Chapter 12: Township of Ramara

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12 The Township of Ramara

12.1 Introduction

This chapter contains information on four drinking water systems for Township of Ramara. 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 R) for a more in depth description of the methods used, as well as the Glossary for any unfamiliar terms.

12.2 Drinking Water Systems

The Township of Ramara, located in the northeastern portion of Simcoe County, operates groundwater based water supplies in four (4) communities and surface water based supplies in

two (2). As shown in Table 12-1 and Figure 12-1 all of the groundwater supplies and the surface water supplies are within the South Georgian Bay-Lake Simcoe (SGBLS) Source Protection

Region (SPR). Table 12-1 also indicates the SPR and corresponding lead Source Protection Authority (SPA) for the municipal water supplies.

Table 12-1: Municipal Surface and Groundwater Supplies in the Township of Ramara

Local Municipality	Community Water Supply	Drinking Water Information System (DWIS) Number	Source Water Body/ Aquifer	Number of Intakes/ Wells	Source Protection Region (SPR) & Source Protection Authority (SPA)	Location where entire Assessment can be obtained
Township of Ramara	Lagoon City Surface Intake	210001273	Lake Simcoe	1	**SPR:** SGBLS **SPA:** Lake Simcoe	This chapter
Township of Ramara	South Ramara Water Treatment Plant	220010681	Lake Simcoe	1	**SPR:** SGBLS **SPA:** Lake Simcoe	This chapter
Township of Ramara	Bayshore Village Wells	220012724	Bedrock (Limestone)	3	**SPR:** SGBLS **SPA:** Lake Simcoe	This chapter
Township of Ramara	Val Harbour Wells	210010690	Bedrock (Limestone)	2	**SPR:** SGBLS **SPA:** Lake Simcoe	This chapter
Township of Ramara	Davy Drive Subdivision* Wells	220007141	Bedrock (Granite)	3	**SPR:** SGBLA **SPA:** Couchiching / Black River	Black Severn Assessment Report (Chapter 8)
Township of Ramara	Park Lane Subdivision* Wells	210007132	Bedrock (Gneissic)	2	**SPR:** SGBLA **SPA:** Couchiching / Black River	Black Severn Assessment Report (Chapter 8)

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While still in the Township of Ramara and in the SGBLS Source Protection Region, the Davy Drive and Park Lane Subdivision Water Supply systems are located in the Black-Severn River watershed and can be found in Part 2 of this report (Chapter 8).

12.3 Bayshore Village Subdivision Well Supply

The Bayshore Village well supply is located on Lot 24, Concession 6 in the Township of Ramara and services an estimated population of 750 (348 lots) in Bayshore Village. The Bayshore Village Well Supply consists of three water supply wells: Well 3, Well 4 and Well 5 as shown in Figure 12a-1. All three wells were drilled into limestone bedrock and have been in operation since 1975.

The Bayshore Village wells operate under Permit to Take Water 4512-66JSJZ dated November 9, 2004, which expires November 1, 2014. Well 3 is permitted to operate at a maximum rate of 409 L/min (196,387 L/day), Well 4 is permitted to operate at a maximum rate of 1682 L/min (807,370 L/day) and Well 5 is permitted to operate at a maximum rate of 500 L/min (240,029 L/day). All three wells can operate up to a maximum combined taking of 1,243,786 L/day for the system.

All three wells were constructed with a 203 mm diameter steel casing set 0.6 m into the bedrock. Well 3 was completed to a total depth of 17 m and encountered bedrock at a depth of 11 m. Wells 4 and 5 were drilled to a total depth of 13 m and encountered bedrock at 9.4 and 9.1 m, respectively.

The Bayshore Village wells are constructed in the limestone bedrock aquifer, which is under confined artesian conditions at this location. The bedrock aquifer is confined by varying thicknesses of fine grained till or deep water, fine-grained lacustrine sediments over most of the area. There is no indication of bedrock outcropping near the lakeshore with overburden in this area of between 6 and 10 m. A thin sand and gravel aquifer is observed at the contact with the bedrock at municipal wells 4 and 5 and at private wells to the east. It is expected that this overburden aquifer has a hydraulic connection with the bedrock aquifer.

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

12.3.1 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 Bayshore Village water supply has been delineated following the process recommended in the Technical Rules. The areas determined to contribute groundwater to the wells within the 25 years were delineated as WHPA. The Groundwater Vulnerability within the WHPA was assessed and included consideration for the effects of man-made (anthropogenic) 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 Bayshore Village WHPA. Details of the methods for the Vulnerability Analysis are provided in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO).

12.3.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for the Bayshore Village wells 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 Bayshore Village well locations and the WHPA. The updated well locations and the WHPA are shown in Figure 12a-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-B, 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 reflect groundwater flow from northeast to southwest toward Lake Simcoe. This is reasonable based on available data describing regional groundwater flow patterns.

12.3.1.2 Groundwater Vulnerability

The Bayshore Village wells draw water from the bedrock aquifer layer. The Groundwater Vulnerability for the bedrock aquifer in the area to the northeast of Lake Simcoe was determined following the methods outlined in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO) for the areas where the hydrostratigraphic models are not available. The Groundwater Vulnerability has been based on available data for overburden thickness with consideration for overburden materials where the overburden thickness is greater than 6 m. The regional Groundwater Vulnerability is illustrated in Technical Memorandum B1 – Regional Groundwater Vulnerability Mapping (Appendix MO).

The Groundwater Vulnerability within the WHPA of the three municipal wells in the Bayshore Village water supply is shown in Figure 12a-2. The Groundwater Vulnerability for the municipal water supply aquifers within the WHPA is considered to be High.

12.3.1.3 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.

The Groundwater Vulnerability map (Figure 12a-2) shows that the Groundwater Vulnerability for the municipal water supply aquifers within the WHPA is High and cannot be increased further. Figure 12a-2 was therefore used to generate the Vulnerability Scores.

12.3.1.4 WHPA-E

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.

12.3.1.5 Vulnerability Score

The WHPA zones for Bayshore Village water supply, as shown in Figure 12a-1, and the Groundwater Vulnerability, as shown in Figure 12a-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 12a-3 illustrates the Vulnerability Scores for the Bayshore Village WHPA. Figure 12a-3 will be used to assess Drinking Water Threats in Section 12.3.3.

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

The assessment of 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 Bayshore Village WHPA is High. The Vulnerability Rating for the Bayshore Village well 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).

12.3.2 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 Bayshore Village municipal water supplies has 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 the Township of Ramara are provided in Technical Memorandum M2 – Drinking Water Issues Evaluation – Ramara Groundwater(Appendix R).

No Drinking Water Issues have been identified for the Bayshore Village Well Supply wells.

Several parameters were observed on occasion or in low concentrations that are consistently less than the Ontario Drinking Water Quality Standard (ODWQS) values. Trends of increasing concentrations that would exceed the ODWQS value within 50 years were not observed. Sodium concentrations at Wells 4 and 5 display an increasing trend that is not projected to exceed the ODWQS objective within the next 50 years.

Several other naturally occurring water quality parameters are present in the water in concentrations that may exceed the aesthetic or operational guidelines of the ODWQS.

Lead concentrations were observed on rare occasions to be greater than the ODWQS value. The occurrence of lead was not consistent. Lead can be expected naturally in groundwater within the limestone bedrock in Southern Ontario.

12.3.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Bayshore Village water supply was completed in accordance with the detailed methodology presented in Technical Memorandum – 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 Bayshore Village water supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes preparation of:

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

12.3.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the Bayshore Village 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.

12.3.3.2 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 Bayshore Village Well Supply:

- 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 Ramara staff to identify potential Conditions within the identified WHPA for the drinking water supply.

No confirmed Conditions have been identified for the Bayshore Village water supply. No potential Conditions have been identified for consideration at this time.

12.3.3.3 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 Technical Rules threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The cirumstances can be found at: https://threats.swpip.ca/. ~~The maps combined with the table of drinking water threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at Ontario.ca: https://www.ontario.ca/page/tables-drinking-water-threats~~.

12.3.3.3.1 Pathogen Parameters

The Technical Rules ~~MECP table of drinking water threats~~ can be used in conjunction with the Vulnerability Scores on Figure 12a-4 to identify the areas where Activities associated with pathogen threats are or would be Significant, Moderate, or Low Drinking Water Threats for the

Bayshore Village Well Supply. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 10. Pathogens can also only be a Significant, Moderate or Low Threat within WHPA-A and WHPA-B.

12.3.3.3.2 Chemical Parameters

The Technical Rules ~~MECP table of drinking water threats~~ can be used in conjunction with the Vulnerability Scores on Figure 12a-5 to identify the areas where activities associated with chemical threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Bayshore Village Well Supply. Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is equal to or greater than 8.

12.3.3.3.3 DNAPL Chemical Parameters

Figure 12a-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 Bayshore Village Well Supply. The Technical Rules ~~MECP table of drinking water threats~~ can be used in conjunction with the Vulnerability Scores on Figure 12a-6 to identify the circumstances in which these Activities would be Significant or Moderate Drinking Water Threats.

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

Further to Section 12.3.3.2, no Conditions have been confirmed within the WHPA for the Bayshore Village Well 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 12a-3 illustrates the Vulnerability Score map for Bayshore Village well supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

12.3.3.5 Enumerating Drinking Water Threats

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The number of Significant Drinking Water Threats for the Bayshore Village Well 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 12-2 documents the enumeration of existing activities that are considered to be Significant Drinking Water Threats within the WHPA for the Bayshore Village Well Supply. 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.

Two (2) activities that are considered to be potential Significant Drinking Water Threats were identified in association with two (2) land areas within the WHPA for the Bayshore Village Well Supply. One (1) parcel is identified to represent the municipal sanitary sewer system and connections. 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 75 residential parcels within this area.

Table 12-2: Number of Significant Drinking Water Threats for the Bayshore Village Well Supply.

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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

Threat Number	Threat	Significant threat counts Number of threats
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.	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
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
15.	The handling and storage of fuel.	0
16.	The handling and storage of dense non-aqueous phase liquid.	0
17.	The handling and storage of an organic solvent.	0

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Threat Number	Threat	Significant threat counts Number of threats
18.	The management of runoff that contains chemicals used in the de-icing of aircraft.	0
19.	An activity that takes water from an aquifer or a surface water body without returning the water taken to the safe aquifer or surface water body.	0
20.	Any activity that reduces the recharge of an aquifer.	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	0
-	**Totals:**	**2** significant threats (on **2** properties)

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12.3.3.5.1 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 Technical Rules ~~the Table of Drinking Water Threats~~.

Managed Lands were identified and the managed lands proportions were determined for the WHPA of the Bayshore Village Well Supply as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.3.3.5). 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 12a-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Bayshore Village Well Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

12.3.3.5.2 Livestock Density

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

The Livestock Density was determined for the delineated WHPA zones of the Bayshore Village Well Supply as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.3.3.5). 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 12a-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Bayshore Village Well Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D. The Livestock Density was estimated for the identified Agricultural Managed Lands as determined in accordance with Technical Memorandum A5 (Appendix MO).

12.3.3.5.3 Impervious Surfaces

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

The proportion of impervious surfaces within the delineated WHPA zones for the Bayshore Village Well Supply 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 12.3.3.5). The Impervious Surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt).

Figure 12a-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

12.4 Val Harbour Subdivision Well Supply

The Val Harbour Well Supply is located on Lot 24, Concession 7 in the Township of Ramara and serves an estimated population of 148 (74 lots) in the Val Harbour subdivision (2007). The Val Harbour Water system consists of two wells as shown in Figure 12b-1.

The Val Harbour wells operate under Permit to Take Water 94-P-3026 dated November 2, 2001, which expires November 30, 2011. Well 1 is permitted to operate at a maximum rate of 47 L/min (67,680 L/day) while Well 2 is permitted to operate at a maximum rate of 97 L/min (139,680 L/day).

Both wells were installed in 1972. Well 1 was drilled to a total depth of 18.9 m through 16.8 m of unoxidized clay/boulder till and 2.1 m into the limestone bedrock. Water was encountered at 17.4 mbgl within the bedrock formation. The well casing was placed to a depth of 17.1 m and an annular seal of bentonite was installed over the upper 6.1 m of the annulus. Well 2 was drilled through 14.6 m of unoxidized clay/boulder till and approximately 1 m of bedrock. Water was encountered at a depth starting at 14.6 mbgl and casing is reported to extend to a depth of 15.6 mbgl. The precise well depth is unknown, but is estimated to 15.6 mbgl (Golder, 2005).

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

12.4.1 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 Val Harbour groundwater supply has been delineated following the process recommended in the Technical Rules. 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 Val Harbour Well Supply. Details of the methods for the Vulnerability Analysis are provided in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO).

12.4.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for the Val Harbour wells 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 Val Harbour well locations. Golder reviewed the WHPA delineation and provided updated WHPA in 2010. The updated well locations and the WHPA are shown in Figure 12b-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. In this case, the WHPA for WHPA-B, the 2-year TOT zone was observed to reflect a steady-state capture area. Therefore, WHPA-C and WHPA-D were not delineated.

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

12.4.1.2 Groundwater Vulnerability

The Val Harbour Well Supply draws water from the bedrock aquifer layer. The Groundwater Vulnerability for the bedrock aquifer in the area to the northeast of Lake Simcoe was determined following the methods outlined in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO) for the areas where the hydrostratigraphic models are not available. The Groundwater Vulnerability has been based on available data for overburden thickness with consideration for overburden materials where the overburden thickness is greater than 6 m. The regional Groundwater Vulnerability is illustrated in Technical Memorandum B1 – Regional Groundwater Vulnerability Mapping (Appendix MO).

The Groundwater Vulnerability within the WHPA of the two municipal wells in the Val Harbour Well Supply is shown in Figure 12b-2. The Groundwater Vulnerability for the municipal water supply aquifer (bedrock) within the WHPA is considered to be Medium in the area of the wells and High toward the extent of the WHPA.

12.4.1.3 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.

According to the available data, no potential Transport Pathways were identified within the Medium Vulnerability section of the WHPA that would increase the assigned rating. A High Vulnerability rating cannot be increased further. The Groundwater Vulnerability map (Figure 12b-2), will therefore be used to generate the Vulnerability Scores.

12.4.1.4 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.~~

12.4.1.5 Vulnerability Score

The WHPA zones for the Val Harbour Water Supply, as shown in Figure 12b-1, and the Groundwater Vulnerability, as shown in Figure 12b-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 12b-3 illustrates the Vulnerability Scores for the Val Harbour Water Supply. Figure 12b-3 will be used to assess Drinking Water Threats in Section 12.4.3.

12.4.1.6 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 Val Harbour WHPAs was determined by peer reviewers from Dillon Consulting using a standard scoring matrix (Table 1, Appendix MO). The Uncertainty Rating assigned for the Val Harbour WHPAs is High. The full results of the WHPA delineation

Peer Review process, for Val Harbour is available in Appendix R and discussed in Chapter 5 (Methods Overview).

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

The Uncertainty Rating assigned for the Vulnerability Assessment component for the Val Harbour WHPA is High. The Vulnerability Rating for the Val Harbour 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.

12.4.2 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 Val Harbour groundwater supply has 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 the Township of Ramara Groundwater are provided in Technical Memorandum M2 – Drinking Water Issues Evaluation – Ramara Groundwater (Appendix R).

No Drinking Water Issues were identified for the Val Harbour Well Supply

Several parameters were observed on occasion or in low concentrations that are consistently less than the Ontario Drinking Water Quality Standard (ODWQS) values. Trends of increasing concentrations that would exceed the ODWQS value within 50 years were not observed. Several other naturally occurring water quality parameters are present in the water in concentrations that may exceed the aesthetic or operational guidelines of the ODWQS.

12.4.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Val Harbour Well 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 Val Harbour Well Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes preparation of:

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

12.4.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Val Harbour Well 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.

12.4.3.2 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 Val Harbour Water Supply system:

- Files provided by the ~~Ministry of the Environment~~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~~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 Ramara staff to identify potential conditions within the identified WHPA for the drinking water supply.

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

12.4.3.3 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 Technical Rules threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The circumstances can be found at: https://threats.swpip.ca/. ~~The maps include references to a series of tables prepared by MOE to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php~~

Field Code Changed

12.4.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 12b-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 Val Harbour Well Supply. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 10. Pathogens can also only be a Significant, Moderate or Low Threat within WHPA-A and WHPA-B.

12.4.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 12b-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 Val Harbour Well Supply, Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is equal to or greater than 8.

12.4.3.3.3 DNAPL Chemical Parameters

Figure 12b-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 Val Harbour Well Supply. The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 12b-6 ~~can be used to can be used~~ to identify the circumstances in which these Activities would be Significant, or Moderate Drinking Water Threats.

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

Further to Section 12.4.3.2, no Conditions have been confirmed within the WHPA for the Val Harbour Well Supply system.

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 12b-3 illustrates the Vulnerability Score map for Val Harbour well supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

12.4.3.5 Enumerating Drinking Water Threats

~~12.4.3.5~~

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The number of Significant Drinking Water Threats for the Val Harbour Well 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 12-3 documents the enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the WHPA for the Val Harbour Well Supply. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is 10.

Thirty-three (33) activities that are considered to be potential Significant Drinking Water Threats were identified in association with 25 land parcels in the WHPA for the Val Harbour Well Supply as shown in Table 12-3. Activities on 23 parcels are associated with residential land use and include 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 22 residential parcels within this area. One additional parcel was identified for potential storage of fuel for non-residential purposes.

Two (2) parcels were identified as having potential for application of agricultural source material and pesticides. One (1) parcel is identified as a potential Significant Drinking Water Threat due to storage of agricultural source material, fertilizer and pesticides, as well as for activities related to livestock.

Table 12-3: Number of Significant Drinking Water Threats for the Val Harbour Well Supply.

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.	23
3.	The application of agricultural source material to land.	2
4.	The storage of agricultural source material to land.	1

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Threat Number	Threat	Significant threat counts Number of threats
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.	1
10.	The application of pesticide to land.	~~4~~2
11.	The handling and storage of pesticide.	1
12.	The application of road salt.	0
13.	The handling and storage of road salt.	0
14.	The storage of snow.	0
15.	The handling and storage of fuel.	2
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
19.	An activity that takes water from an aquifer or a surface water body without returning the water taken to the safe aquifer or surface water body.	0

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Threat Number	Threat	Significant threat counts Number of threats
20.	Any activity that reduces the recharge of an aquifer.	0
21.	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	1
22.	The establishment and operation of a liquid hydrocarbon pipeline	0
-	**Totals:**	**3~~53~~** significant threats (on **27** properties)

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Note for the table above: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel

12.4.3.5.1 Managed Lands

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

Managed Lands were identified and the managed lands proportions were determined for the WHPA of the Val Harbour Well Supply as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.4.3.5). 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 12b-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Val Harbour Well Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

12.4.3.5.2 Livestock Density

Technical Rule 16(10) ~~(August 2009)~~ requires the Assessment Report to include maps showing the livestock density within WHPA-A, -B, -C, -D, and –E. This mapping is not required where the

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

The Livestock Density was determined for the delineated WHPA zones of the Val Harbour Well Supply as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.4.3.5). 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 12b-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Val Harbour Well 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).

