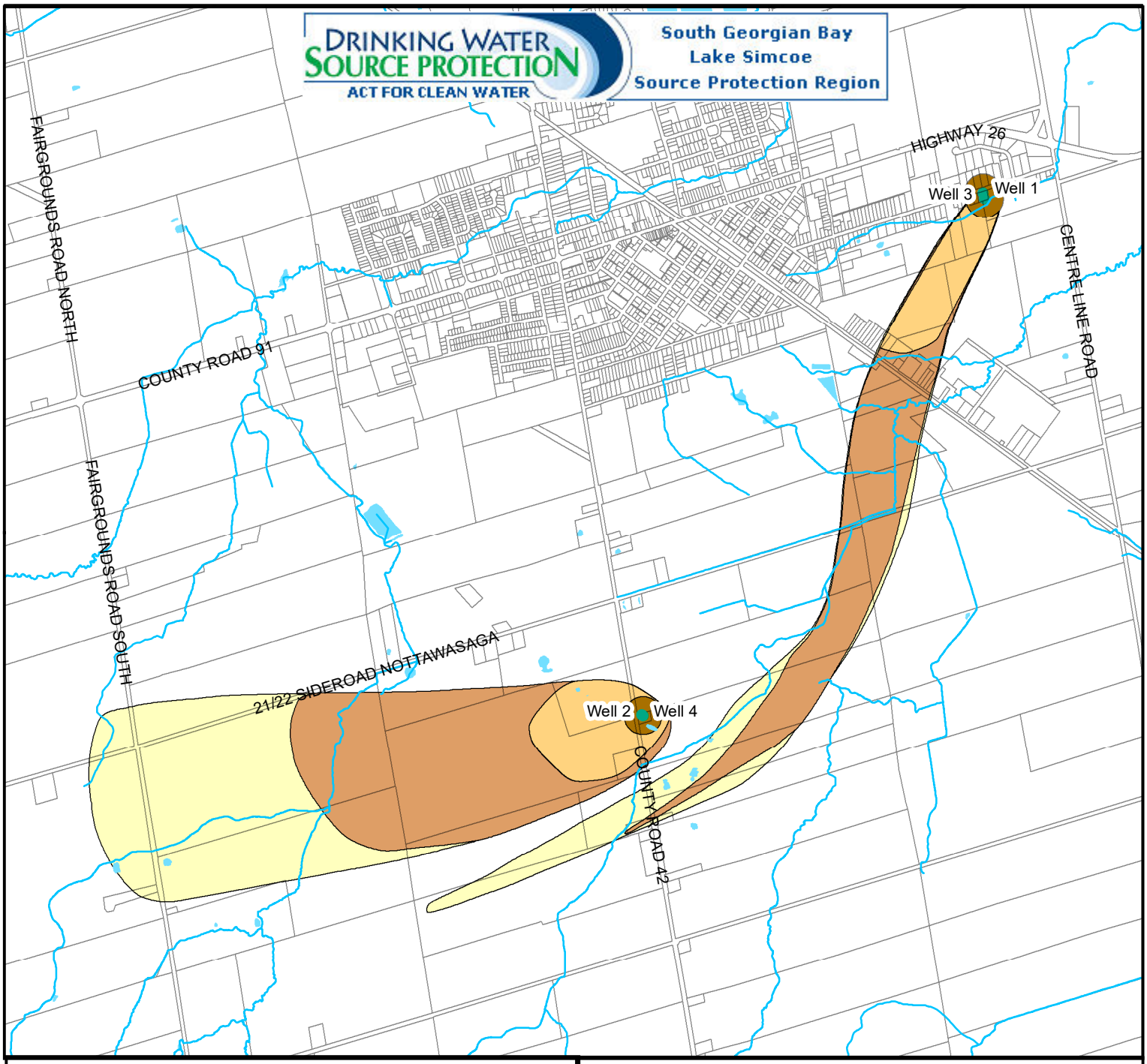
Scale: 1:12,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

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

330 165 0 330 Meters

WELLHEAD PROTECTION AREAS-STAYNER, CLEARVIEW

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Proetction Region

Created by: NVCA
Date: 2021-09

Scale: 1:30,000

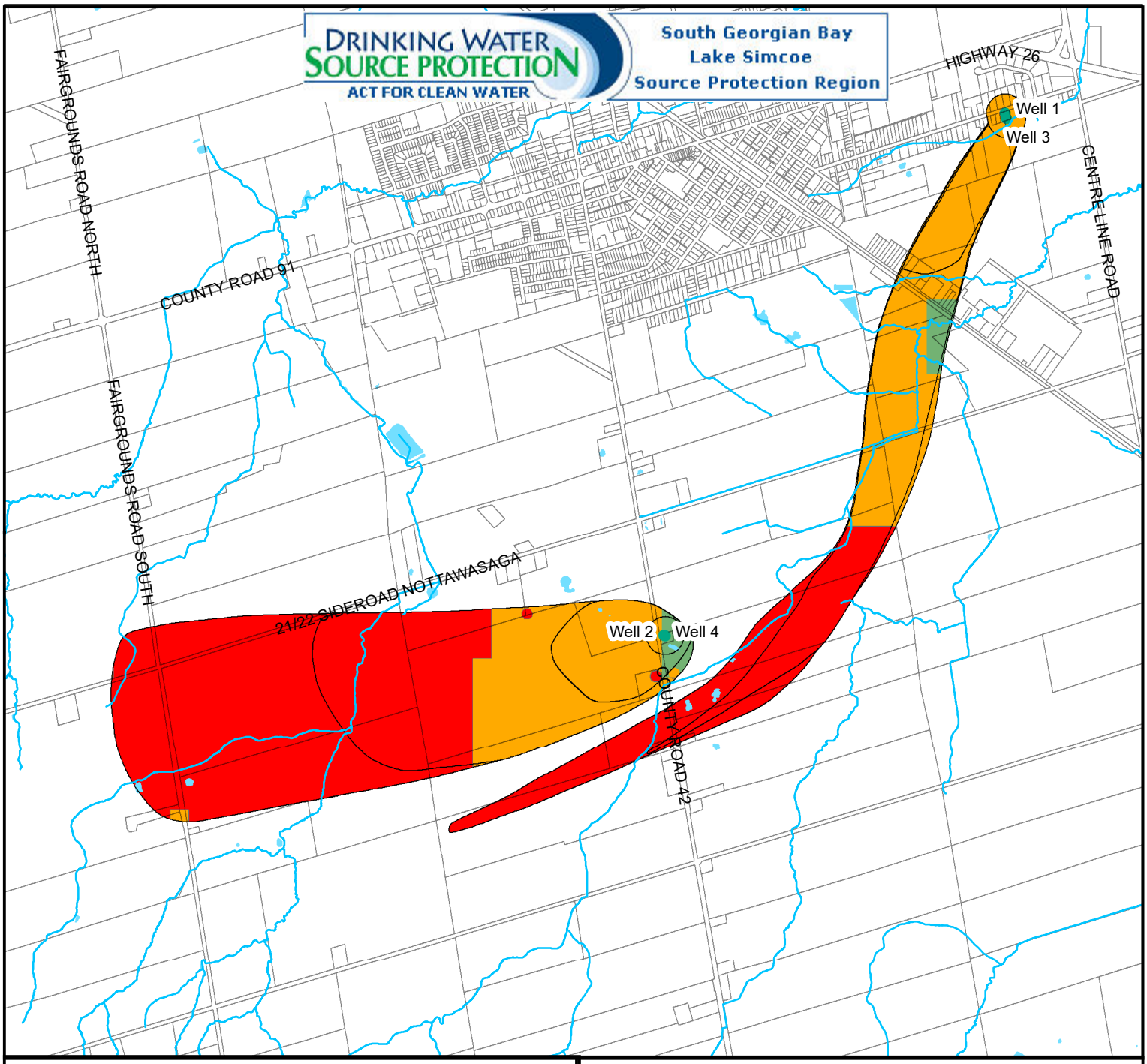
UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-1

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have benn compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.