12.4.3.5.3 Impervious Surfaces

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

The proportion of impervious surfaces within the delineated WHPA zones for the Val Harbour Well Supply 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 12.4.3.5). The Impervious Surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt).

Figure 12b-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Val Harbour Well Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

12.5 Surface Water Vulnerability Methods and Uncertainties

12.5.1 Surface Water Vulnerability

The following section describes the methods used to assess the Vulnerability of Lagoon City and South Ramara Water Treatment Plants. Intake Protection Zones and Vulnerability Scores for the Lagoon City WTP and South Ramara WTP were delineated by Baird and Associates (Baird, 2010d). The Lagoon City and South Ramara intakes are classified as Type D surface water intake (Rule 55; MOE, 2008a). For Type D intakes, three zones are to be delineated: the IPZ-1 is based on a fixed radius around the intake; the IPZ-2 acts as a secondary protection zone around the IPZ-1; and the IPZ-3 is considered an additional protection zone. For the purposes of delineating the IPZ-3, the Lake Simcoe intakes are also identified as a special case (Rule 68) and those rules applicable to Type A and B intakes also apply in this regard.

12.5.1.1 Delineating IPZ-1 and IPZ-2

IPZ-1 was delineated according to the Technical Rules and as outlined in Chapter 5. The IPZ-1 was based on the 1km radius and the 120m setback from the shoreline and was prepared using GIS.

The IPZ-2 is defined based on the area that may contribute water to the intake where the time-of-travel to the intake is equal to or less than the time that is sufficient to allow the operator of the system to respond to an adverse condition in the quality of the surface water (Rule 65; MOE, 2008a). The two hour minimum response time was used for the Township of Ramara intakes, as the operator response time to shut-down the intake was a maximum of 0.5 to 1.0 hours of receiving notification.

The IPZ-2 is comprised of four areas:

1. In-lake IPZ-2: the area within each surface water body and an extension up tributaries flowing into the IPZ-2;
2. Up-tributary: IPZ-2 is extended up tributary to the 2-hour time-of-travel limit;
3. Inland setback: Greater of either the 120 m setback inland along the abutted land or the regulation limit;
4. Transport Pathways: an extension to include areas that contribute water to the IPZ-2 through a Transport Pathway.

12.5.1.1.1 In-lake IPZ-2 delineation

The approach used in this study was to define the in-water IPZ-2 based on the currents predicted by the MIKE3 hydrodynamic model as described in Baird (2010d). The Lake Simcoe

model is based on the original model developed for the Assimilative Capacity Studies as described in Baird (2006). This previous work demonstrated that MIKE3 model could successfully simulate both wind driven currents and thermocline development in Lake Simcoe.

For delineating IPZ-2, currents were developed for 10 year return period wind events, for eight wind directions, run at 45^{o} intervals (Appendix R – Table 2.2, Baird 2010d). For each wind condition, the model was run with a constant wind applied to the surface of the lake, until the currents in the lake were fully developed. Reverse particle tracking was used to track the paths that the currents would have transported neutrally buoyant particles to the intake over a 2 hour period. Although the intakes are located near the lakebed, particles were introduced at the surface and near the lakebed. The particles released at both depths were considered in delineating the IPZ-2, as this is a more conservative approach. The impact of the water withdrawn by the intake on the local currents was also investigated, with the model indicating that the intake only significantly influences the currents within a 2 m to 5 m radius of the intake.

Currents inshore of the breaker or surf zone are complex and are not well defined by existing numerical models. Comparison of the intake depth with the depth at the estimated lakeward limit of the surf zone suggests that the intakes at Lagoon City and South Ramara are located inside the surf zone, where wave-induced currents and the associated mass transport and mixing are more likely to affect the IPZ-2 delineation. However, it is recognized that there is potential for currents in the surf zone to transport a contaminant in an offshore direction from the shoreline. The significance of this increases for intakes located in high wave energy environments and for intakes located within the surf zone. A preliminary assessment of the location of the surf zone was undertaken by Baird (2010d). The assumption is that mixing processes inside the surf zone could transport a contaminant to the offshore limit of the surf zone. Estimated depth at offshore limit of surf zones is presented in Appendix R – Table 5.1, Baird 2010d.

12.5.1.1.2 Up Tributary

The upstream limit of the IPZ-2 was calculated as (2 hours minus the travel time from the intake to tributary mouth) multiplied by the tributary velocity. Tributary velocity was based on velocity at bank full stage as per the MOE (2006a) recommendation and it was assumed that bank full flow is equivalent to the 2 year return period event.

There are a number of tributaries located within the IPZ-2s of the Township of Ramara WTP intakes. The tributaries within the Lagoon City WTP IPZ-2 have velocities that range from 0.10 m/s to 1.0 m/s while the tributaries within the South Ramara WTP IPZ-2 have velocities of 2.69 m/s (Appendix R – Baird 2010d). Tributary velocities provided by the LSRCA where used where

available. Alternatively, the velocity was estimated from bank full discharge divided by the approximate area of the cross-section at the mouth of the tributary.

12.5.1.1.3 Inland Setback

Where the IPZ-2 abuts land, it includes the greater of either (1) a setback of not more than 120 m inland along the abutted land measured from the high water mark of the surface water body; or (2) the area of land within the Conservation Authority Regulation Limit along the abutted land (Rule 65; MOE, 2008a). The Regulation Limit for Lake Simcoe was provided by LSRCA, and is the April 24, 2009 Board of Directors approved version.

The shorelines of Lake Simcoe were used in lieu of the high water mark (HWM). The shoreline was developed by digitizing the lake boundary from the 2002 colour 20 cm orthorectified aerial photography.

It must be noted however that the definition of HWM used in this assessment differs to that provided by the MOE. MOE, 2009b, defines the HWM for water bodies where a long term water level record exists, as the 80$_{th}$ percentile for the month within which the highest water level occurs, or where a long term record of water levels does not exist, the level at which flood plains are flooded and leave a mark where natural vegetation changes from predominantly aquatic vegetation to terrestrial vegetation. The HWM is defined by LSRCA in terms of fish habitat, as the average annual high water which is 219.15 m above sea level (masl). A review of the shoreline used to define the HWM for the IPZ delineation and the HWM provided by LSRCA (219.15 masl) was completed in the Baird (2010d) report. The review found the two shorelines to be comparable. More information on the difference between these two approaches is documented Baird (2010) report located in Appendix R.

12.5.1.1.4 Transport Pathways

The IPZ-2s were modified to include potential Transport Pathways based on Rules 72 to 74 of the Technical Rules. A complete description of the methodology, analysis and Transport Pathway delineation is provided in Baird 2010d.

Data were acquired by LSRCA from field surveys, in-house development, and from participating municipalities. Datasets included (but were not limited to) Storm sewersheds;Storm water pond locations; Sewershed outfall locations, diameters, flows and velocities; Ditch locations and cross-sections; Rural drainage networks;Impervious areas;Subsurface tile drains; Watercourse engineered and modeled cross-sections; Soils and land use data; and Ortho-imagery.

The sewersheds discharging into the IPZ-2 were identified from LSRCA and municipal storm water network datasets. Residence time and the velocity were then used to estimate a

maximum within-sewershed travel distance. A summary of travel distance calculations for Lagoon City and South Ramara can be found in Baird 2010d. In all sewersheds, the travel distance was greater than the assumed longest flow path in the sewershed, so the entire sewershed was included in the revised IPZ-2.

12.5.1.2 Delineating IPZ-3

The MIKE3 model was used to delineate the area within the surface water body through which contaminants released during an extreme event could be transported to the intake. An extreme event is defined in MOE (2008a) as: a period of heavy precipitation or winds up to a 100 year storm event; a freshet; or a surface water body exceeding its high water mark.

Three events were initially selected for modeling: a 100 year return period wind event with average flows in tributaries; a 10 year return period wind event with 2 year return period non-freshet flows; and a 2 year return period freshet with average winds.

Preliminary test runs with the MIKE3 model showed that the effects of the tributary flows on currents within the lake were very localized (limited to close proximity to the mouth of the tributary). Desktop calculations showed that for the tributaries in the Lake Simcoe watershed, a contaminant could be transported from the headwaters to Lake Simcoe during a freshet or extreme non-freshet flow event. Evaluating the spatial distribution of potential transport within the lake therefore became the focus of the modeling investigations. The details of these investigations can be found in Baird, 2010d.

The modeling demonstrates that a contaminant could reach an intake from anywhere in Lake Simcoe, during extreme events. The size and irregular shape of the lake, with two large bays (Cook's Bay and Kempenfelt Bay) means that movement of the contaminant across the lake, behind islands, and in and out of bays is highly dependent on the directionality of the wind. To complicate matters further, there are eight intakes in Lake Simcoe, and there is substantial overlapping of the IPZ-3s. Based on discussions with LSRCA and MOE, it was agreed that the modeling supports the original direction in MOE (2006a), to extend the IPZ-3 to the watershed limits. Additional site specific contaminant modeling will be undertaken in the next phase. It will consider specific threats to determine whether or not a contaminant could reach the intake that is of sufficient concentration to compromise the drinking water at the intake (MOE, 2008a; Rule 130).

The IPZ-3 sub-areas, used to define areas with varying Vulnerability Scores, were delineated based on the sub-watershed boundaries. The Lake Simcoe water body was also delineated as one sub-area. Although Lake Simcoe generally flows into Lake Couchiching through Atherley Narrows, data showed that reverse flow does occur, with water flowing from Lake Couchiching into Lake Simcoe. The Lake Couchiching water body and watershed were therefore included as

IPZ-3 sub-areas. The IPZ-3 was extended up tributaries from the lake, to the watershed limit. A setback of 120 m was applied on Lake Couchiching (as there is no Regulation Limit) and the Regulation limit used to define the setback within the Lake Simcoe watershed.

12.5.1.3 IPZ Vulnerability Scores

The Vulnerability Score ranks the relative Vulnerability of the intake to contaminants. Vulnerability Score is based on the Area Vulnerability Factor and the Source Vulnerability Factor using the formula below:

B x C

where,

B = the Area Vulnerability Factor of the area of the IPZ

C = the Source Vulnerability Factor of the surface water of the IPZ

The range of possible Vulnerability Scores can be found in Table 5-5, Section 5.3.2 of Chapter 5: Methods Overview.

12.5.1.3.1 Area Vulnerability Factor

Each of the Intake Protection Zones is assigned an Area Vulnerability Factor (B) with the IPZs closest to the intake having the highest factor.

For IPZ-1s, the Area Vulnerability Factor is assigned a value of 10 due to its close proximity to the intake (Rule 88; MOE, 2008a).

For the IPZ-2, a 'base' Area Vulnerability Factor of 8 (the median factor for an IPZ-2) was initially assigned, and then altered by four modifier scores based factors such as land cover, hydrology, slope and the characteristics of the subwatershed that the IPZ-2 is located in (the four potential modifiers can be found in Baird, 2010d).

The IPZ-2 base Area Vulnerability Factor, modifiers and final Area Vulnerability Factor for the Lagoon City and South Ramara WTPs intakes are listed in Table 12-4. An Area Vulnerability Factor of 9 was recommended for Lagoon City, in part due to the large on land extent of the IPZ-2. An Area Vulnerability Factor of 8 was recommended for South Ramara.

Table 12-4: Derivation of IPZ-2 Area Vulnerability Factor (B) for Lagoon City and South Ramara WTP Intakes.

Intake	Sub-watershed Closest to Intake	Base Area Vuln. Factor	IPZ-2 Land % Modifier[1]	Drainage Density Modifier[1]	SCS Curve Number Modifier	Land Use Modifier	Relief/ Length Ratio Modifier	IPZ-2 Final Area Vuln. Factor (B)
Lagoon City	Ramara Creeks	8	1	0	0	0	0	9
South Ramara	Ramara Creeks	8	0	0	0	0	0	8

[1] The IPZ-2 Land Modifier and Drainage Density Modifier both reflect the ratio of water to land. The sum of these two modifiers cannot change the Area Vulnerability Factor by more than +/- 1.

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The Area Vulnerability Factors for the IPZ-3 sub-areas were determined, using the same methodology as IPZ-2, with some minor additions. IPZ-3 sub-areas were defined as the sub-watersheds within the Lake Simcoe watershed and Lake Couchiching subwatershed. The Lake Simcoe and Lake Couchiching water bodies were also defined as IPZ-3 sub-areas. As stated previously, the Area Vulnerability Factors that are assigned to the IPZ-3 sub-areas cannot be greater than the Area Vulnerability Factor assigned to the IPZ-2 (Rule 91; MOE, 2008a). Methodology can be found in Baird, 2010d.

The IPZ-3 sub-area base Area Vulnerability Factors, modifiers and final Area Vulnerability Factors for the Lagoon City and South Ramara WTPs are listed in Table 12-5.

Table 12-5: Derivation of IPZ-3 Area Vulnerability Factors for: Lagoon City and South Ramara Intakes.

IPZ-3 Subzones	Base Area Vulnerability Factor (Lagoon City/South Ramara)	Distance Modifer[1] (Lagoon City/South Ramara)	Drainage Density Modifier[2]	SCS Curve Number Modifer[3]	Land Use Modifier[4]	Relief Length Modifier[5]	Final Area Vulnerability Factor (B)[6] (Lagoon City/South Ramara)
Lake Simcoe waterbody (including islands)	8/7	0/0	-	-	-	-	8/7
Lake Couchiching waterbody (including islands)	8/7	0/0	-	-	-	-	8/7
Ramara Creeks subwatershed	8/7	-1/-1	0	0	0	0	7/6
Upper + Lower Talbot River subwatershed	8/7	-1/-1	0	-1	0	-1	5/4
Whites Creek Subwatershed	8/7	-1/-1	0	+	0	0	7/6
Beaver River subwatershed	8/7	-2/-1	0	-1	0	0	5/5
Lake Couchiching subwatershed	8/7	-2/-2	-1	0	0	0	5/4
Oro Creeks North subwatershed	8/7	-2/-2	0	0	1	1	8/7
Hawkestone Creel subwatershed	8/7	-2/-2	0	-1	0	1	6/5
Pefferlaw Brook + Uxbridge Brook subwatershed	8/7	-2/-2	0	0	-1	0	5/4

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IPZ-3 Subzones	Base Area Vulnerability Factor (Lagoon City/South Ramara)	Distance Modifer[1] (Lagoon City/South Ramara)	Drainage Density Modifier[2]	SCS Curve Number Modifer[3]	Land Use Modifier[4]	Relief Length Modifier[5]	Final Area Vulnerability Factor (B)[6] (Lagoon City/South Ramara)
Oro Creeks South subwatershed	8/7	-2/-2	0	0	0	0	6/5
Black River subwatershed	8/7	-2/-2	0	0	-1	0	5/4
Georgina Creeks subwatershed	8/7	-3/-3	-1	1	0	0	5/4
Innisfil Creeks subwatershed	8/7	-3/-3	0	0	0	0	5/4
Hewitts Creek subwatershed	8/7	-3/-3	0	0	0	0	5/4
Lovers Creek subwatershed	8/7	-3/-3	0	0	0	0	5/4
Barrie Creeks subwatershed	8/7	-4/-4	0	0	1	1	5/4
Maskinonge subwatershed	8/7	-4/-4	0	1	0	0	5/4
West Holland subwatershed	8/7	-4/-4	1	0	0	0	5/4
East Holland subwatershed	8/7	-4/-4	1	0	1	0	6/5

[1] If waterbody area or nearest subwatershed, Modifier = 0. If further subwatershed, Modifier: Within: <-1 S.D. of mean = -1,>-1 S.D. and mean = -2, mean and <+1 S.D. = -3, >+1 S.D. = -4.

[2] Drainage density = (Total Length of Streams)/(Subwatershed Area).Modifier: Within +/-1 S.D. of mean = 0: >+1 S.D. of mean = +1: <-1 S.D. of mean = -1

[3] Adjusted SCS Curve Number. Modifier: Within +/-1 S.D. of mean = 0: >+1 S.D. of mean = +1: <-1 S.D. of mean = -1. Lake Couchiching CN is average of all other subwatersheds since no data was available.

[4] Land use: Natural/Forested = -1: Agricultural = 0: Urban/Developed = +1, coarsely interpreted from 1999 LandSat Imagery

[5] Relief-Length Ratio = (Relief)/(Subwatershed Length). Modifier: Within +/-1 S.D. of mean = 0: >+1 S.D. of mean = +1: <-1 S.D. of mean = -1

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[6] Final Area Vulnerability Factor plus/minus all modifiers

12.5.1.3.2 Source Vulnerability Factor

A Source Vulnerability Factor is assigned to each surface water intake (Rule 94; MOE, 2008a). Source Vulnerability for intakes within the SGBLS Source Protection Region was based on that developed by the Michigan Department of Environmental Quality (MDEQ). The first three rows in Table 12-6 were taken directly from MDEQ (2004), while the fourth row lists the corresponding Vulnerability Factor assigned for the Lagoon City and South Ramara WTPs.

Table 12-6: Intake Vulnerability Criteria based on Intake Distance from Shore and Depth (adapted from MDEQ, 2004).

Category[1]	Nearshore-Shallow Water	Nearshore-Deep Water	Offshore-Shallow Water	Offshore-Deep Water
Parameters[1]	<350 m offshore <6 m depth	<350 m offshore >6 m depth	>350 m offshore <6 m depth	>350 m offshore >6 m depth
Vulnerability [1] (MDEQ)	High	High to Moderate	High to Moderate	Moderate
Recommended Source Vulnerability Factor based on Intake Offset and Depth	1.0	0.9	0.9	0.8

[1]Category, parameters and vulnerability based on MDEQ (2004).

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None of the water treatment plant operators interviewed by LSRCA for this study reported a plant shut down due to water quality issues, similarly the Issues Evaluation (below) did not identify any Issues for this intake. As no Water Quality Issues were identified the Source vulnerability Score was based on the water depth and distance offshore only. The Lagoon City WTP intake is located 465 m from shore in a water depth 4.5 m. A Source Vulnerability Factor (C) of 0.9 was therefore assigned, based on the values presented in Table 7 (MDEQ, 2004). The South Ramara WTP intake is located 80 m from shore in a water depth 2.7 m. A Source Vulnerability Factor (C) of 1.0 was therefore assigned, based on the values presented in Table 12-6 (MDEQ, 2004).