Legend

- MUNICIPAL WELL LOCATION

Aquifer Vulnerability Index

- High
- Medium
- Low

400 200 0 400 Meters

N W E S

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GROUNDWATER VULNERABILITY-STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Proetction Region

Created by: NVCA
Date: 2021-09

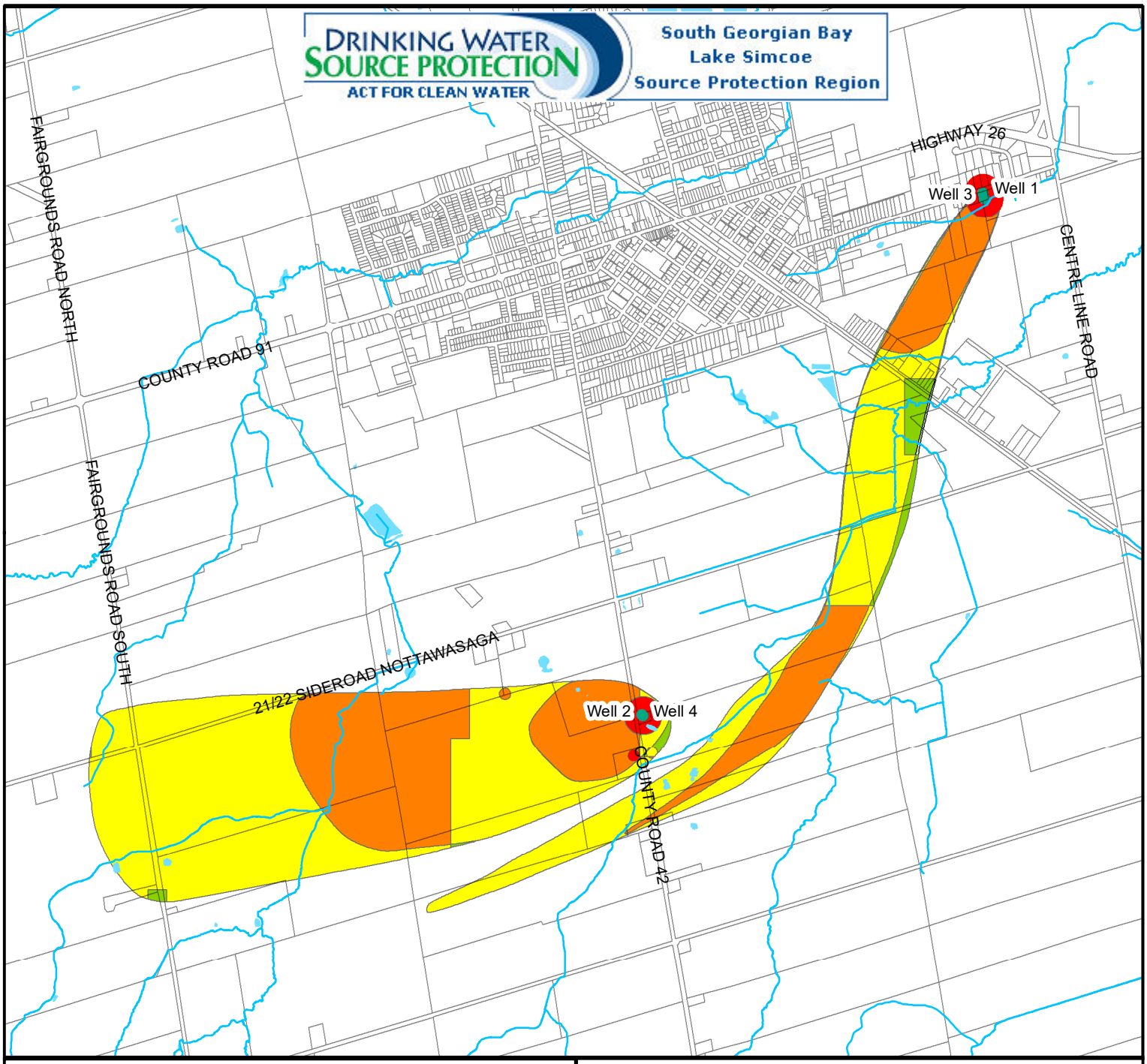
Scale: 1:30,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-2



Legend

- MUNICIPAL WELL LOCATION

VulnerabilityScore

- 10
- 8
- 6
- 4
- 2

400 200 0 400 Meters

N W E S

VULNERABILITY SCORES-STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Proetction Region

Created by: NVCA
Date: 2021-09

Scale: 1:30,000

UTM Zone 17N, NAD83

Ontario

Figure 10f-3

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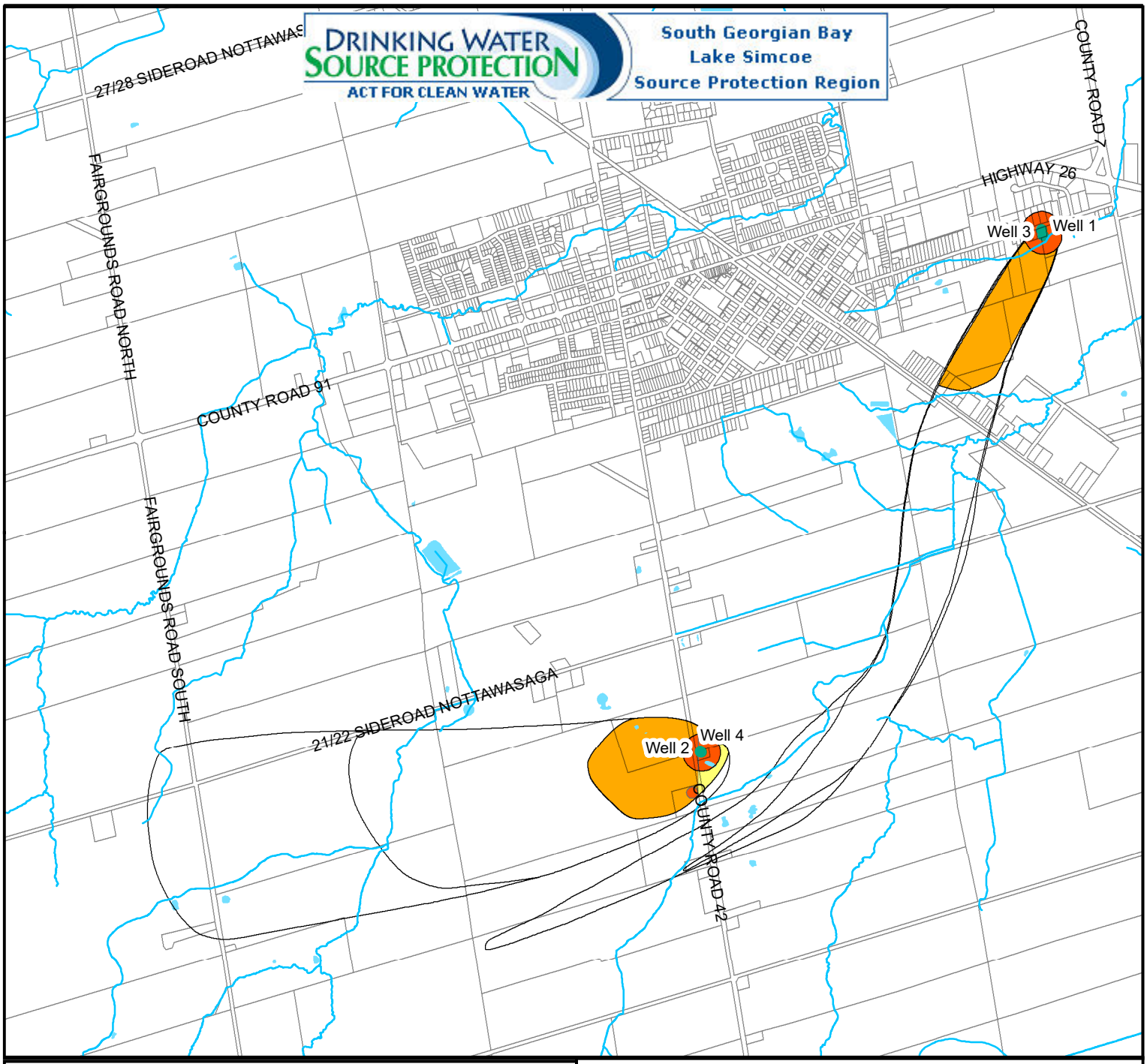

Legend

- MUNICIPAL WELL LOCATION

VulnerabilityScore

- 10
- 8
- 6

N W E S

300 150 0 300 Meters

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 Proetction 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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Created by: NVCA
Date: 2021-09

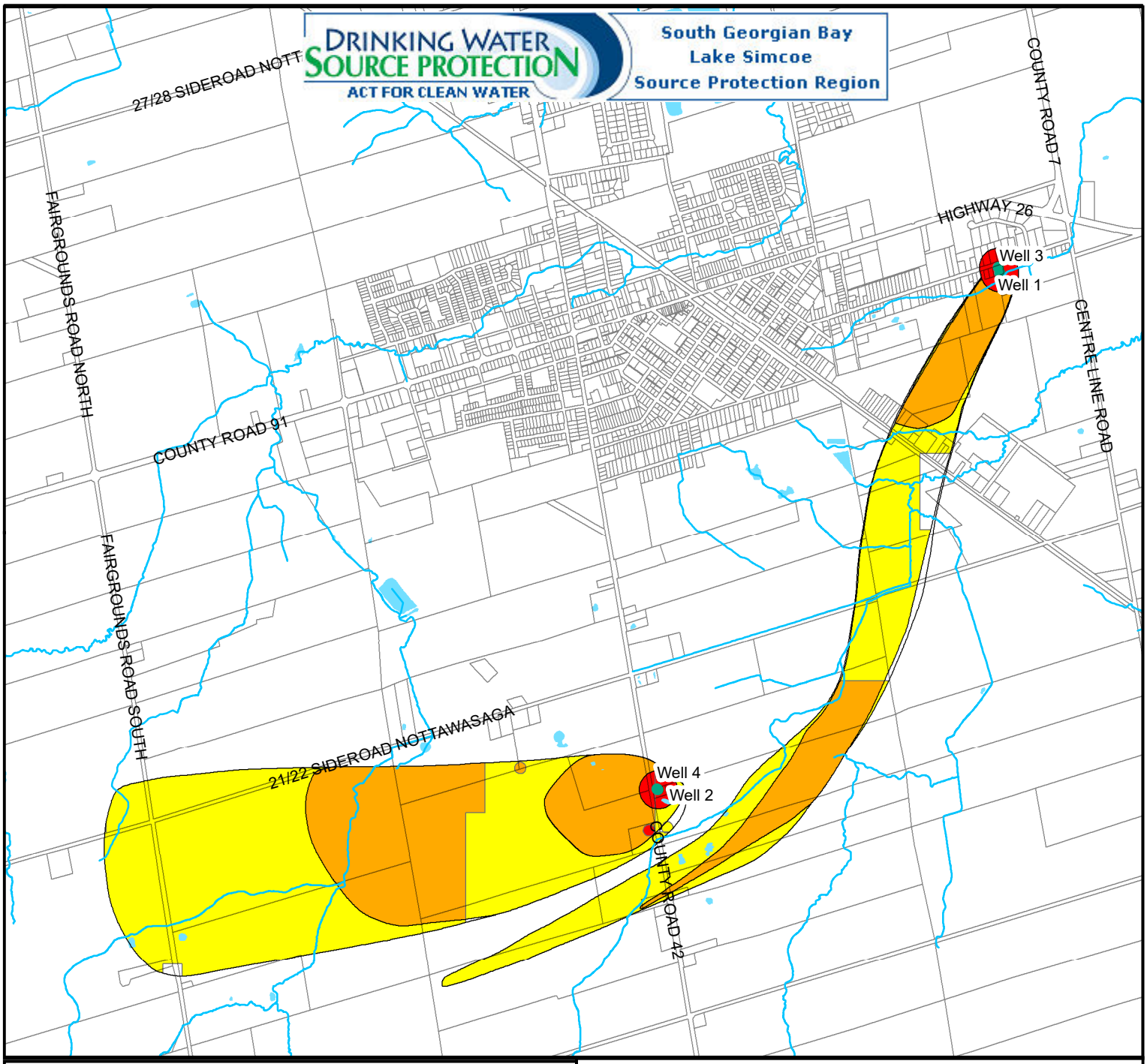
Scale: 1:30,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-4