12.5.1.4 Uncertainty Assessment

This section summarizes some of the uncertainty identified by Baird (2010d) when delineating IPZs and the assigning Vulnerability Scores; the entire discussion of uncertainties is presented in Baird 2010d, Appendix R. This assessment was used by Baird (2010d) to assign Uncertainty Ratings of either “High” or “Low” for each area and source Vulnerability Score.

12.5.1.4.1 Data Quality and Gaps:

Data gaps and data quality issues identified during the study included: bathymetry and shoreline delineation data sets that may be out of date or too low resolution; wind data from a single location (Lagoon City Buoy) being applied to the entire lake; tributary flow data being limited to the major tributaries; lower level of confidence in the calibration for the Lake Couchiching model, due to the limited measured current data used in the model calibration; and limited raw water quality data is available. Complete list of data quality and gaps listed in Baird 2010d, Appendix R.

12.5.1.4.2 Model Capabilities and Application

A model is a tool that is used to improve our understanding of the physical processes. It is important to understand the model limitations, as well as the limitations of the application, that is how the model was set up, the data was used as input to the model, the model runs undertaken, and the interpretation of the results. The limitations of the model used in this study include: (A complete list and description of model uncertainties is provided by Baird (2010d), Appendix R.

- The MIKE3 model does not consider waves and wave induced currents;
- Separate models for Lake Simcoe and Lake Couchiching means that flow through Atherley Narrows may not be accurately modeled since the Narrows are considered as an open boundary;
- Wind direction (45° intervals) and speed (10 year return periods) data that enables consistency between projects was used, but this does not capture actual shifts in wind speed and direction;
- Complex river networks and flow patterns at the north end of Lake Couchiching with limited gauge data and tributary cross-sections in this area;
- Flow velocities were estimated using either measured cross-section data from the mouth of the tributary or approximated cross-sections developed from the bathymetry field sheets for the lake. However, modeling indicated that the effect of tributary flow was localized, and did not significantly impact the in-lake IPZs
- Model application does not consider temperature induced density currents or lake stratification. Where the temperature of a tributary flowing into a lake differs from the lake temperature, there is potential for reduced travel times to the intake, as a result of density driven currents.

12.5.1.4.3 Quality Assurance/Quality Control

In completing this project, Baird followed their established *Project Quality Control Program (QCP),* which includes: Preparation of the Project Control Plan (PCP); Identification of the Project Manager (PM), Project Team (PT), Quality Control Reviewers (QCRs) and Quality Assurance Manager (QAM); Schedule and Budget; Description of tasks, project phases and/or deliverables to be reviewed; Identification of checklists to be utilized during reviews; Discussion of Quality Assurance procedures to be used during the project life cycle.

12.5.1.4.4 Extent and Level of Model Calibration/Validation

The MIKE3 model was calibrated with measured current data from two locations on Lake Simcoe, and one location in Lake Couchiching. It is important to note that the ADCP data sets are of limited duration and spatial coverage. They did not include the extreme events that were modeled for the matrix runs. The level of calibration was based on the available data and in general, the models captured the trends in the surface currents. Based on the calibration undertaken, the model seemed to capture the general trends in current speed and direction.

12.5.1.4.5 Area and Source Vulnerability Factors

The factors considered in assigning the Area Vulnerability values include: the percentage of the area of the IPZ-2 or IPZ-3, as the case may be that is composed of land; the land cover, soil type, permeability of the land and the slope of any setbacks; the hydrological and hydrogeological conditions in the area that contributes water to the area through Transport Pathways; and in respect of an IPZ-3, the proximity of the area of the IPZ-3 to the intake. The only subwatershed characteristic that is relatively uncertain is the SCS Curve, with the uncertainty arising from the fact that the SCS Curve No. is based on many parameters including rainfall, land cover, soil permeability and slope. The parameters considered in assigning the Source Vulnerability Factors were the distance of the intake from shore and the depth of water that it is located in, and the history of water quality concerns. Technical Memorandum M3 did not report any water quality Issues in their Issues Evaluation report, however limited data were available for the analysis.

12.6 Lagoon City Water Treatment Plant

The Lagoon City Water Treatment Plant is located on the east shore of Lake Simcoe near the Harbour Canal in the community of Lagoon City. The current maximum design flow of the facility is 4.0 ML/day, serving the communities of Lagoon City, Brechin, and Concord Point (The Corporation of the Township of Ramara, 2006). In the year 2000, the estimated population served was 2,945 (Township of Ramara, 2001).

Construction of the Lagoon City Water Treatment Plant and associated intake pipe was approved in 1978. The Lagoon City Treatment Plant uses pre-chlorination to prevent zebra mussel growth at the intake, coagulation with alum, flocculation, filtration through sand and granulated active carbon filters and post chlorination with sodium hypochlorite (The Corporation of the Township of Ramara, 2006).

The intake consists of 485 m of 300 mm diameter polyethylene pipe, extending from the plant and terminating at the inlet structure. The pipeline extends approximately 465 m offshore of the shoreline. The total depth at the intake is assumed to be 4.5 m for this study.

Based on the interview with the representative of the Lagoon City WTP, conducted by personnel from LSRCA on Aug 29, 2006, the WTP can be shut down within minutes upon notification, however 0.5 to 1.0 hours are required for staff to travel to the site. The WTP representative was not able to estimate the notification time (by MOE) in the event of a spill.

IPZ delineation and Vulnerability presented in this section is based on Baird (2010d) while the Issues and Threats Assessment is based on Genivar 2010a report.

12.6.1 Intake Protection Zones (IPZ)

The IPZ-1 and IPZ-2 for the Lagoon City WTP are shown in Figure 12c-1. IPZ-1 consists of a 1 km radius centered on the intake, extending 120 m inland or the regulated area. The IPZ-2 includes Transport Pathways, such as drains and ditches that extend the IPZ-2 in various locations within the Lagoon City community. The IPZ-3 for the Lagoon City WTP, as with all intakes in Lake Simcoe, has been defined as the entire Lake Simcoe and Lake Couchiching sub-watershed (Figure 12c-2). The Lake Couchiching water body and watershed were included as IPZ-3 sub-areas because current flow measurements show reverse flow (i.e. from Lake Couchiching to Lake Simcoe), do occur.

12.6.2 Intake Protection Zone (IPZ) Vulnerability Scores

The Vulnerability Factors and Scores for the IPZ-1, IPZ-2 and IPZ-3 sub-areas are summarized below in Table 12-7 and Figure 12c-1 and Figure 12c-2.

Table 12-7: Summary of Vulnerability Factors and Scores for Lagoon City WTP Intake.

IPZ and IPZ-3 sub-zones	Area Vulnerability Factor (B)	Source Vulnerability Factor (C)	Vulnerability Score (V)
IPZ-1	10	0.9	9
IPZ-2	9	0.9	8.1
IPZ-3 Sub-areas	-	-	-
Lake Simcoe waterbody (incl. islands)	8	0.9	7.2
Lake Couchiching waterbody (incl. islands)	8	0.9	7.2
Ramara Creeks subwatershed	7	0.9	6.3
Upper + Lower Talbot River subwatershed	5	0.9	4.5
Whites Creek subwatershed	7	0.9	6.3
Beaver River subwatershed	5	0.9	4.5
Lake Couchiching subwatershed	5	0.9	4.5
Oro North Creeks subwatershed	8	0.9	7.2
Hawkestone Creek subwatershed	6	0.9	5.4
Pefferlaw Brook + Uxbridge Brook subwatershed	5	0.9	4.5
Oro South Creeks subwatershed	6	0.9	5.4
Black River subwatershed	5	0.9	4.5
Georgina Creeks subwatershed	5	0.9	4.5
Innisfil Creeks subwatershed	5	0.9	4.5
Hewitts Creek subwatershed	5	0.9	4.5
Lovers Creek subwatershed	5	0.9	4.5
Barrie Creeks subwatershed	6	0.9	5.4
Maskinonge subwatershed	5	0.9	4.5
West Holland subwatershed	5	0.9	4.5
East Holland subwatershed	6	0.9	5.4

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12.6.3 Uncertainty for IPZ Delineation and Vulnerability

Based on the factors discussed above, Baird (2010d) recommended an IPZ delineation Uncertainty Rating for the IPZ-1 as Low and IPZ-2 and IPZ-3 as High. The Uncertainty Rating for the IPZ-1, -2 and -3 Vulnerability Scores are all High (Table 12-8).

While the location of the intake was relatively well defined and no Drinking Water Issues were reported (see Section 12.6.4) based on the data analyzed, limited data were available for the Issues Analysis and the operator raised some concerns (Baird, 2010d). A High Uncertainty was therefore assigned to the Vulnerability Score for the IPZ-1.

The IPZ-2 delineation is based on current velocities in the vicinity of the intake. Based on the data, model, model application, and model calibration limitations presented in this section, a High rating of Uncertainty is recommended. The High levels of Uncertainty are not a reflection of the quality of work, but recognition of the limitations presented. With respect to extension of the IPZ-2 up tributaries, the velocities in small tributaries, in many cases were assumed, due to lack of data. Similarly, no fieldwork was undertaken to define the characteristics of Transport Pathways and there are significant data gaps. A High level of Uncertainty was therefore assigned to the IPZ-2 delineation. Vulnerability Scores for the IPZ-2 were assigned based on the Area and Source Vulnerability Factors. The Uncertainty Rating for the data used to define the Source Vulnerability Factor (offset from shore, depth and history of water quality concerns) is High as discussed for the IPZ-1. The level of Uncertainty for the Area Vulnerability for the IPZ-2 is also High due to the degree of uncertainty in the methodology used to develop the Area Vulnerability Factor. This in part stems from the fact that the Rules (MOE, 2009a) do not provide specific guidance.

Table 12-8: Summary of Uncertainty Ratings for the Lagoon City WTP Intake IPZs and Vulnerability Scores.

IPZ	Uncertainty for IPZ Delineation	Uncertainty for Vulnerability Scores
IPZ-1	Low	High
IPZ-2	High	High
IPZ-3	High	High

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Contaminant specific modeling to determine if an activity represents a Significant Drinking Water Threat [Rule 130; MOE, 2008a] has not been completed as part of this project. This modeling is required to determine if release of a chemical or pathogen would be transported through the surface water IPZ to the intake and result in deterioration of the water for use as a drinking water source. Concentration, specific gravity, decay rate and the size of the spill must all be considered. Contaminant specific modeling should be undertaken in the future to improve the level of certainty in the IPZ-3 delineation. A High level of Uncertainty has therefore been assigned to the IPZ-3 delineation.

A High level of Uncertainty has also been assigned to the Vulnerability Scoring for the IPZ-3 subareas, for the reasons discussed with respect to the IPZ-1 and IPZ-2.

12.6.4 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, treated water quality, and water quality monitoring in sentry wells in the area around the Lagoon City WTP has 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 Lagoon City are provided in Technical Memorandum M1 – Drinking Water Issues Evaluation– Ramara Surface Water (Appendix R).

No Drinking Water Issues were identified for the Lagoon City Water Treatment Plant

Several parameters were observed on occasion or in low concentrations that are consistently less than the Ontario Drinking Water Quality Standard (ODWQS). Trends were not observed for the majority of these parameters. Several other naturally occurring water quality parameters are present in the water in concentrations that may exceed the aesthetic or operational guidelines of the ODWQS.

Surface water in Lake Simcoe was observed to have variable concentrations of pathogen parameters typically indicated by presence of total coliform or *E.coli* bacteria. Treatment consisting of adequate filtration and disinfection is in place and maintained in accordance with Provincial standards under the Safe Drinking Water Act. As this treatment is effective, the coliform and *E.coli* bacteria are not considered to be Drinking Water Issues. The water quality of the surface water source will be benefited by any measures within the contributing area to the water supply intake that will reduce the concentrations of bacterial parameters within the surface water system.

12.6.5 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the water supply to the Lagoon City WTP 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 Lagoon City WTP builds on the information from the Vulnerability Analysis and Issues Evaluation and includes preparation of:

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

12.6.5.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the Lagoon City WTP is provided in Chapter 5, section 5.3.5.1.

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

12.6.5.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing Conditions that could affect the water supply to the Lagoon City WTP:

- Files provided by the ~~Ministry of the Environment~~Ministry of the Environment, Conservation and Parks local offices pertaining to licenses, and records of spills in the area of the delineated IPZs.
- Records available from the ~~Ministry of the Environment~~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 Ramara staff to identify potential conditions within the identified IPZs for the drinking water supply.

No confirmed Conditions have been identified for the IPZs of the Lagoon City WTP. No potential Conditions have been identified for consideration at this time.

12.6.5.3 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 Technical Rules threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The circumstances can be found at: https://threats.swpip.ca/. ~~The maps include references to a series of tables prepared by MOE to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php~~

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12.6.5.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 12c-3 ~~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 water supply to the Lagoon City WTP. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is greater than 8.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 12c-4).

12.6.5.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores~~The Key Table~~ on Figure 12c-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 water supply to the Lagoon City WTP. Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is greater than 8.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 12c-6).

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

Further to Section 12.6.5.2, no Conditions have been confirmed within the IPZ for the Lagoon City WTP.

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 12c-1 and Figure 12c-2 illustrates the Vulnerability Score maps for Lagoon City WTP that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

12.6.5.5 Enumerating Drinking Water Threats

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The number of Significant Drinking Water Threats for the water supply to the Lagoon City WTP has been determined using the methodology outlined in Technical Memorandum A5 (Appendix MO) and refined by Township of Ramara staff members. There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 12-9 documents the enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the IPZ for the Lagoon City WTP. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is greater than 8 in IPZ-1 and IPZ-2.

A total of 134 activities that are potentially Significant Drinking Water Threats were identified on 50 land parcels within the IPZ-2. The activities that were identified as potential Significant Drinking Water Threats for pathogens on these parcels include storage of agricultural source material (ASM) (15 parcels), application of ASM (48 parcels), application of non-agricultural source material (NASM) (7 parcels), and livestock grazing/pasture land (15 parcels). Activities with potential to be Significant Drinking Water Threats related to application of pesticide to land were identified on 46 parcels based on the size of the parcel. Three (3) activities that have

potential to be Significant Drinking Water Threats were also identified in association with a sewage treatment facility within IPZ-2.

Table 12-9: Number of Significant Drinking Water Threats for the Lagoon City WTP.

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.	3
3.	The application of agricultural source material to land.	48
4.	The storage of agricultural source material to land.	15
5.	The management of agricultural source material.	0
6.	The application of non-agricultural source material to land.	7
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.	39~~46~~
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.	0
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
19.	An activity that takes water from an aquifer or a surface water body without returning the water taken to the safe aquifer or surface water body.	0
20.	Any activity that reduces the recharge of an aquifer.	0
21.	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	15
22.	The establishment and operation of a liquid hydrocarbon pipeline	0
-	**Totals:**	**1253~~34~~*** significant threats (on 43 properties)

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*134 potential Threats that all require further verification

Note for the table above: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel

12.6.5.5.1 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 IPZ-1, -2 and -3 . 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 Technical Rules~~the Table of Drinking Water Threats~~.

Managed Lands were identified and the Managed Lands proportions were determined for IPZ-1 and IPZ-2 for the water supply to the Lagoon City WTP as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.6.5.5). 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 12c-7 illustrates the location and proportion of Managed Lands within the delineated IPZ-1 and IPZ-2 for the Lagoon City WTP. The Managed Lands proportions for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 12c-8.

12.6.5.5.2 Livestock Density

Technical Rule 16(10) ~~(August 2009)~~ requires the Assessment Report to include maps showing the livestock density within including IPZ-1, -2 and -3. 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 Technical Rules~~the Table of Drinking Water Threats~~.

The Livestock Density was determined for IPZ-1 and IPZ-2 for the water supply to the Lagoon City WTP as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.6.5.5). 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 12c-9 illustrates the distribution of Livestock Density within the delineated IPZ-1 and IPZ-2 for the Lagoon City WTP. The Livestock Density for the IPZ-3 associated with the surface water intakes in Lake Simcoe is presented Figure 12c-10.

12.6.5.5.3 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 including IPZ-1, -2 and -3. 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 Technical Rules~~the Table of Drinking Water Threats~~.

The proportion of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the water supply to the Lagoon City WTP 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 Intake Protection Zones using the 2021 Technical Rules. The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.6.5.5). The Impervious Surfaces are used in the identification of Threat activities associated with the application of winter de-icing agents (salt).

Figure 12c-11 illustrates the distribution of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the water supply to the Lagoon City WTP. The proportion of Impervious Surfaces for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 12c-12.

12.7 South Ramara Water Treatment Plant

The South Ramara Water Treatment Plant is located on the east shore of Lake Simcoe near the community of Heritage Farms in the Township of Ramara. The WTP serves the communities of Heritage Farms and Mara Shore Estate. The maximum design flow of the facility is 0.39 ML/day but it can handle a peak hour flow of 0.58 ML/day. In 2004, the existing population supplied was 221 (Township of Ramara, 2001).

Construction of the South Ramara Water Treatment Plant and associated intake pipe was completed in 1982 for water supply to Heritage Farms. A connection was made to the Mara Estates distribution system in 2001. The facility upgraded and expanded in 2005. The most recent Certificate of Approval (C of A) provided including amendments to the C of A was dated June 2005. The South Ramara Treatment Plant uses two package water treatment units in parallel to treat the water from Lake Simcoe. Treatment consists of a flocculation tank, settling tank, and mixed media filter (one with granular activated carbon, anthracite and gravel and the other with anthracite and a sand filter bed). Sodium hypochlorite and alum are used for primary disinfection and an on-line Supervisory Control And Data Acquisition (SCADA) system monitors the treatment process. Prechlorination is also applied in the intake to prevent zebra mussel growth.

The intake consists of 80 m of 150 mm diameter pipe, extending from the shoreline and terminating at the inlet structure in 3 m of water. A total water depth of 2.7 m will be assumed in this study.

Based on the interview with the representative of the South Ramara WTP, conducted by personnel from LSRCA on Aug 29, 2006, the WTP can be shut down within minutes upon notification, however 0.5 to 1.0 hours are required for staff to travel to the site. The WTP representative was not able to estimate the notification time (by MOE) in the event of a spill.

IPZ delineation and Vulnerability presented in this section is based on Baird (2010d) while the Issues and Threats Assessment is based on Genivar 2010a report.

12.7.1 Intake Protection Zones (IPZ)

The IPZ-1 and IPZ-2 for the South Ramara WTP are shown in Figure 12d-1. IPZ-1 consists of a 1 km radius centered on the intake, extending 120 m inland or the regulated area. The IPZ-2 includes Transport Pathways, such as drains and ditches that extend the IPZ-2 in various locations within the community. The IPZ-3 for the South Ramara WTP, as with all intakes in Lake Simcoe, has been defined as the entire Lake Simcoe and Lake Couchiching sub-watershed (Figure 12d- 2). The Lake Couchiching water body and watershed were included as IPZ-3 sub-

areas because current flow measurements show reverse flow (i.e. from Lake Couchiching to Lake Simcoe), do occur.

12.7.2 Intake Protection Zone (IPZ) Vulnerability Scores

The Vulnerability Factors and Scores for the IPZ-1, IPZ-2 and IPZ-3 sub-areas are summarized below in Table 12-10 and Figure 12d-1 and Figure 12d- 2.

Table 12-10: Summary of Vulnerability Factors and Scores for South Ramara WTP Intake.

IPZ and IPZ-3 sub-zones	Area Vulnerability Factor (B)	Source Vulnerability Factor (C)	Vulnerability Score (V)
IPZ-1	10	1.0	10
IPZ-2	8	1.0	8.0
IPZ-3 Sub-areas	-	-	-
Lake Simcoe waterbody (incl. islands)	7	1.0	7.0
Lake Couchiching waterbody (incl. islands)	7	1.0	7.0
Ramara Creeks subwatershed	6	1.0	6.0
Upper + Lower Talbot River subwatershed	4	1.0	4.0
Whites Creek subwatershed	6	1.0	6.0
Beaver River subwatershed	5	1.0	5.0
Lake Couchiching subwatershed	4	1.0	4.0
Oro North Creeks subwatershed	7	1.0	7.0
Hawkestone Creek subwatershed	5	1.0	5.0
Pefferlaw Brook + Uxbridge Brook subwatershed	4	1.0	4.0
Oro South Creeks subwatershed	5	1.0	5.0
Black River subwatershed	4	1.0	4.0
Georgina Creeks subwatershed	4	1.0	4.0
Innisfil Creeks subwatershed	4	1.0	4.0
Hewitts Creek subwatershed	4	1.0	4.0
Lovers Creek subwatershed	4	1.0	4.0
Barrie Creeks subwatershed	5	1.0	5.0
Maskinonge subwatershed	4	1.0	4.0
West Holland subwatershed	4	1.0	4.0
East Holland subwatershed	5	1.0	5.0

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12.7.3 Uncertainty for IPZ Delineation and Vulnerability

Based on the factors discussed above, Baird (2010d) recommended an IPZ delineation Uncertainty Rating for the IPZ-1 as low and IPZ-2 and IPZ-3 as High. The Uncertainty Rating for the IPZ-1, -2 and -3 Vulnerability Scores are all High (Table 12-11).

While the location of the intake was relatively well defined and no Drinking Water Issues were reported in Section 12.7.4, based on the data analyzed, limited data were available for the Issues Analysis and the operator raised some concerns (Baird, 2010d). A High Uncertainty was therefore assigned to the Vulnerability Score for the IPZ-1.

The IPZ-2 delineation is based on current velocities in the vicinity of the intake. Based on the data, model, model application, and model calibration limitations presented in this section, a High rating of Uncertainty is recommended. The High levels of Uncertainty are not a reflection of the quality of work, but recognition of the limitations presented. With respect to extension of the IPZ-2 up tributaries, the velocities in small tributaries, in many cases were assumed, due to lack of data. Similarly, no fieldwork was undertaken to define the characteristics of Transport Pathways and there are significant data gaps. A High level of Uncertainty was therefore assigned to the IPZ-2 delineation. Vulnerability Scores for the IPZ-2 were assigned based on the Area and Source Vulnerability Factors. The Uncertainty Rating for the data used to define the Source Vulnerability Factor (offset from shore, depth and history of water quality concerns) is High as discussed for the IPZ-1. The level of Uncertainty for the Area Vulnerability for the IPZ-2 is also High due to the degree of uncertainty in the methodology used to develop the Area Vulnerability Factor. This in part stems from the fact that the Rules (MOE, 2009a) do not provide specific guidance.

Table 12-11: Summary of Uncertainty Ratings for the South Ramara WTP Intake IPZs and Vulnerability Scores.

IPZ	Uncertainty for IPZ Delineation	Uncertainty for Vulnerability Scores
IPZ-1	Low	High
IPZ-2	High	High
IPZ-3	High	High

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Contaminant specific modeling to determine if an activity represents a Significant Drinking Water Threat [Rule 130; MOE, 2008a] has not been completed as part of this project. This modeling is required to determine if release of a chemical or pathogen would be transported through the surface water IPZ to the intake and result in deterioration of the water for use as a drinking water source. Concentration, specific gravity, decay rate and the size of the spill must all be considered. Contaminant specific modeling should be undertaken in the future to

improve the level of certainty in the IPZ-3 delineation. A High level of Uncertainty has therefore been assigned to the IPZ-3 delineation.

A High level of Uncertainty has also been assigned to the Vulnerability Scoring for the IPZ-3 subareas, for the reasons discussed with respect to the IPZ-1 and IPZ-2.

12.7.4 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 South Ramara WTP 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 South Ramara are provided in Technical Memorandum M1 – Drinking Water Issues Evaluation– Ramara Surface Water (Appendix R).

No Drinking Water Issues were identified for the South Ramara Water Treatment Plant

Several parameters were observed on occasion or in low concentrations that are consistently less than the Ontario Drinking Water Standard. Trends were not observed for the majority of these parameters. Several other naturally occurring water quality parameters are present in the water in concentrations that may exceed the aesthetic or operational guidelines of the Ontario Drinking Water Quality Standards (ODWQS).

Surface water in Lake Simcoe was observed to have variable concentrations of pathogen parameters typically indicated by presence of total coliform or *E. coli* bacteria. Treatment consisting of adequate filtration and disinfection is in place and maintained in accordance with Provincial standards. As this treatment is effective, the coliform and *E. coli* bacteria are not considered to be Drinking Water Issues. The water quality of the surface water source will be benefited by any measures within the contributing area to the water supply intake that will reduce the concentrations of bacterial parameters within the surface water system.

12.7.5 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the South Ramara WTP was completed in accordance with the detailed methodology presented in Technical Memorandum – 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 South Ramara WTP builds on the information from the Vulnerability Analysis and Issues Evaluation and includes preparation of:

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

12.7.5.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the South Ramara WTP is provided in Chapter 5, section 5.3.5.1.

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

12.7.5.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing Conditions that could affect the water supply to the South Ramara WTP:

- Files provided by the ~~Ministry of the Environment~~Ministry of the Environment, Conservation and Parks local offices pertaining to licenses, and records of spills in the area of the delineated IPZs.
- Records available from the ~~Ministry of the Environment~~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 Ramara staff to identify potential conditions within the identified IPZs for the drinking water supply.

No confirmed Conditions have been identified for the South Ramara WTP water supply. No potential Conditions have been identified for consideration at this time.

12.7.5.3 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 Technical Rules threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The circumstances can be found at: https://threats.swpip.ca/. ~~The maps include references to a series of tables prepared by MOE to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php~~

Field Code Changed

12.7.5.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 12d- 3 ~~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 South Ramara WTP. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 8 or greater.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 12d- 4).

12.7.5.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 12d- 6 ~~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 water supply to the Lagoon City WTP. Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is 8 or greater.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 12d- 7).

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

Further to Section 12.7.5.2, no Conditions have been confirmed within the IPZ for the South Ramara WTP.

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 12d-1 and Figure 12c-2 illustrates the Vulnerability Score map for South Ramara WTP that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

12.7.5.5 Enumerating Drinking Water Threats

~~12.7.5.5~~

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The number of Significant Drinking Water Threats for the South Ramara WTP has been determined using the methodology outlined in Technical Memorandum A5 (Appendix A) and refined by Township of Ramara staff members. There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 12-12 documents the enumeration of existing activities that are considered to be Significant Drinking Water Threats within the IPZ for the South Ramara WTP. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is greater than 8 in IPZ-1 and IPZ-2.

Seventy-eight (78) activities that are potentially Significant Drinking Water Threats were identified on 73 land parcels within the IPZ for the South Ramara WTP. The activities that were identified as potential Significant Drinking Water Threats on these parcels include storage of agricultural source material (ASM) (2 parcels), application of ASM to land (4 parcels), use of land for livestock grazing, pasture, outdoor confinement areas, or farm animal yards (2 parcels), and application of pesticide to land (1 parcel). Sixty-nine (69) parcels were identified with potential activities relating to private sewage disposal systems.

Table 12-12: Number of Significant Drinking Water Threats for the South Ramara WTP.

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.	69
3.	The application of agricultural source material to land.	4
4.	The storage of agricultural source material to land.	2
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.	3~~1~~

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Threat Number	Threat	Significant threat counts Number of threats
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
15.	The handling and storage of fuel.	0
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
19.	An activity that takes water from an aquifer or a surface water body without returning the water taken to the safe aquifer or surface water body.	0
20.	Any activity that reduces the recharge of an aquifer.	0
21.	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	2
22.	The establishment and operation of a liquid hydrocarbon pipeline	0
-	**Totals:**	80~~78~~* significant threats (on **75** properties)

*78 potential Threats that require further verification (2015)

Note for the table above: 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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12.7.5.5.1 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 IPZ-1, -2 and -3. 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 Technical Rules~~the Table of Drinking Water Threats~~.

Managed Lands were identified and the Managed Lands proportions were determined for the South Ramara IPZ-1 and IPZ-2 as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.7.5.5). 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 12d-7 illustrates the location and proportion of Managed Lands within the delineated IPZ-1 and IPZ-2 for the South Ramara WTP. The Managed Lands proportions for the IPZ-3 associated with the surface water intakes in Lake are presented in Figure 12c-8.

12.7.5.5.2 Livestock Density

Technical Rule 16(10) ~~(August 2009)~~ requires the Assessment Report to include maps showing the livestock density within IPZ-1, -2 and -3. 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 Technical Rules~~the Table of Drinking Water Threats~~.

The Livestock Density was determined for the South Ramara IPZ-1 and IPZ-2 as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.7.5.5). 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 12d-8 illustrates the distribution of Livestock Density within the delineated IPZ-1 and IPZ-2 for the South Ramara WTP where vulnerability scores were greater than 6. The Livestock Density for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 12c-10.

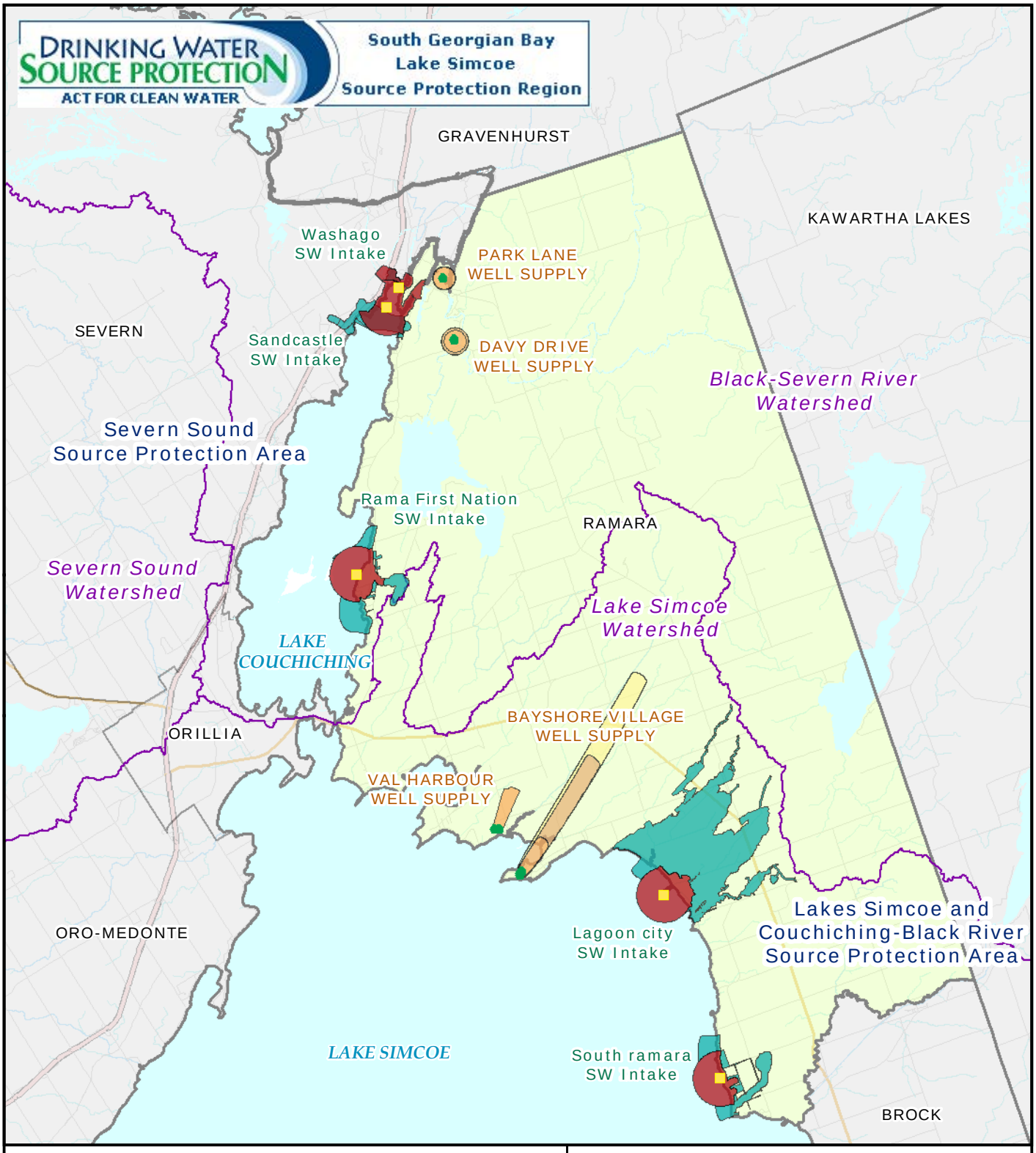
12.7.5.5.3 Impervious Surfaces

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 IPZ-1, -2 and -3. 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 Technical Rules~~the Table of Drinking Water Threats~~.

The proportion of impervious surfaces within the delineated IPZ-1 and IPZ-2 for the South Ramara Water Treatment Plant IPZ~~WHPA~~ 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 Intake Protection Zones using the 2021 Technical Rules. The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.7.5.5). The Impervious Surfaces are used in the identification of Threat activities associated with the application of winter de-icing agents (salt).

Figure 12d-9 illustrates the distribution of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the South Ramara WTP where the Vulnerability Scores were greater than 6. The proportion of Impervious Surfaces for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 12c-12.



- Municipal Surface Water Intakes
- IPZ-1 (1000m on water or 120m inland)
- IPZ-2 (2 hr time of travel)
- Municipal Supply Well
- WHPA-A (100m)
- WHPA-B (2 years tot)
- WHPA-C1 (10 years tot)
- WHPA-D (25 years tot)