Legend

- MUNICIPAL WELL LOCATION

VulnerabilityScore

- 10
- 8
- 6

N W E S

300 150 0 300 Meters

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 Proetction 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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Created by: NVCA
Date: 2021-09

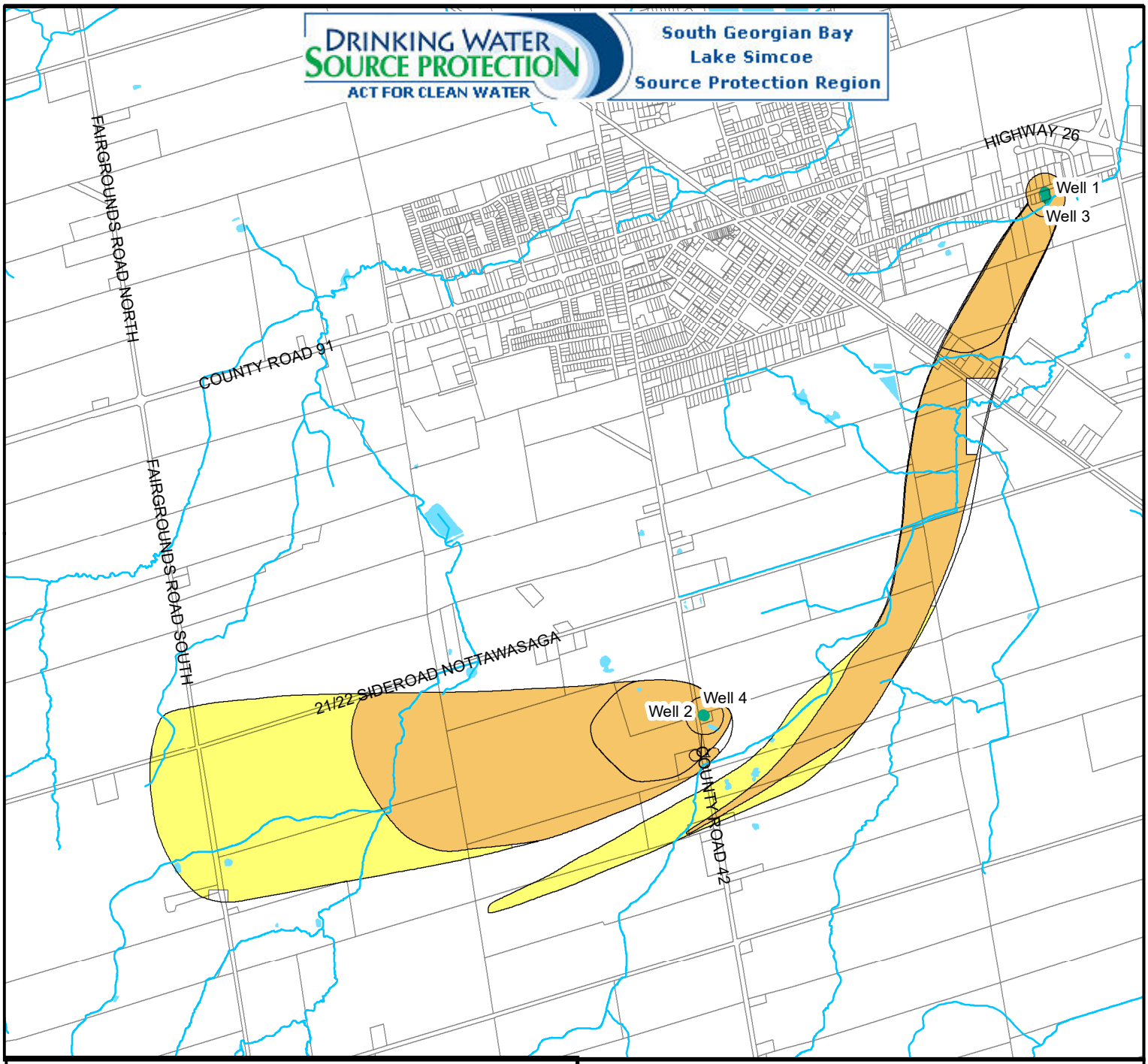
Scale: 1:30,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-5



Legend

- MUNICIPAL WELL LOCATION
- WHPA-C1: 10-YEAR TIME-OF-TRAVEL

VulnerabilityScore

- 6

N W E S

300 150 0 300 Meters

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 Proetction 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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Date: 2021-09

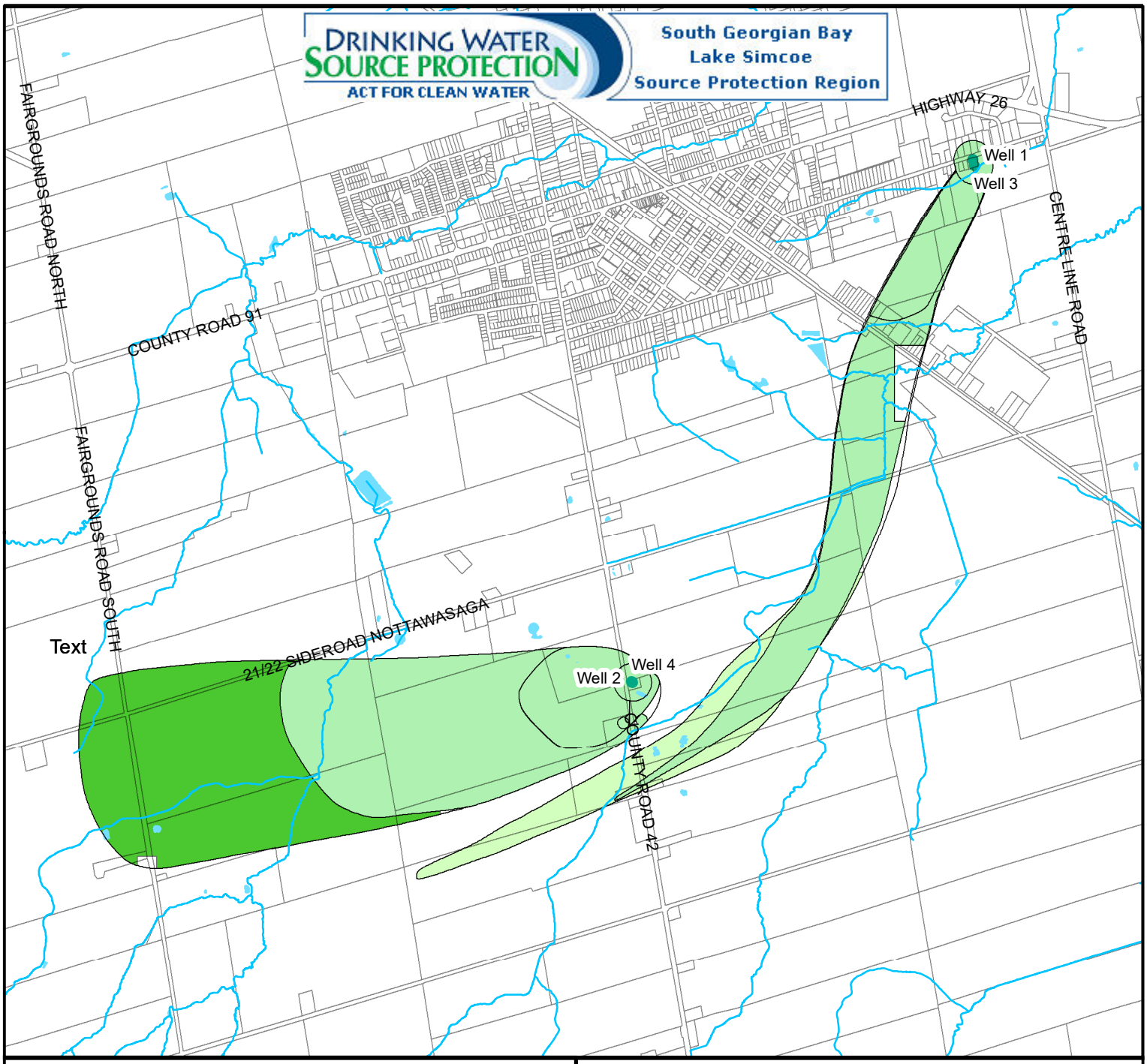
Scale: 1:30,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

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 Meters

The Managed Land proportion is illustrated for the parts of WHPA A-D where the vulnerability scoreis greater than 6.