Drinking Water System
Vunerable Areas in
Township of Ramara

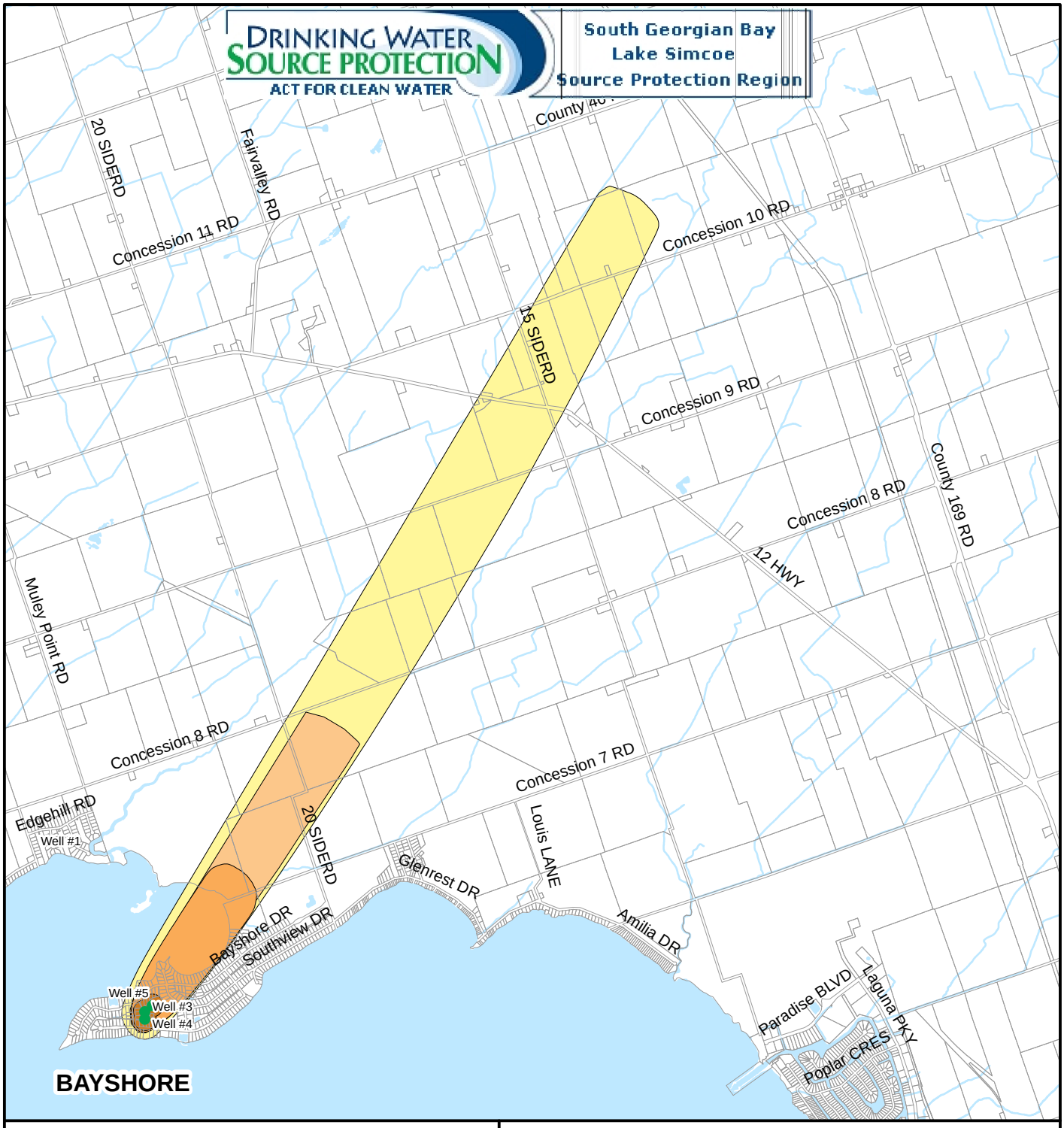
Created by: LSRCA
Date: 2011-05-03

Scale: 1:200,000
0 2.5 5km
UTM Zone 17N, NAD83

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 12-1



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

490 245 0 490 Metres

WELLHEAD PROTECTION AREAS - BAYSHORE WATER SUPPLY, RAMARA

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

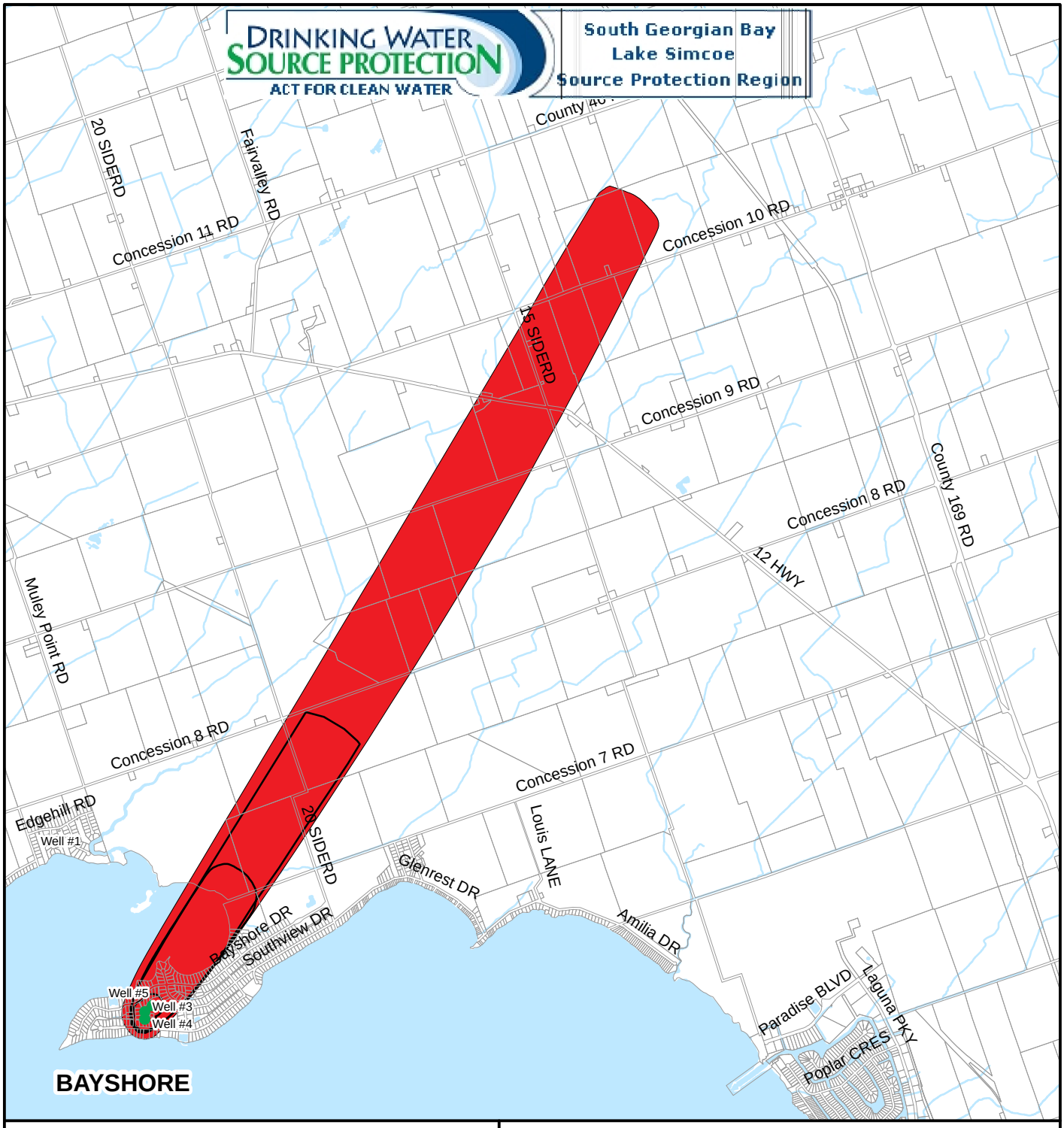
DATE: JUNE 2010	SCALE: 1:50000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.3-1

This map was produced for the Regional Municipality of Durham 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 12□-1



Legend

- MUNICIPAL WELL LOCATION

AQUIFER VULNERABILTY INDEX

- HIGH VULNERABILITY
- MEDIUM VULNERABILITY
- LOW VULNERABILITY

N W E S

500 250 0 500 Metres

GROUNDWATER VULNERABILITY - BAYSHORE

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

DATE: JUNE 2010	SCALE: 1:50000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.3-2

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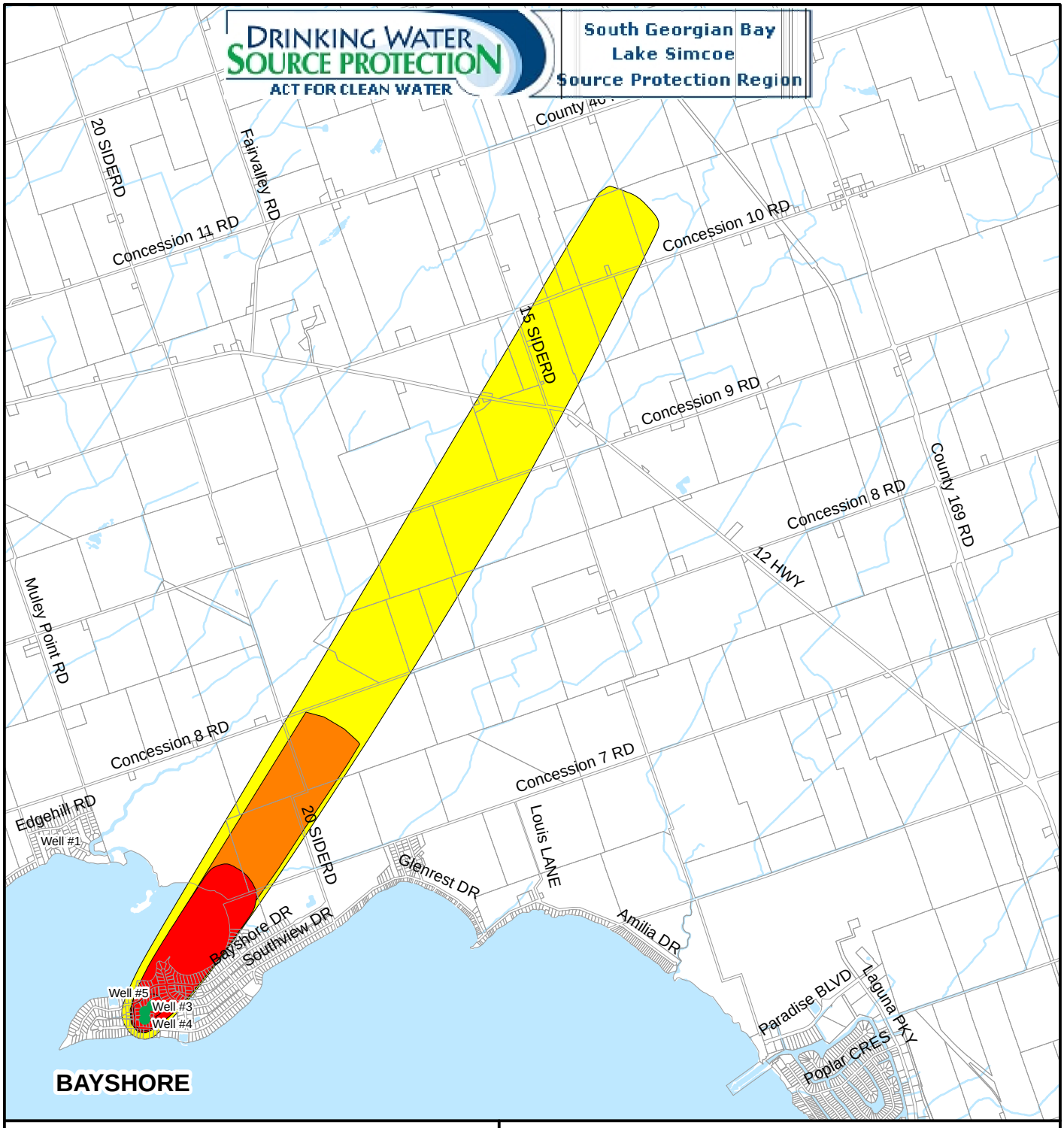
GENIVAR

Ontario

FIGURE 12□-2



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6
- 4
- 2

N
W E
S

500 250 0 500 Metres

VULNERABILITY SCORE - BAYSHORE

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

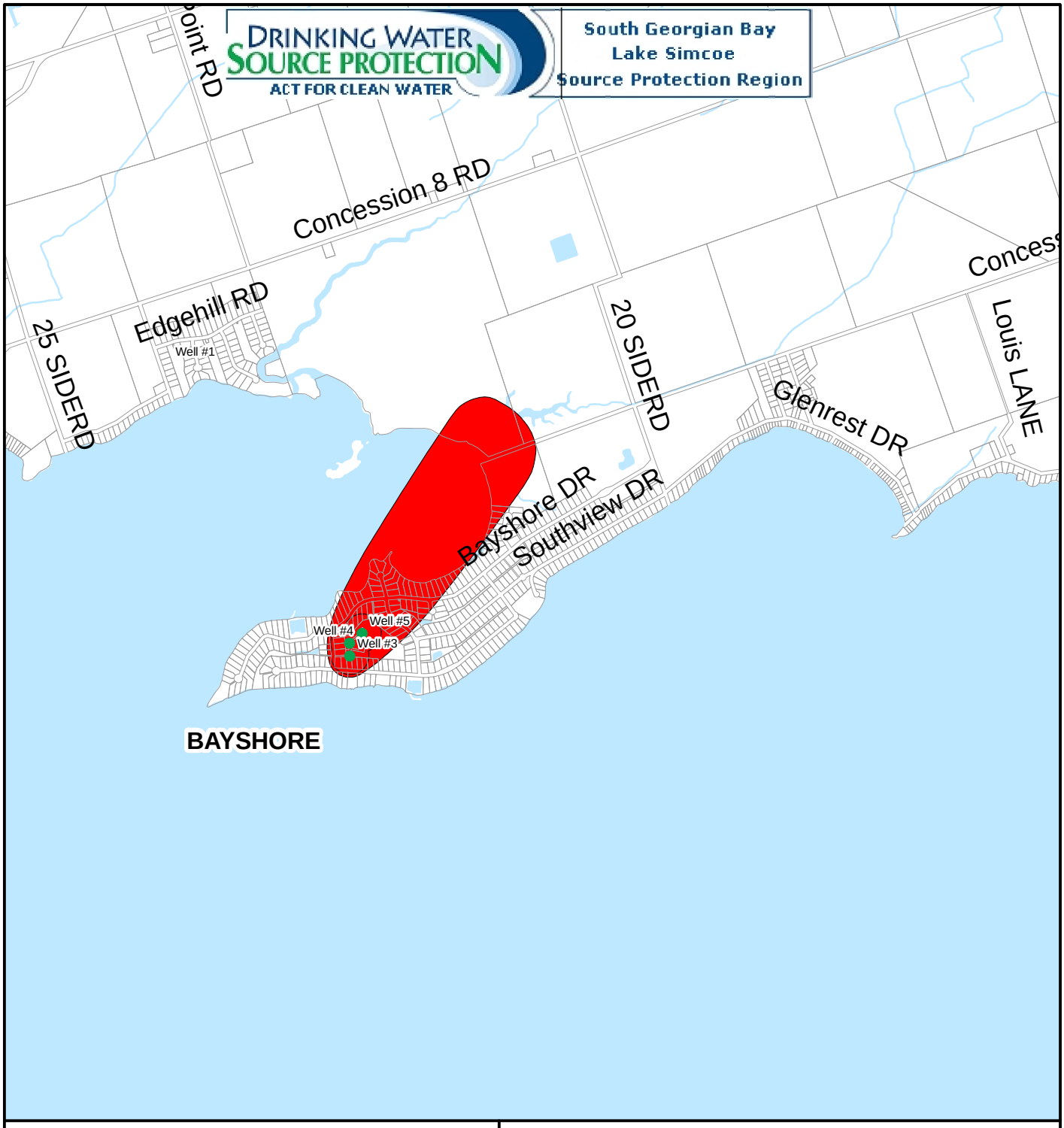
DATE: JUNE 2010	SCALE: 1:50000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.3-3

This map was produced for the Regional Municipality of Durham 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 12□-3



LEGEND

MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

10

8

6

N

W E

S

300 150 0 300 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

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

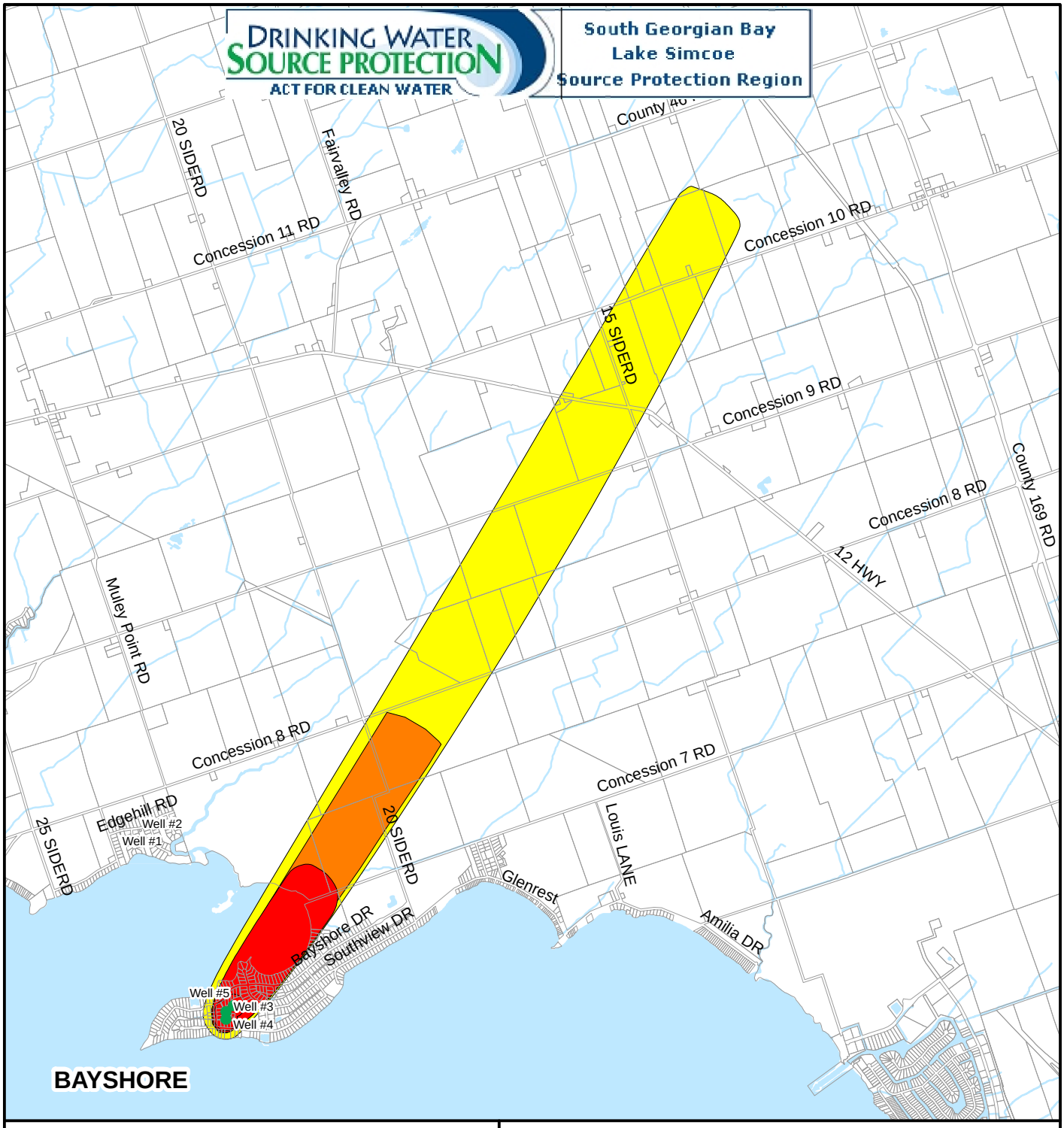
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JUNE 2010	SCALE: 1:30000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.3-4