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MANAGED LANDS-STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Proetction Region

Created by: NVCA
Date: 2021-09

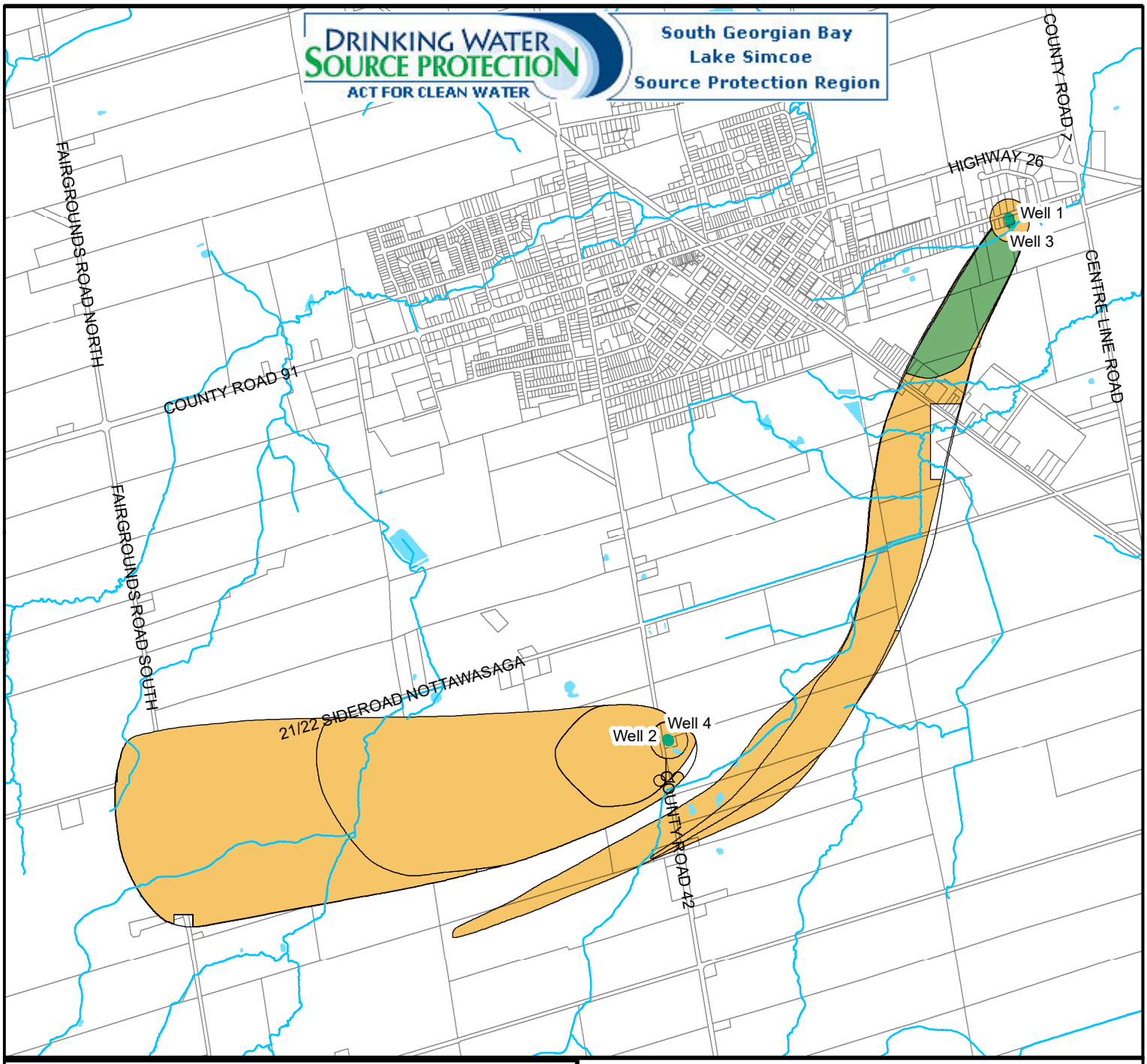
Scale: 1:30,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

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

300 150 0 300 Meters

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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LIVESTOCK DENSITY-
KLONDIKE WELLS, STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Proetction Region

Created by: NVCA
Date: 2021-09

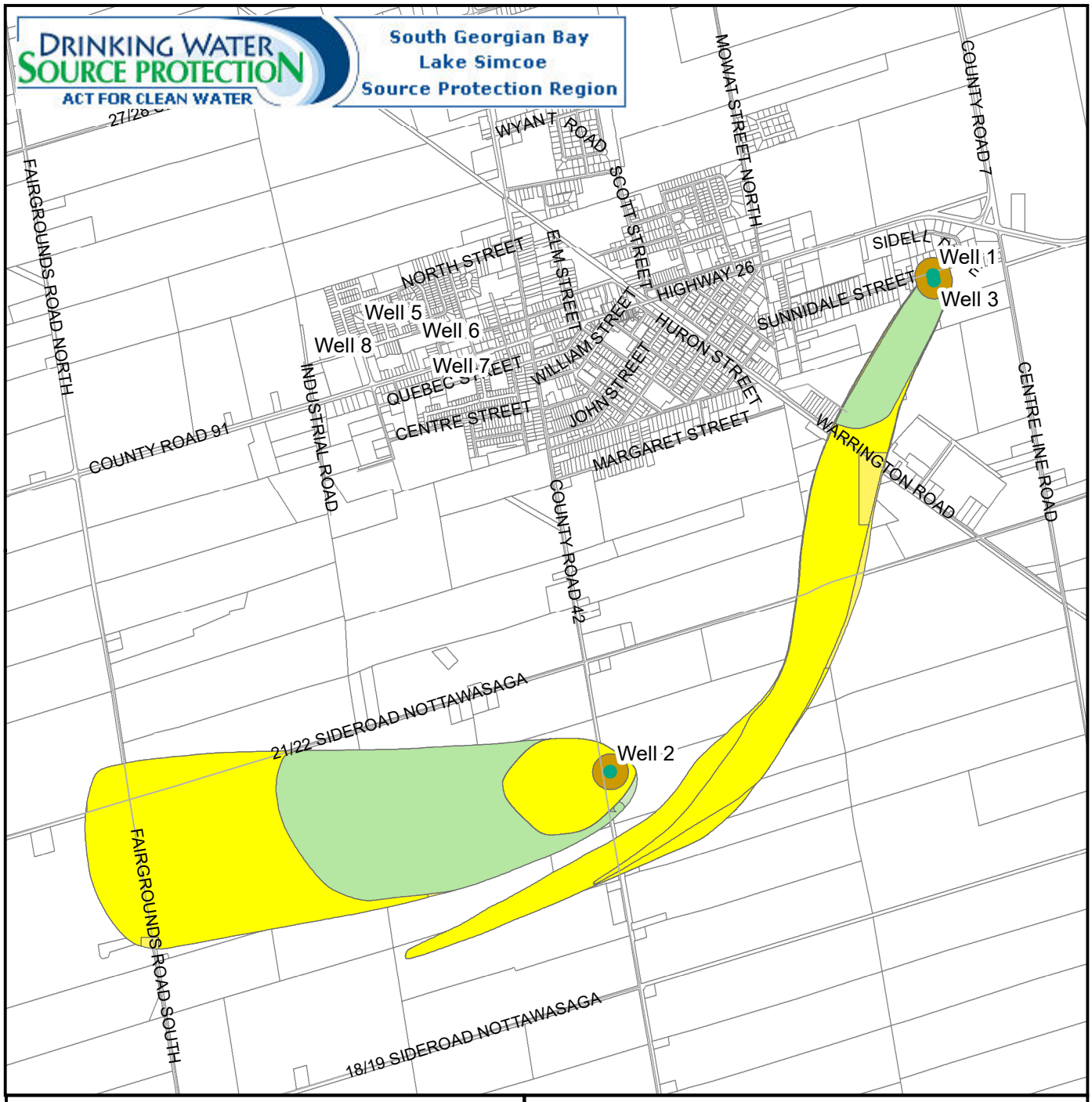
Scale: 1:30,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-8



Legend

- Municipal Well Location
- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- =>30%

N W E S

500 250 0 500 Meters

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IMPERVIOUS SURFACES - STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

Created by: NVCA
Date: 2025-09

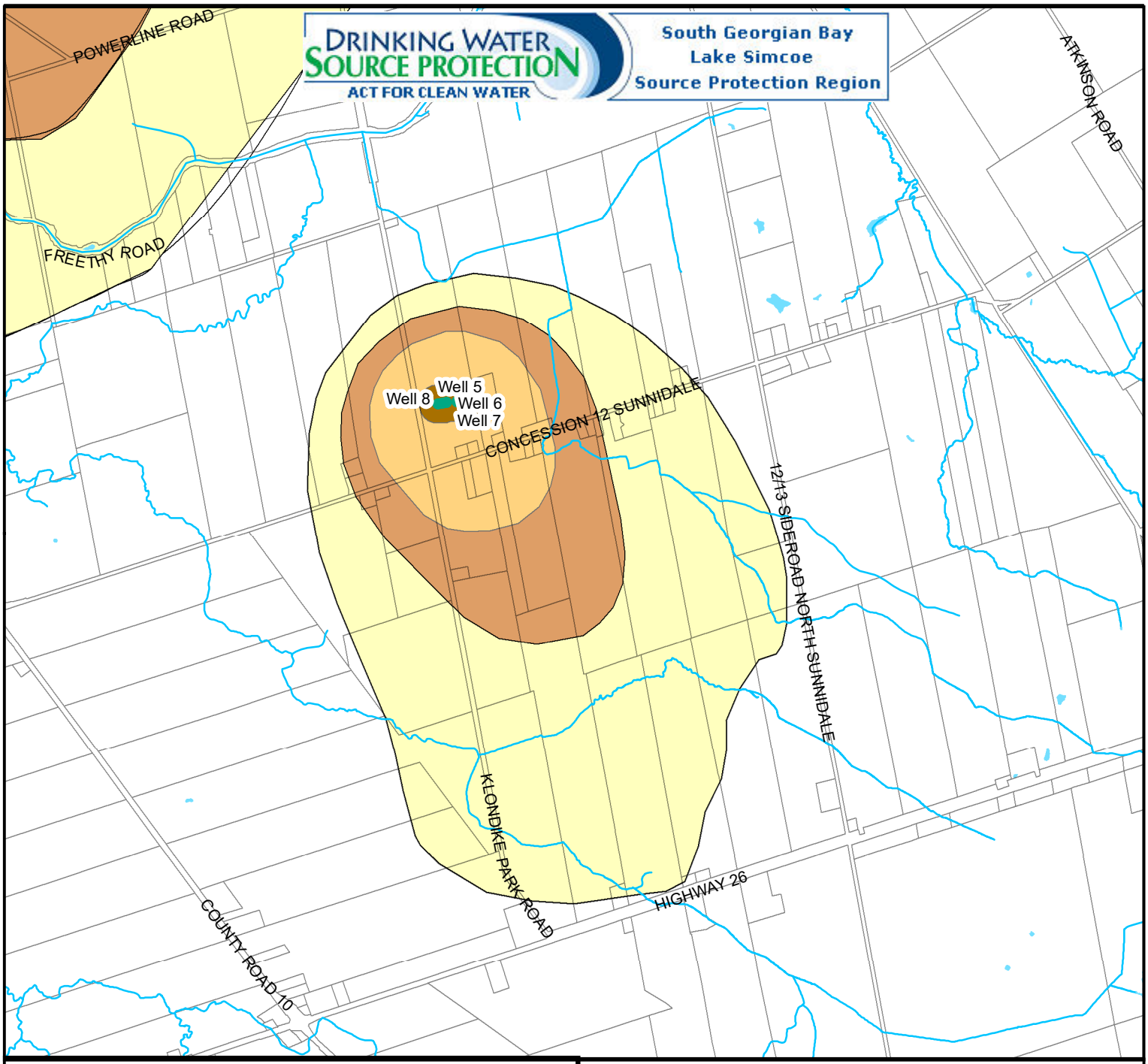
Scale: 1:33,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-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

300 150 0 300 Meters

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WELLHEAD PROTECTION AREAS-
KLONDIKE WELLS, STAYNER, CLEARVIEW

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Proetction Region

Created by: NVCA
Date: 2021-09

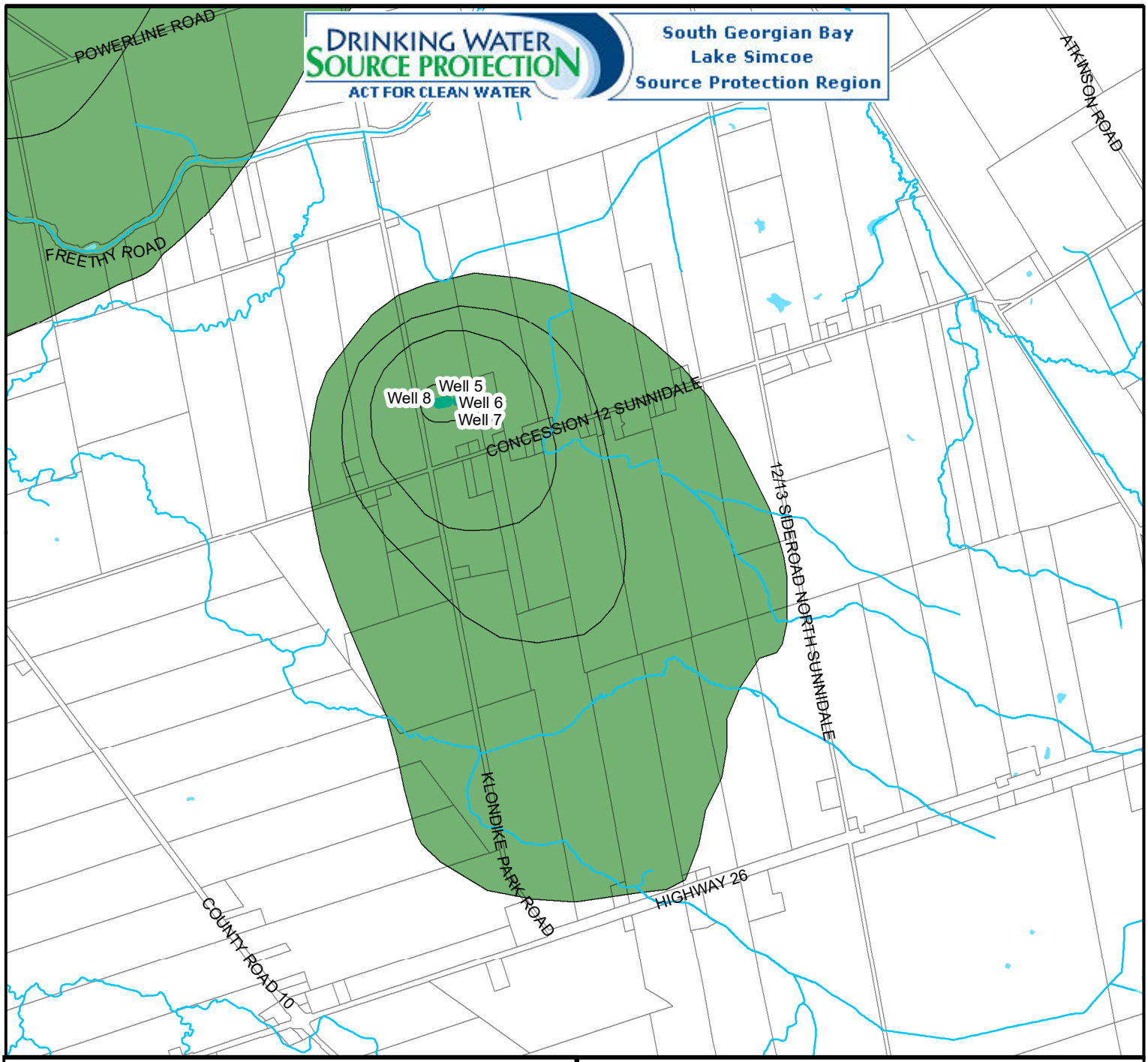
Scale: 1:30,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-10



Legend

- MUNICIPAL WELL LOCATION

Aquifer Vulnerability Index

- High
- Medium
- Low

300 150 0 300 Meters

N W E S

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GROUNDWATER VULNERABILITY-KLONDIKE WELLS, STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Proetction Region