GENIVAR

Ontario

FIGURE
12a-4



LEGEND

MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

10

8

6

N W E S

500 250 0 500 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

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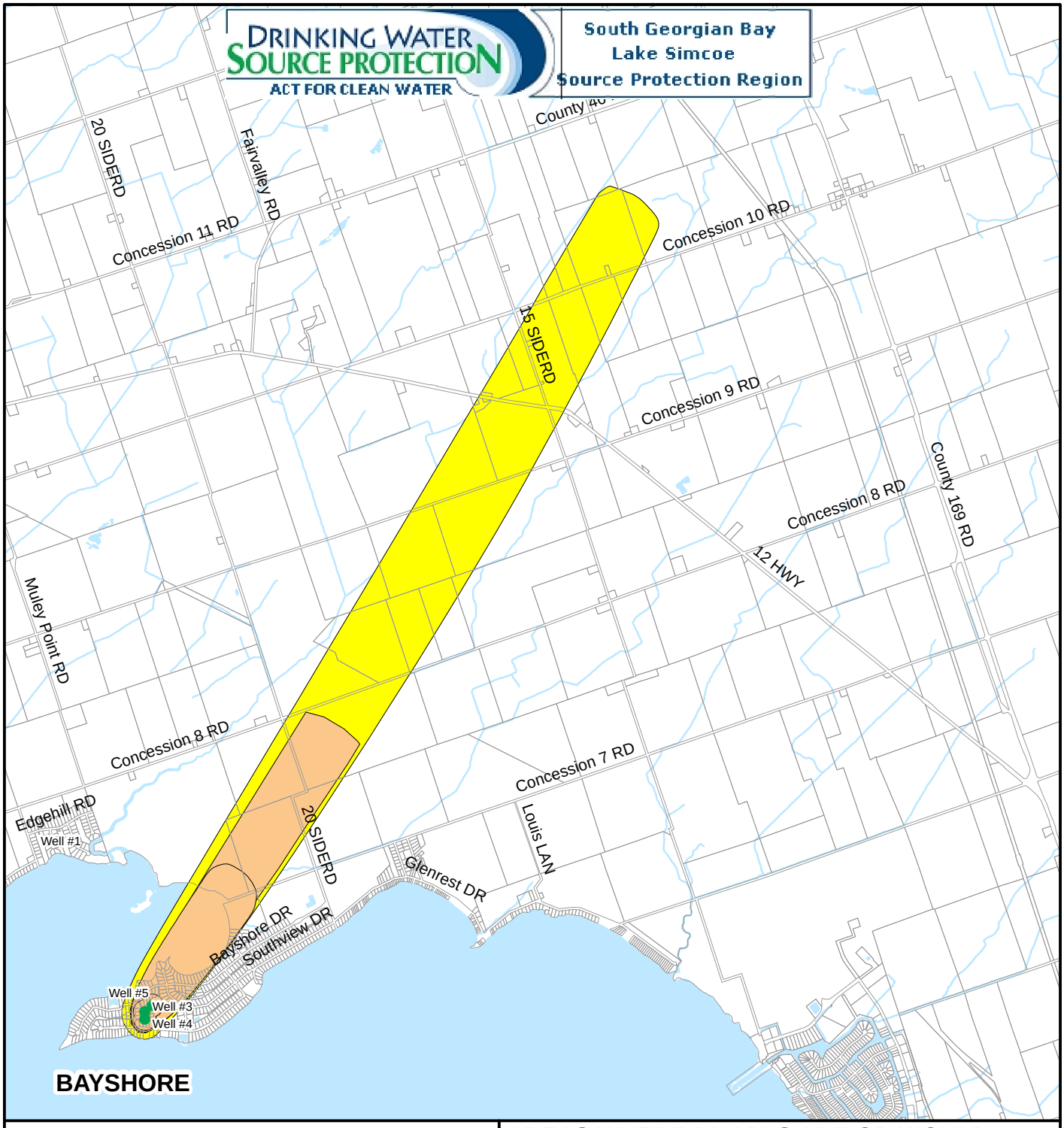
AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - BAYSHORE

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

DATE: JUNE 2010	SCALE: 1:50000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.3-5

GENIVAR Ontario

FIGURE **12a-5**



LEGEND

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

VULNERABILITY SCORING

- 6

N W E S

500 250 0 500 Metres

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

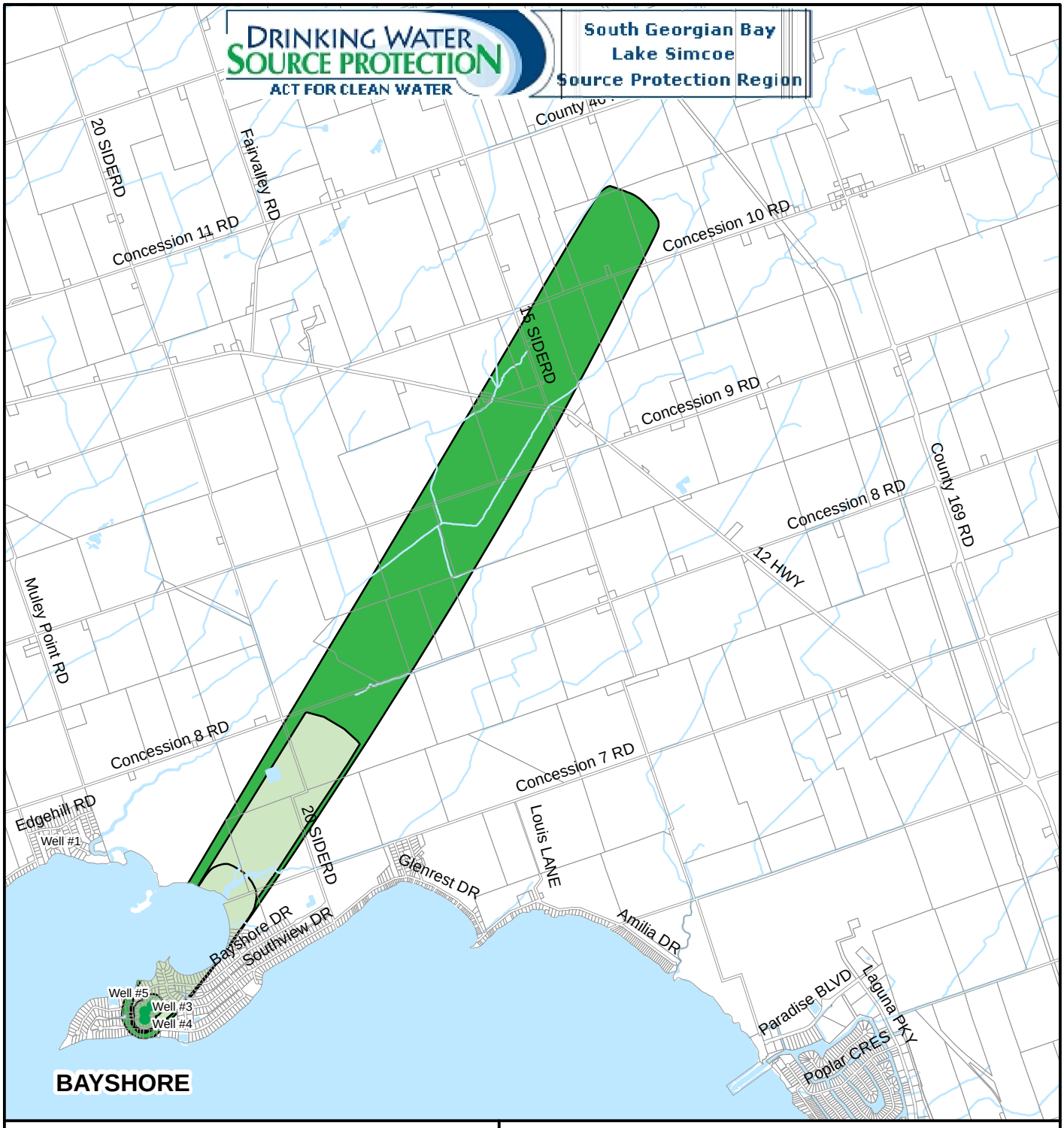
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

DATE: JUNE 2010	SCALE: 1:50000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.3-6

GENIVAR Ontario

FIGURE 12a-6



Legend

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

N W E S

510 255 0 510 Metres

MANAGED LANDS - BAYSHORE

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

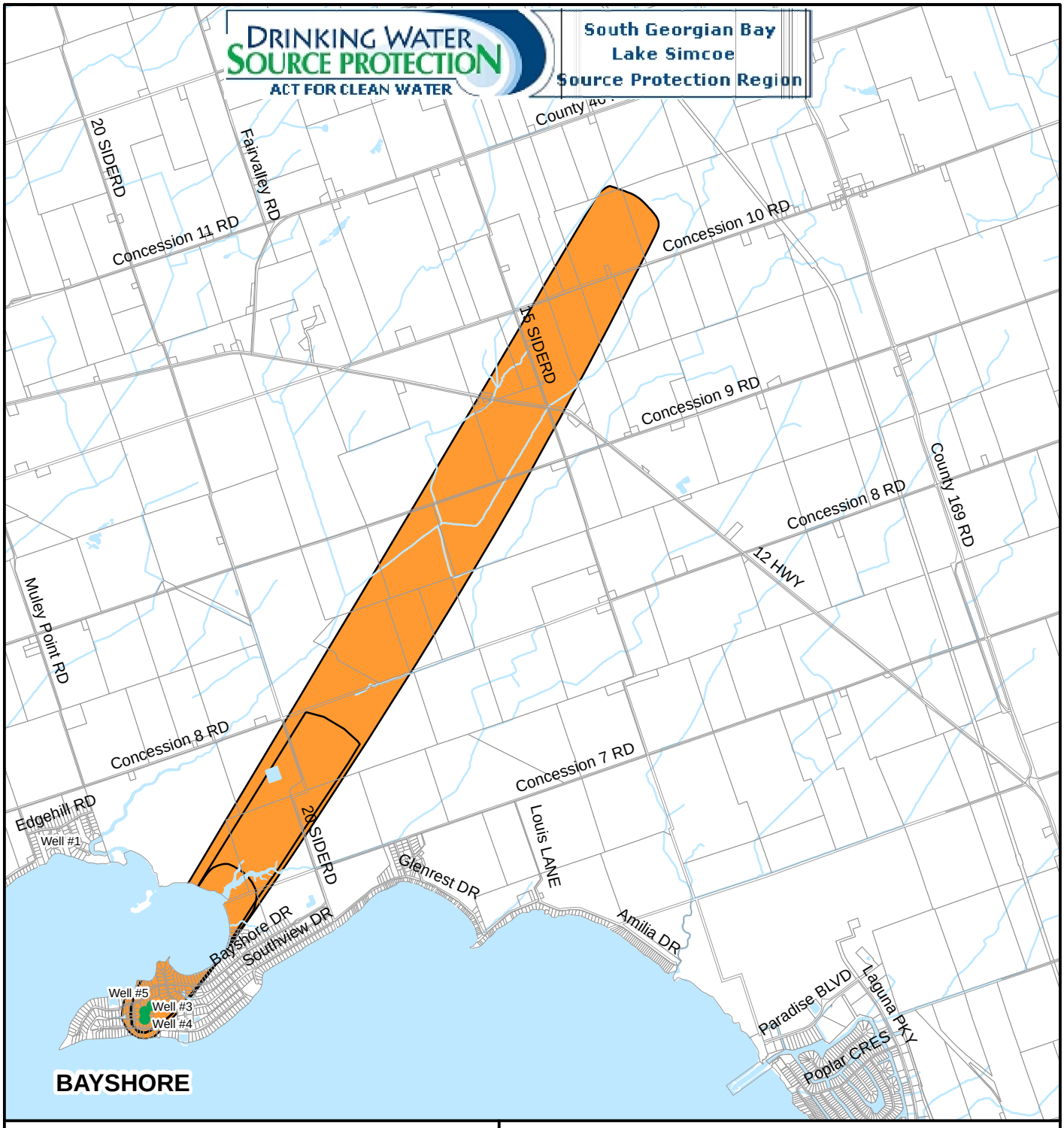
The Managed Land proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JUNE 2010 | SCALE: 1:50000

PROJECT: 0-071948.08 | FILE. NO.:0-07194808F14.3-7

GENIVAR | Ontario

FIGURE 12□-□



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

510 255 0 510 Metres

LIVESTOCK DENSITY - BAYSHORE

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

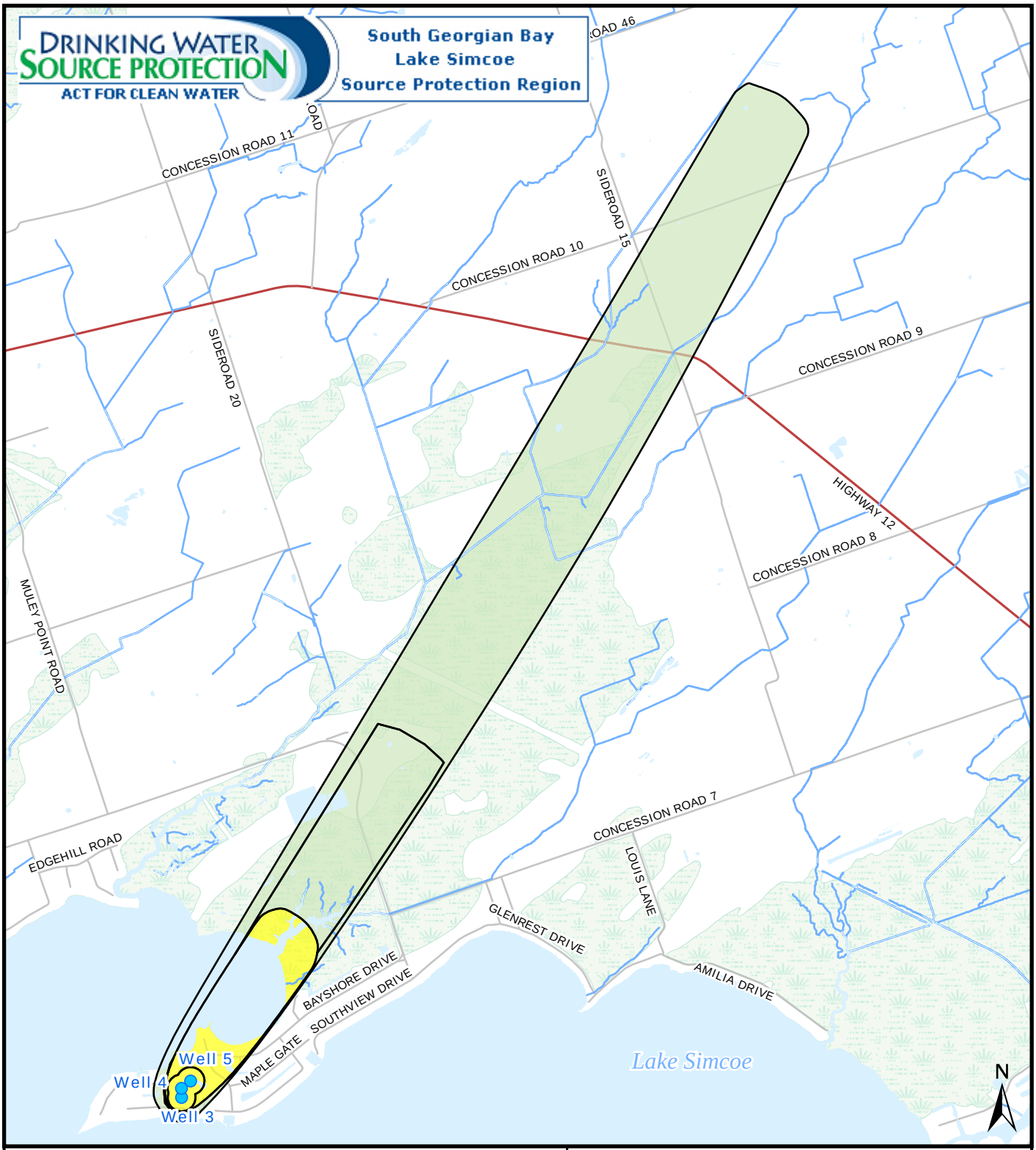
The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JUNE 2010 | SCALE: 1:50000