Created by: NVCA
Date: 2021-09

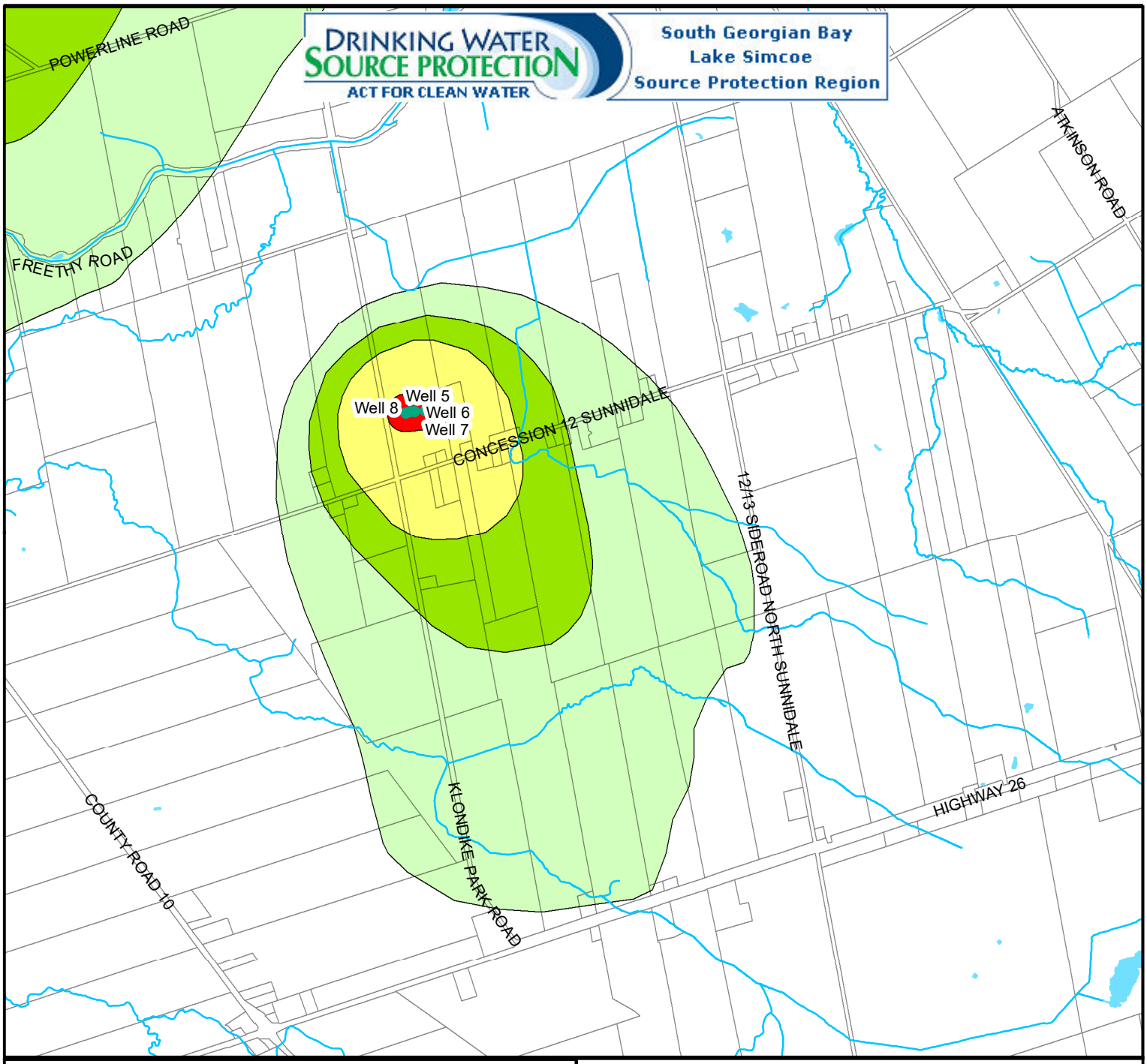
Scale: 1:30,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-11



Legend

- MUNICIPAL WELL LOCATION

VulnerabilityScore

- 10
- 8
- 6
- 4
- 2

N W E S

300 150 0 300 Meters

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VULNERABILITY SCORES- KLONDIKE WELLS, STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Proetction Region

Created by: NVCA
Date: 2021-09

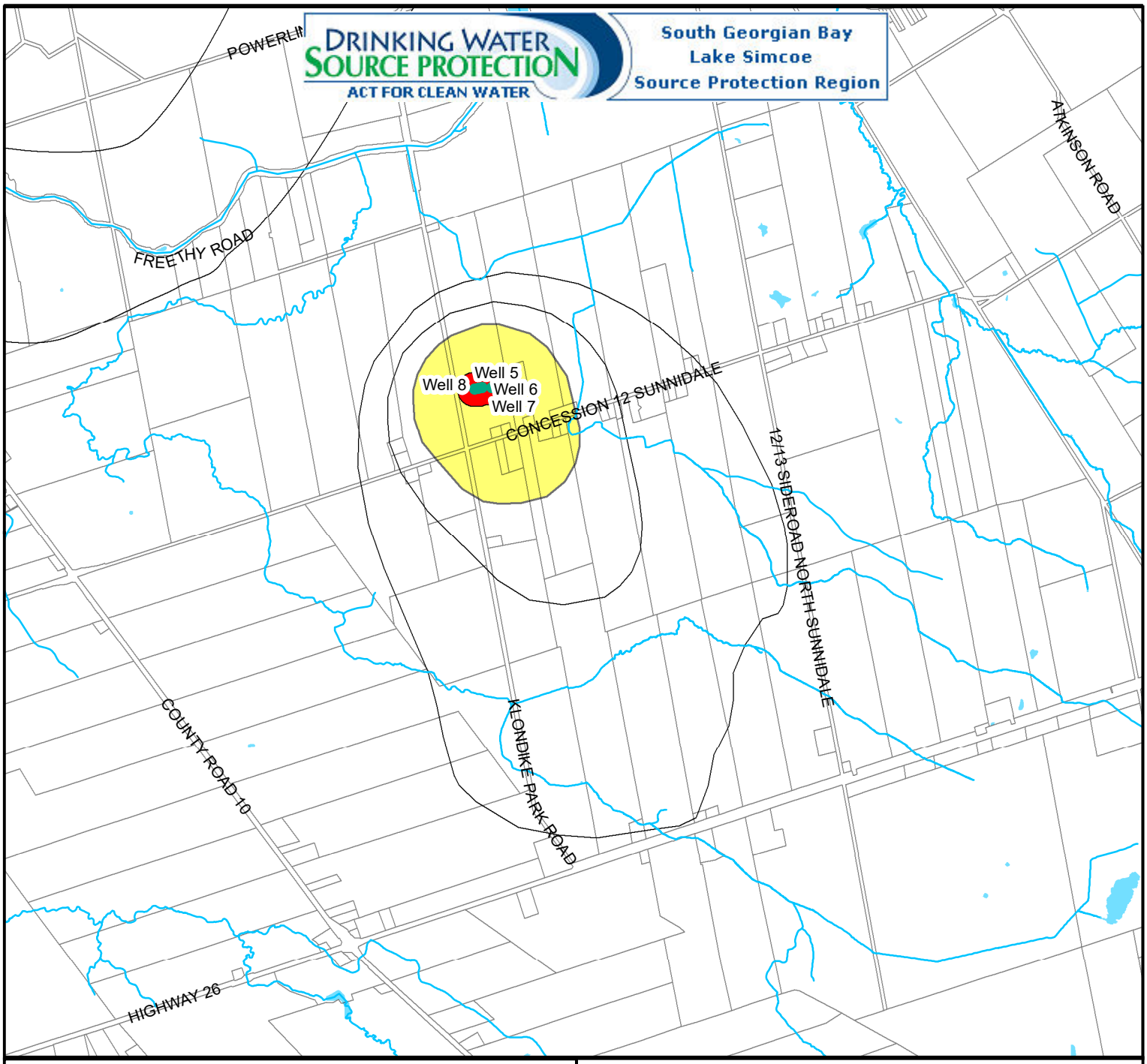
Scale: 1:30,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-12



Legend

- MUNICIPAL WELL LOCATION

VulnerabilityScore

- 10
- 8
- 6

N W E S

330 165 0 330 Meters

AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS- KLONDIKE WELLS, STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Proetction 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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Created by: NVCA
Date: 2021-09