PROJECT: 0-071948.08 | FILE. NO.:0-07194808F14.3-8

GENIVAR | Ontario

FIGURE 12□-□



Well

Impervious Surfaces in WHPA

- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- >30%

Impervious Surfaces - Bayshore WHPA

Created by: LSRCA, 2025-08-05

Scale 1:40,000

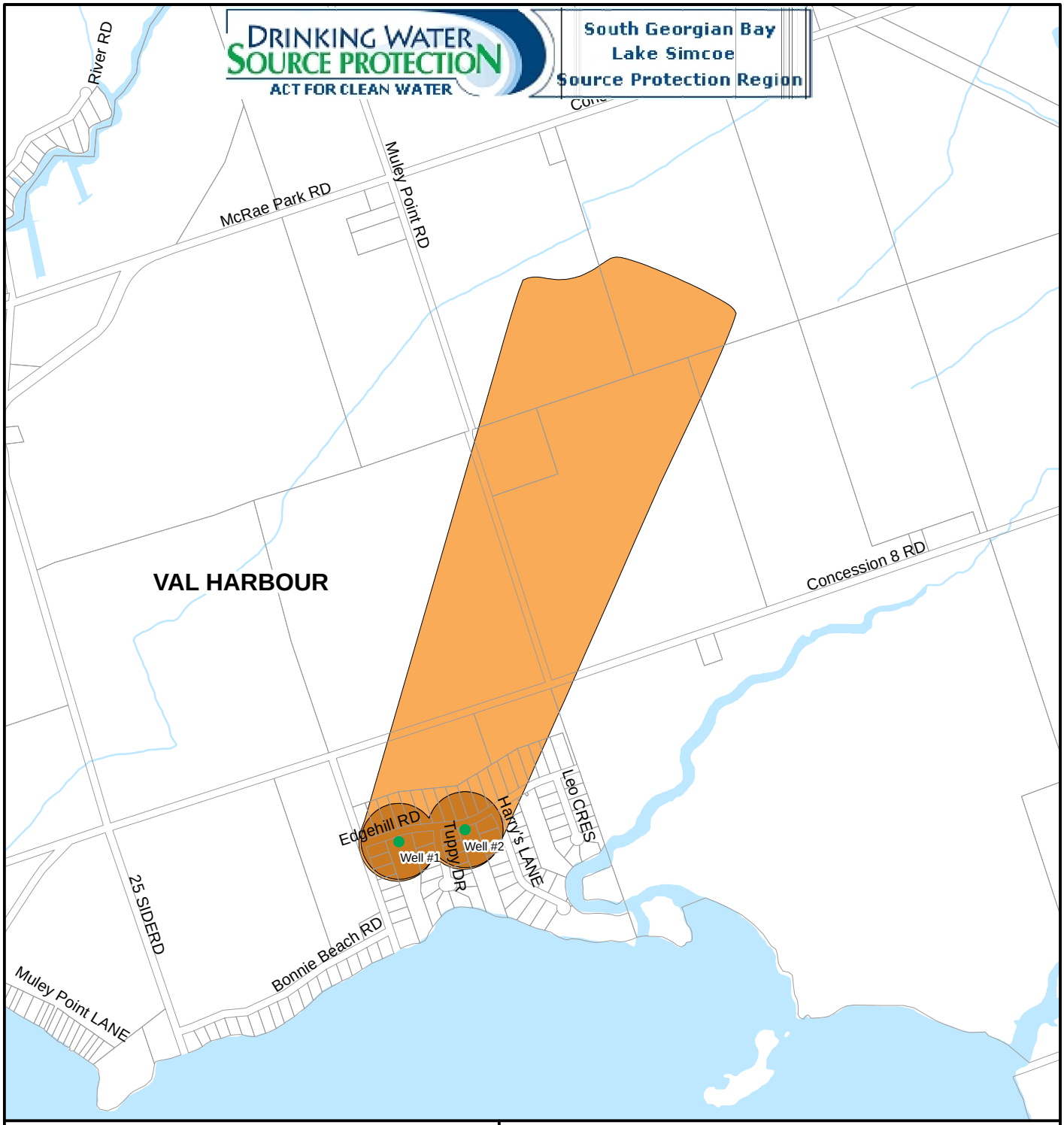
0 345 690 1,380 m

UTM Zone 17N, NAD83

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 12a-9



Legend

- MUNICIPAL WELL LOCATION
- WHPA-A: 100 m RADIUS
- WHPA-B: 2-YEAR TIME-OF-TRAVEL

N W E S

150 75 0 150 Metres

WELLHEAD PROTECTION AREAS -VAL HARBOUR WATER SUPPLY, RAMARA

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

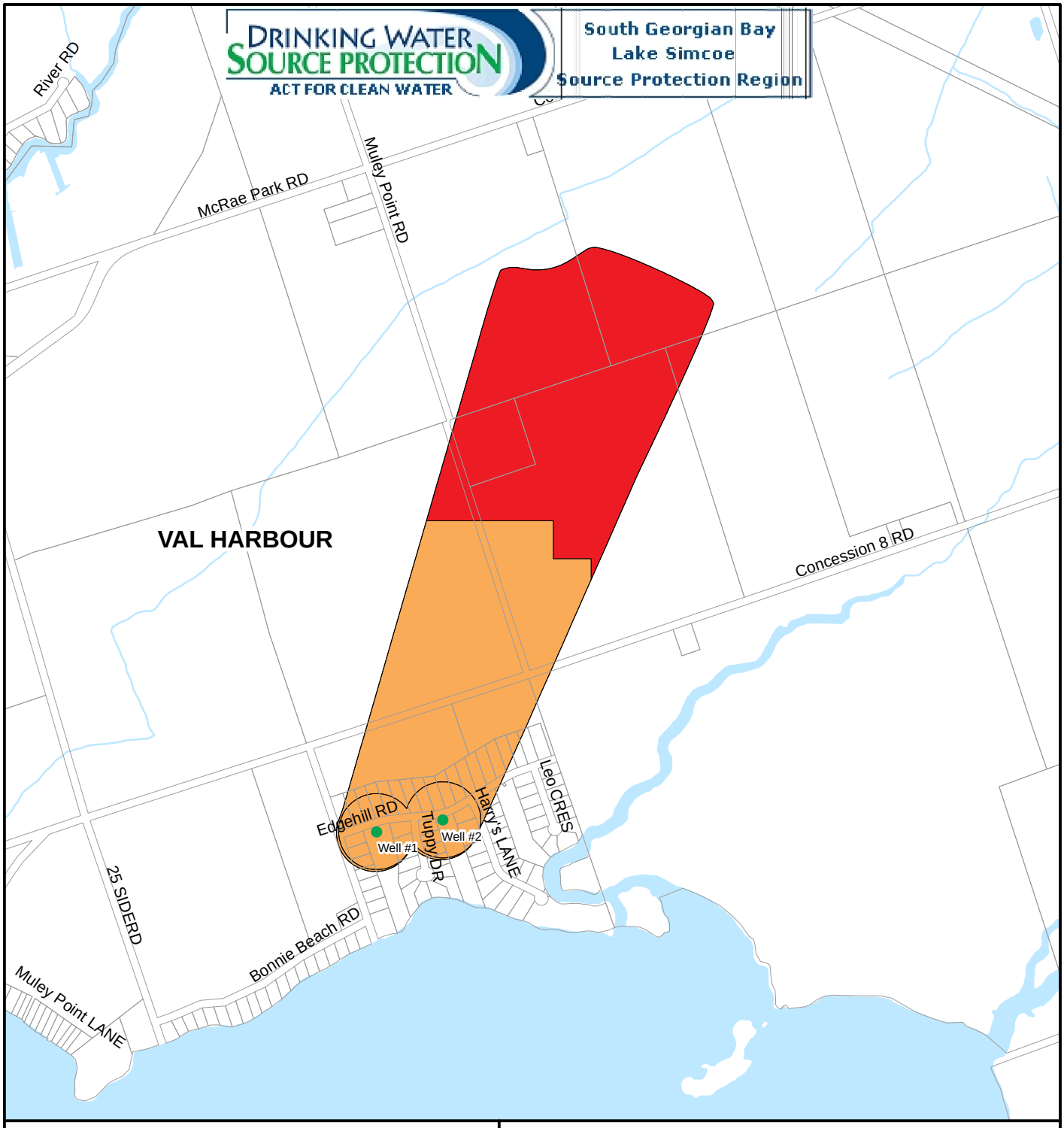
DATE: JUNE 2010	SCALE: 1:15000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.6-1

There are no WHPA B or WHPA C zones as steady state is reached.

GENIVAR

Ontario

FIGURE 12□-1



Legend

- MUNICIPAL WELL LOCATION

AQUIFER VULNERABILTY INDEX

- HIGH VULNERABILITY
- MEDIUM VULNERABILITY
- LOW VULNERABILITY

N W E S

150 75 0 150 Metres

GROUNDWATER VULNERABILITY - VAL HARBOUR

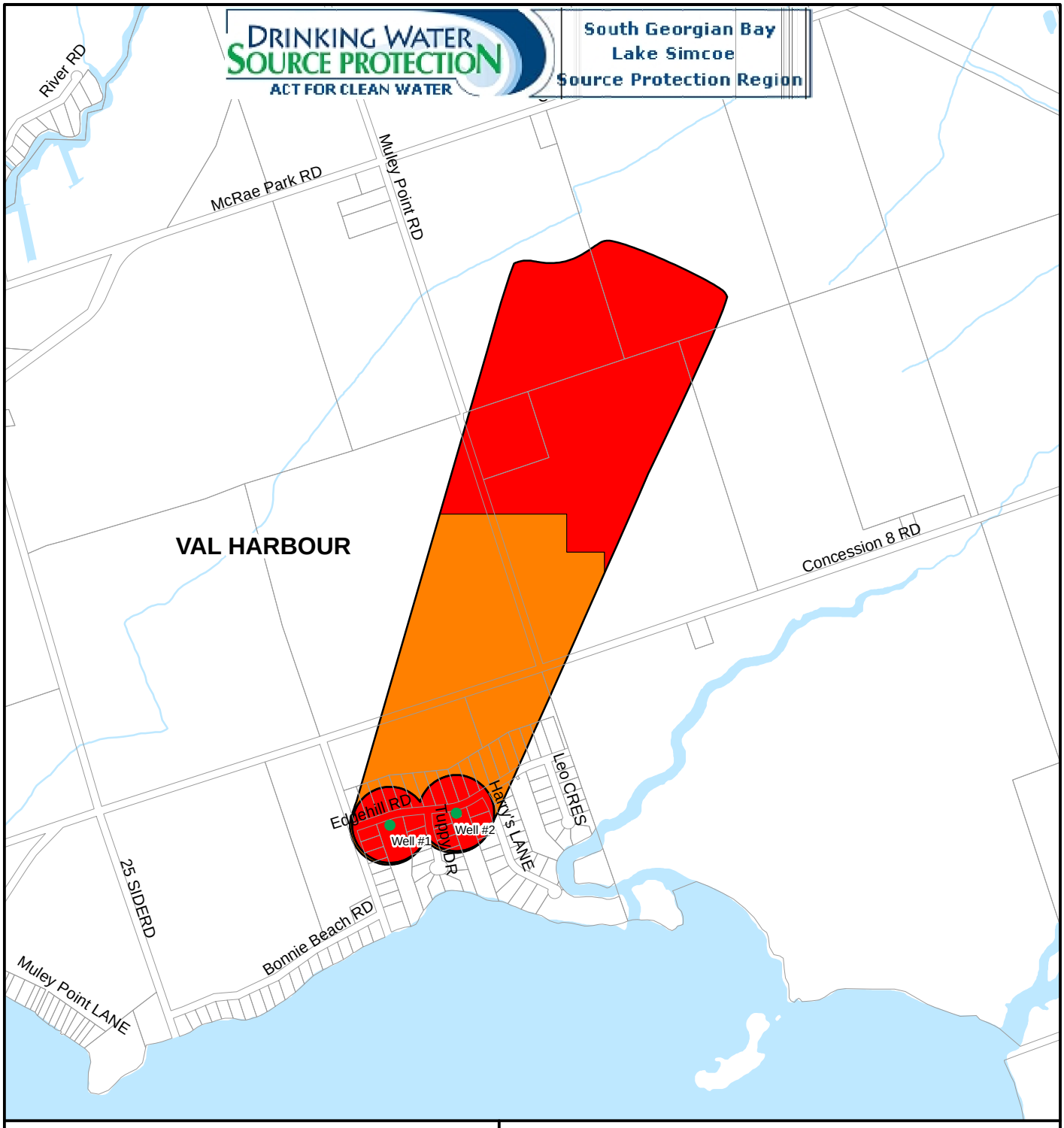
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JUNE 2010	SCALE: 1:15000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.6-2

GENIVAR

Ontario

FIGURE 12□-2



Legend

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6
- 4
- 2

N
W E
S

150 75 0 150 Metres

VULNERABILITY SCORE - VAL HARBOUR

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

DATE: JUNE 2010	SCALE: 1:15000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.6-3

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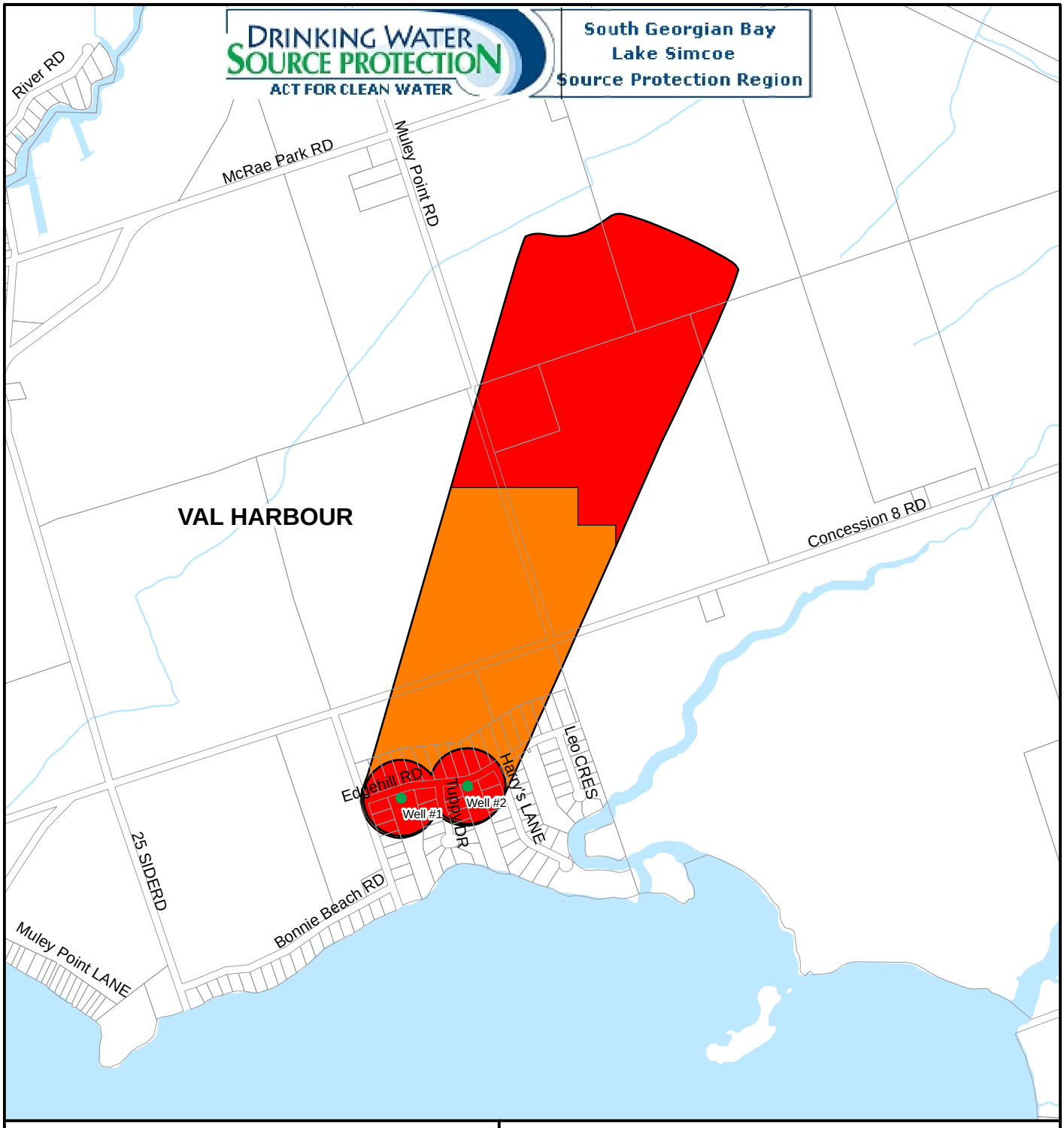
GENIVAR

Ontario

FIGURE 12□-3



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6

N W E S

150 75 0 150 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

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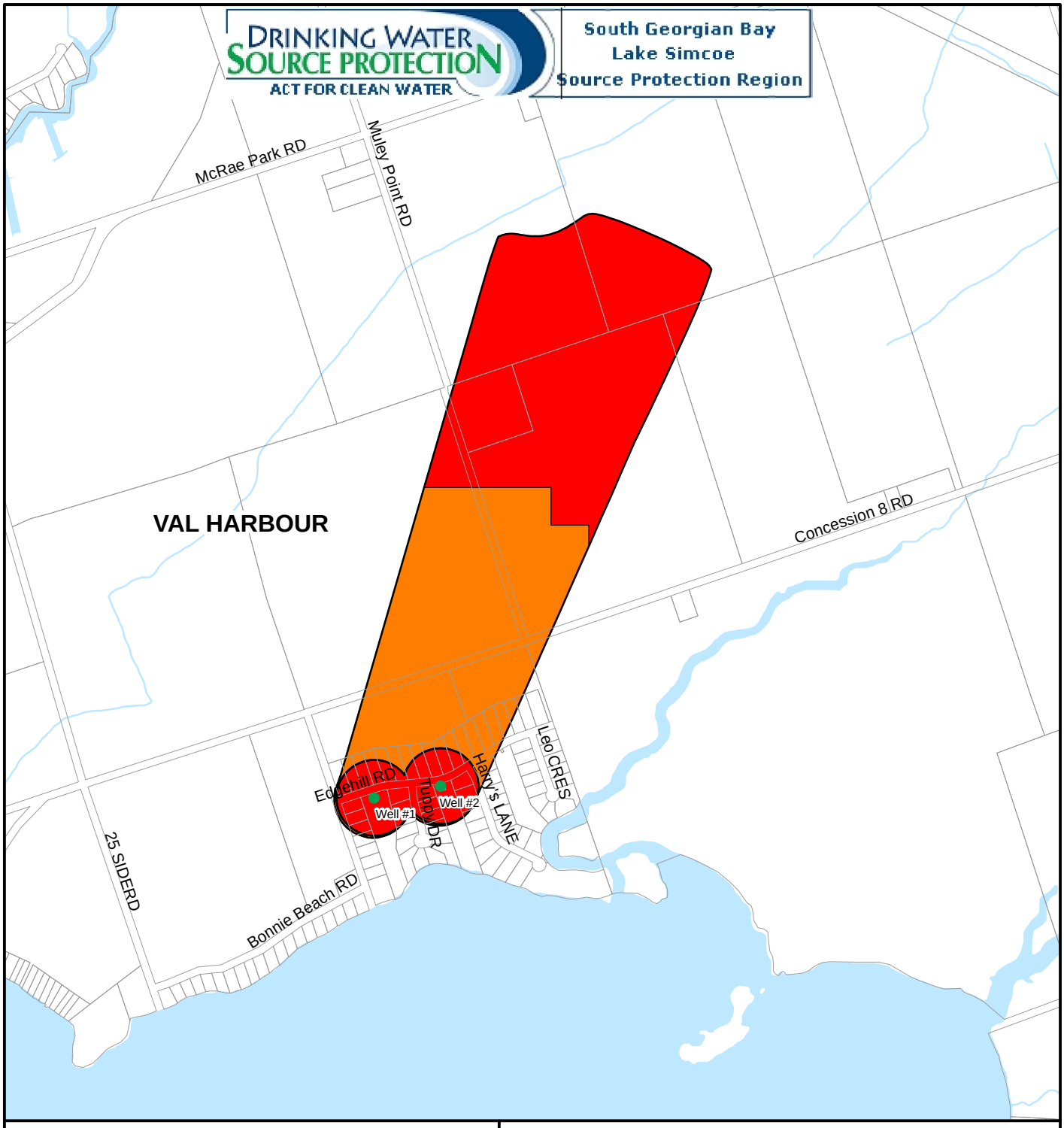
AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - VAL HARBOUR

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

DATE: JUNE 2010	SCALE: 1:15000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.6-4

GENIVAR Ontario

FIGURE **12b-4**



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6

N W E S

150 75 0 150 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

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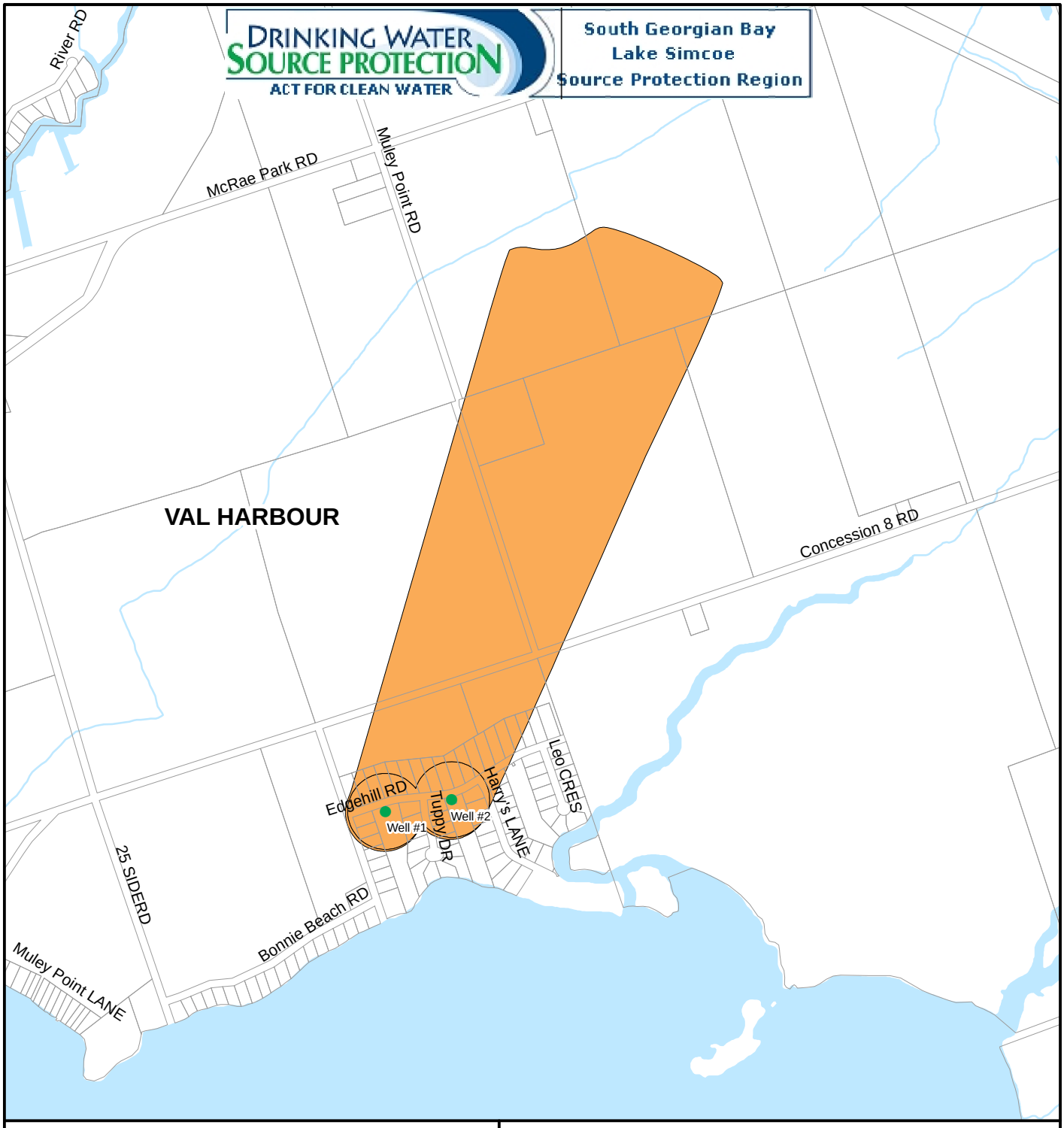
AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - VAL HARBOUR

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

DATE: JUNE 2010	SCALE: 1:15000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.6-5

GENIVAR Ontario

FIGURE **12b-5**



Legend

- MUNICIPAL WELL LOCATION
- WHPA-B: 2-YEAR TIME-OF-TRAVEL

N W E S

150 75 0 150 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.