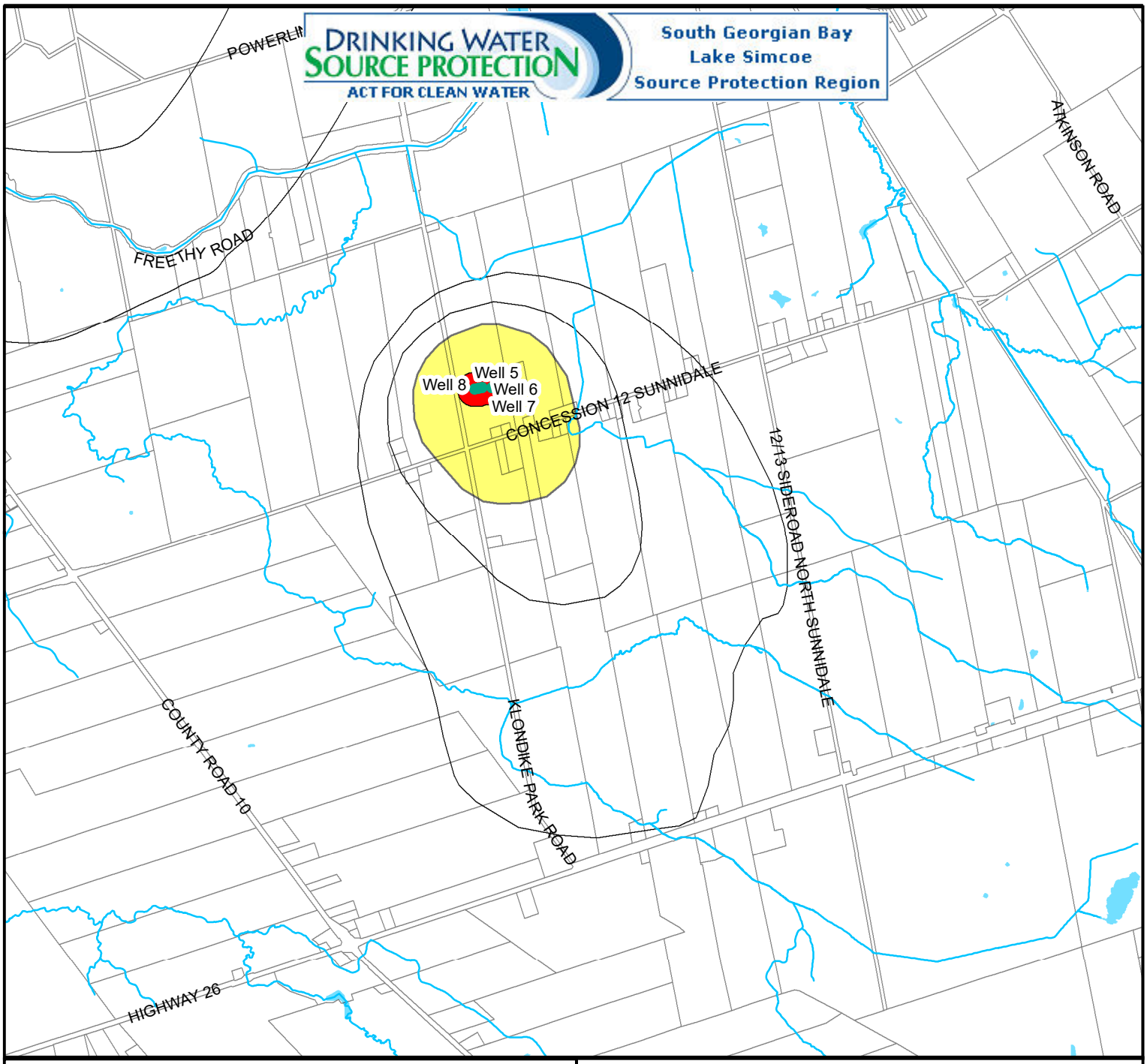
Scale: 1:33,405

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-13



Legend

- MUNICIPAL WELL LOCATION

VulnerabilityScore

- 10
- 8
- 6

N W E S

330 165 0 330 Meters

AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS- KLONDIKE WELLS, STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Proetction 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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Created by: NVCA
Date: 2021-09

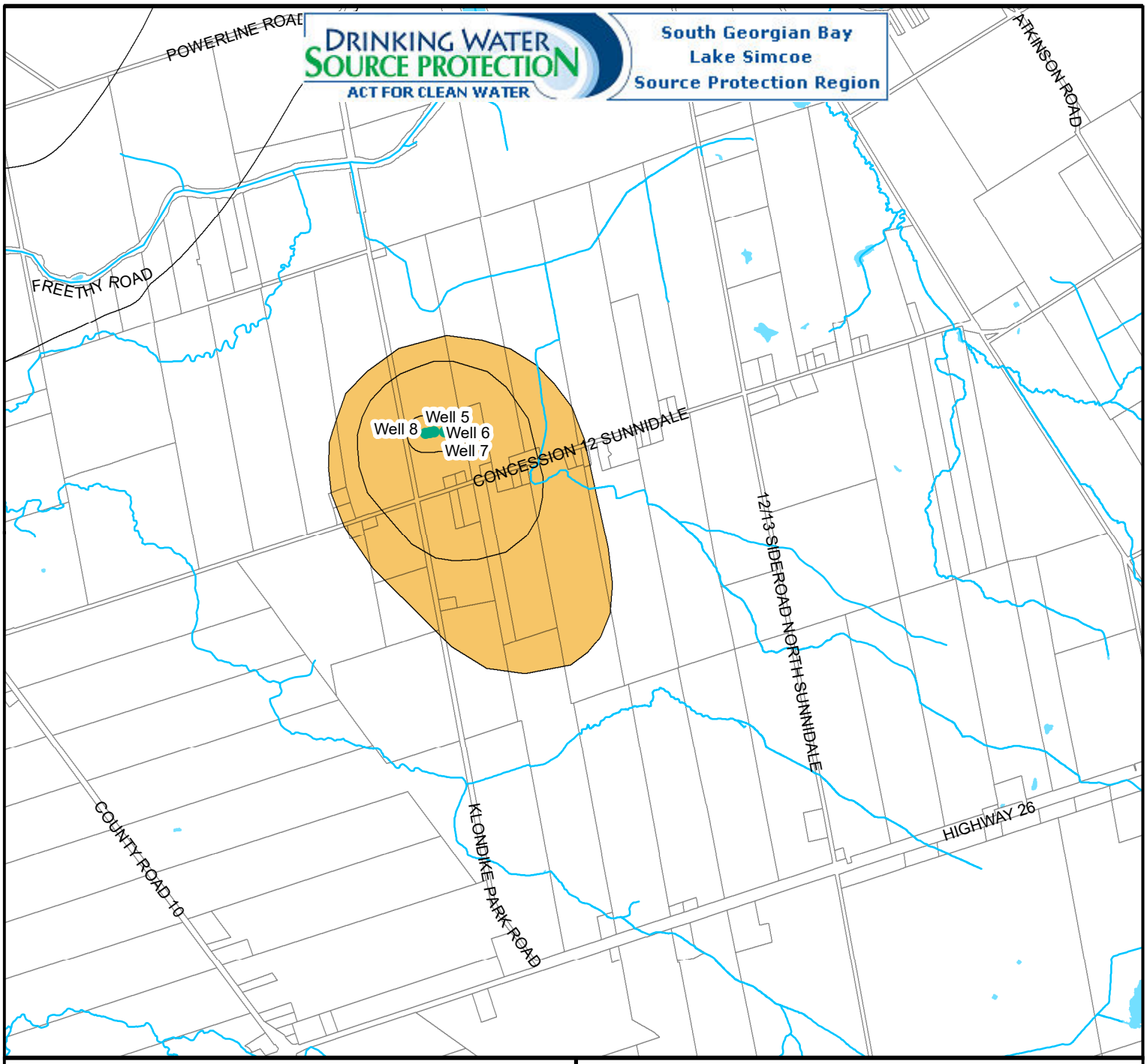
Scale: 1:33,405

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-14



Legend

- MUNICIPAL WELL LOCATION
- WHPA-C: 5-YEAR TIME-OF-TRAVEL

N W E S

300 150 0 300 Meters

AREAS WHERE DNAPLS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS- KLONDIKE WELLS, STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Proetction 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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Created by: NVCA
Date: 2021-09

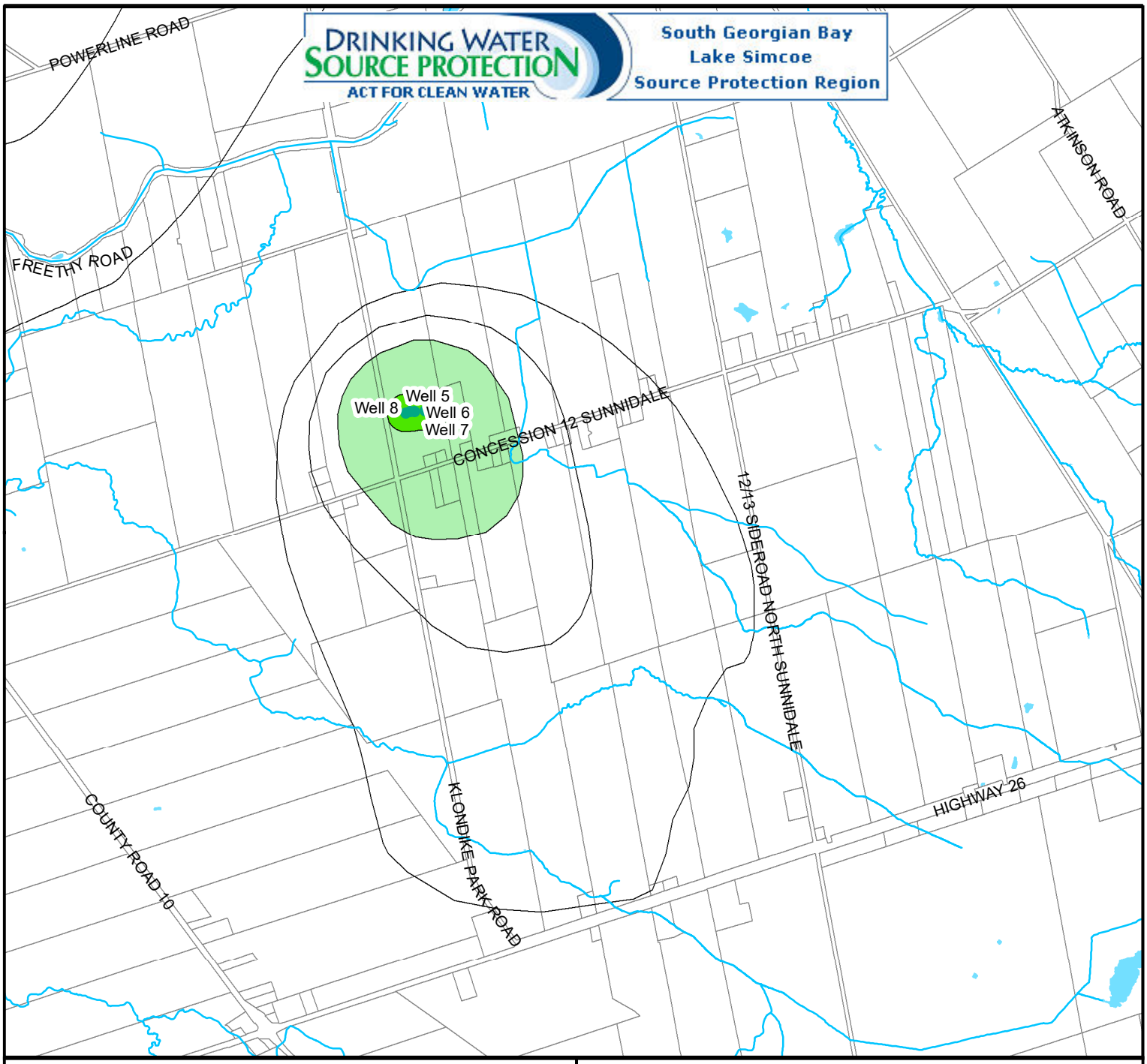
Scale: 1:30,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-15



Legend

- MUNICIPAL WELL LOCATION
- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)

N W E S

300 150 0 300 Meters

The Managed Lands proportion is illustrated for the parts of the WHPA A-D where the vulnerability score is greater than 6.

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MANAGED LANDS-
KLONDIKE WELLS, STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Proetction Region

Created by: NVCA
Date: 2021-09

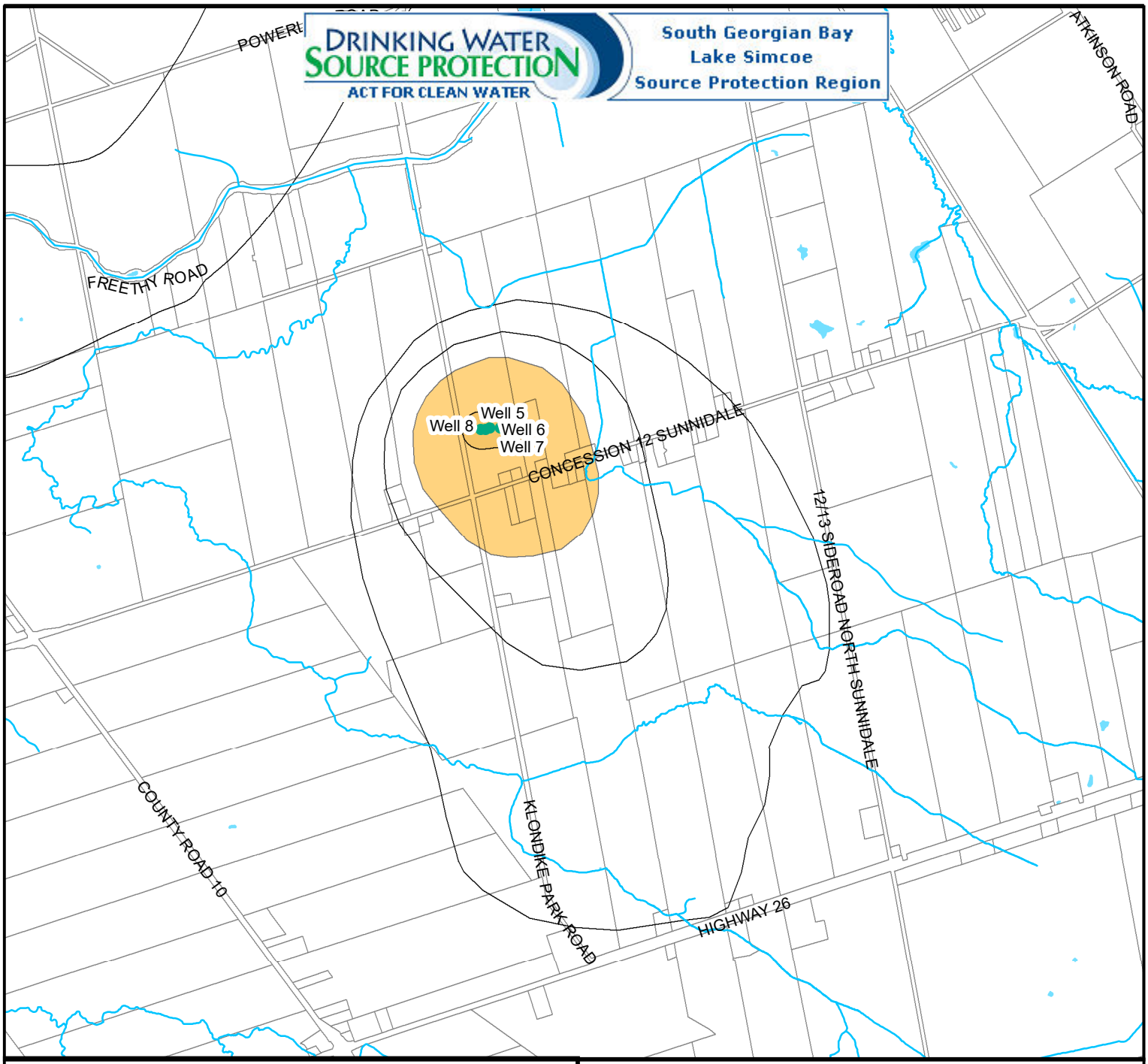
Scale: 1:30,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-16



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

300 150 0 300 Meters

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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LIVESTOCK DENSITY-
KLONDIKE WELLS, STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Proetction Region

Created by: NVCA
Date: 2021-09

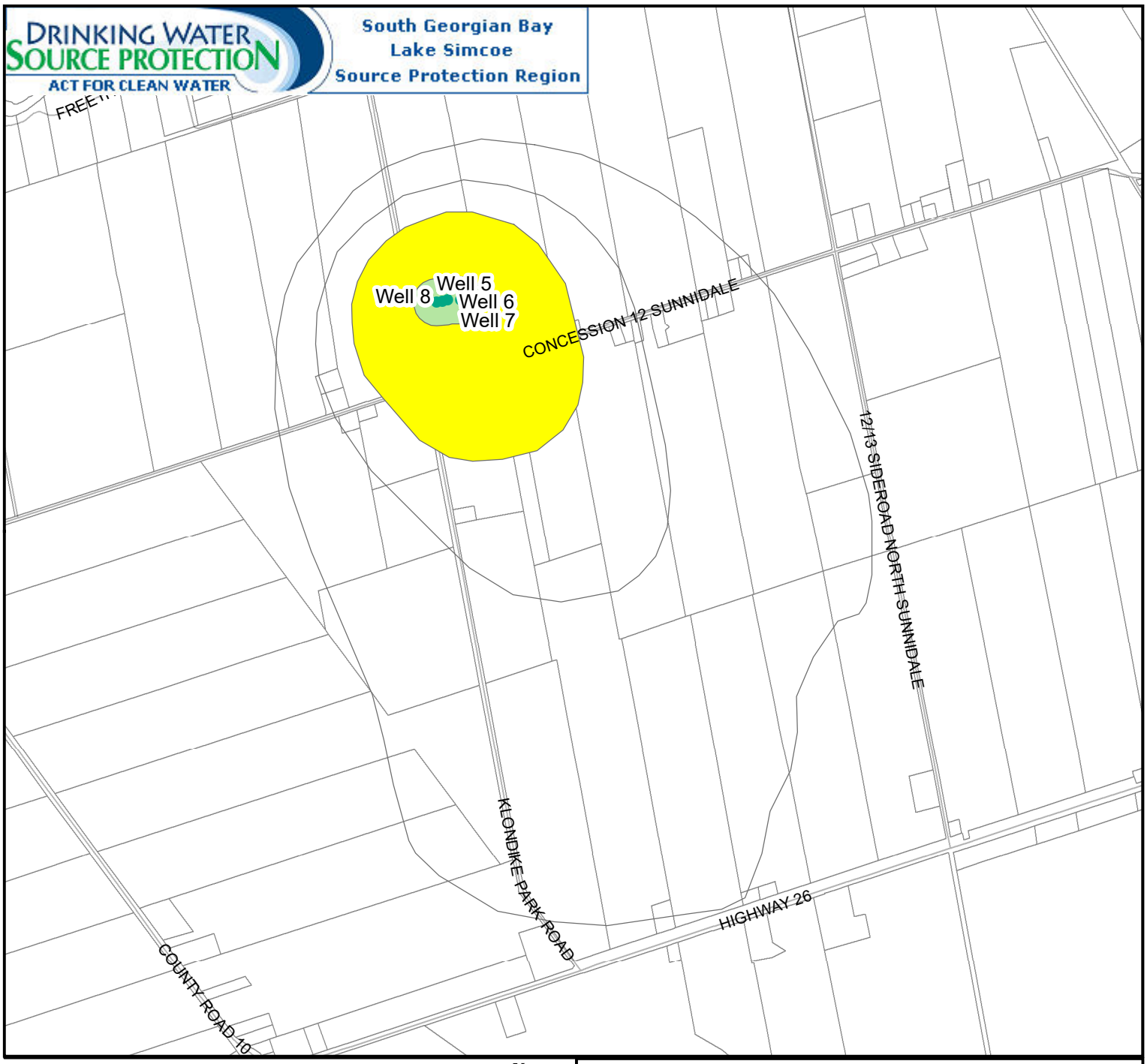
Scale: 1:30,000

UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Ontario

Figure 10f-17



Legend

- MUNICIPAL WELL LOCATION
- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- =>30%

N W E S

240 120 0 240 Meters

The Impervious Surfaces proportion is illustrated where the vulnerability score is greater than 6.

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While every effort has been made to accurately depict the base data, errors may exist.

IMPERVIOUS SURFACES - KLONDIKE WELLS, STAYNER

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

Created by: NVCA
Date: 2025-09

Scale: 1:24,000

UTM Zone 17N, NAD83

Ontario

Figure 10f-18