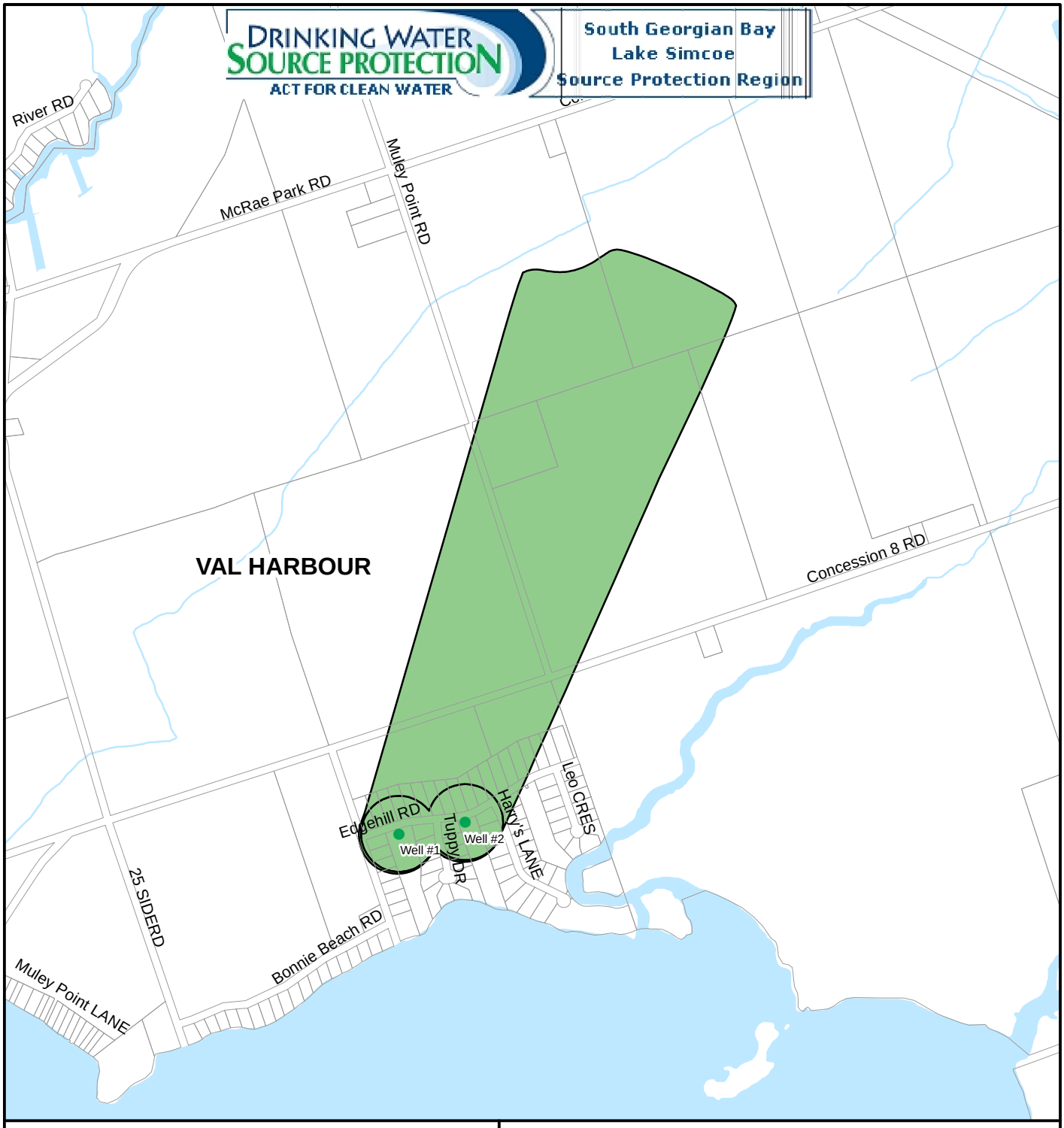
AREAS WHERE DNAPLS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - VAL HARBOUR

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

DATE: JUNE 2010	SCALE: 1:15000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.6-6

GENIVAR Ontario

FIGURE **12b-6**



Legend

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

N W E S

150 75 0 150 Metres

MANAGED LANDS - VAL HARBOUR

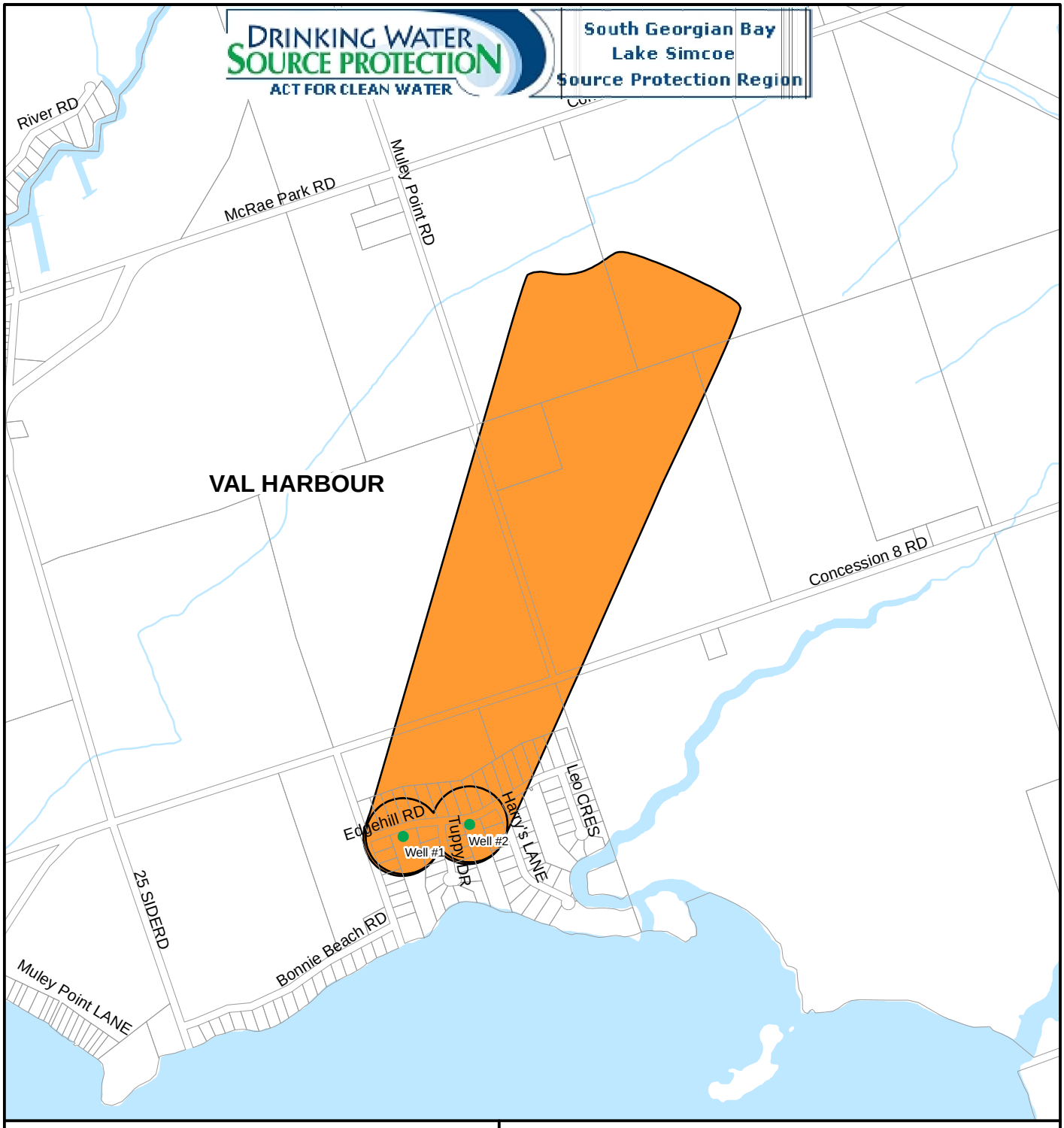
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

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

DATE: JUNE 2010	SCALE: 1:15000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.6-7

GENIVAR Ontario

FIGURE 12□-□



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

150 75 0 150 Metres

LIVESTOCK DENSITY

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

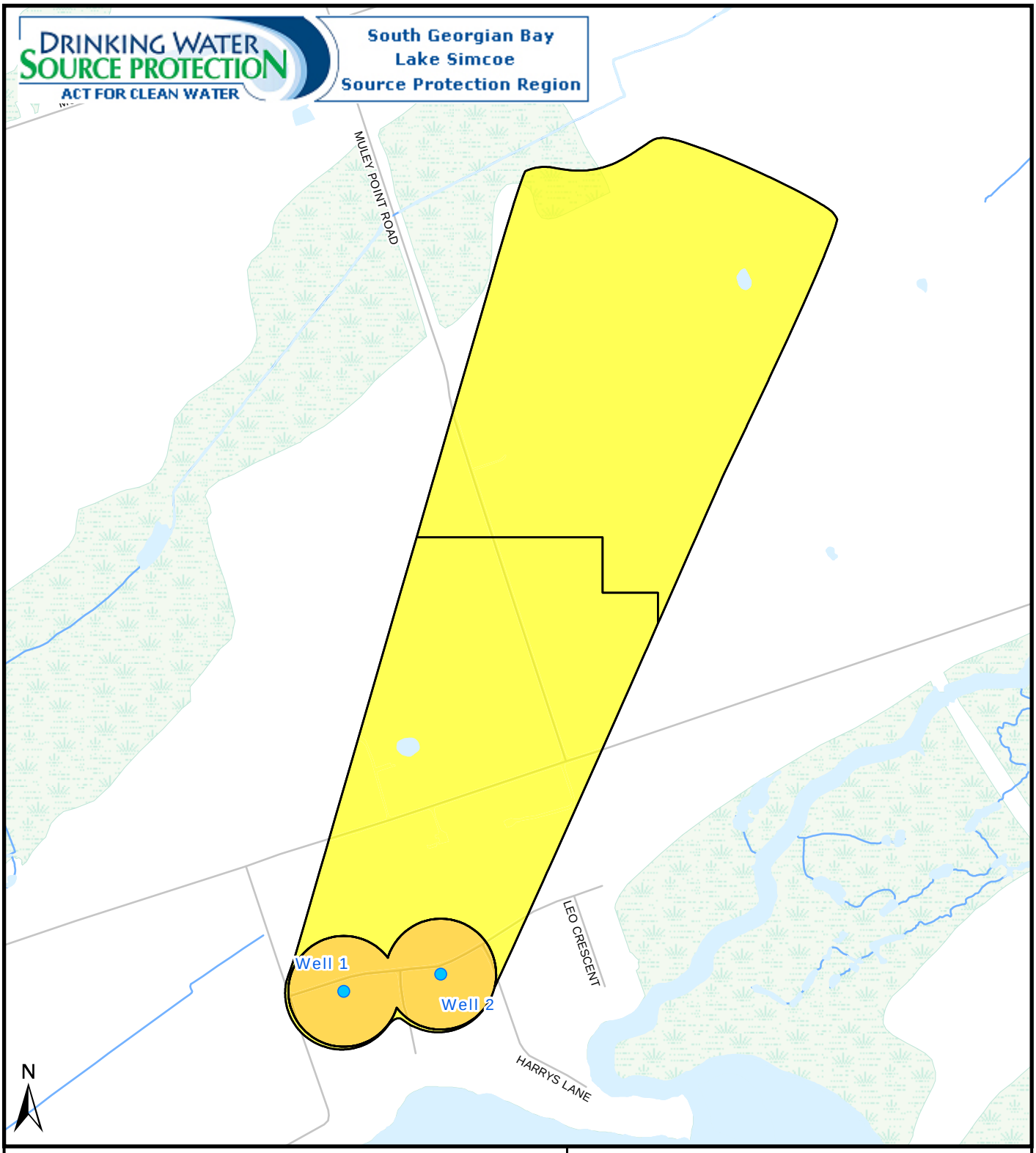
The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JUNE 2010 | SCALE: 1:15000

PROJECT: 0-071948.08 | FILE. NO.:0-07194808F14.6-8

GENIVAR | Ontario

FIGURE 12□-□



Well

Impervious Surfaces in WHPA

- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- >=30%

Impervious Surfaces - Val Harbour WHPA

Created by: LSRCA, 2025-08-05

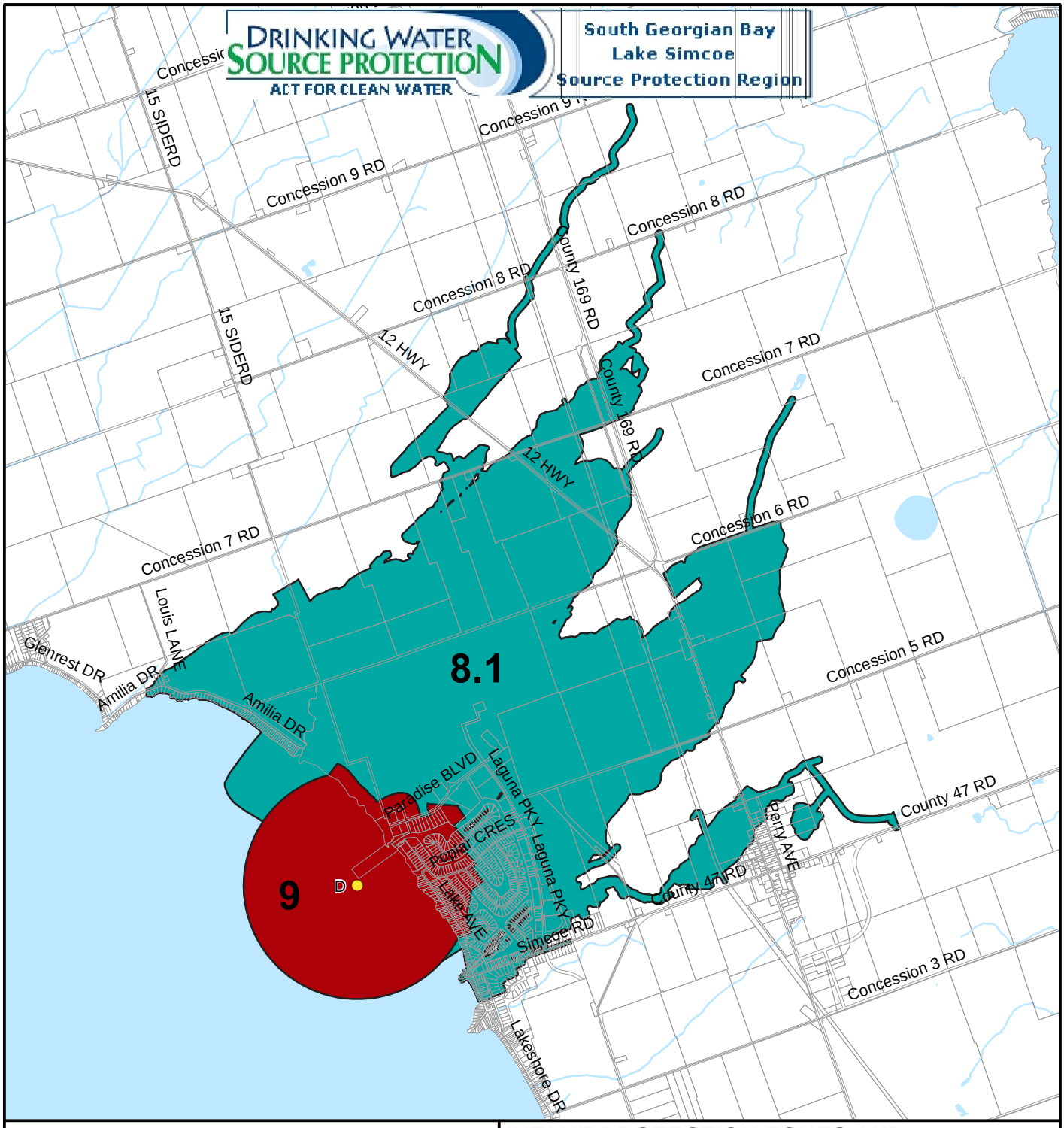
Scale 1:10,000

0 87.5 175 350 m

UTM Zone 17N, NAD83

Ontario

Figure 12b-9



Legend

- IPZ 1 AND VULNERABILITY SCORE (10)
- IPZ 2 AND VULNERABILITY SCORE (9)
- SURFACE WATER INTAKE (TYPE D)

N W E S

390 195 0 390 Metres

INTAKE PROTECTION ZONES AND VULNERABILITY SCORES - LAGOON CITY, RAMARA

DATE: JUNE 2010	SCALE: 1:50000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.1-1

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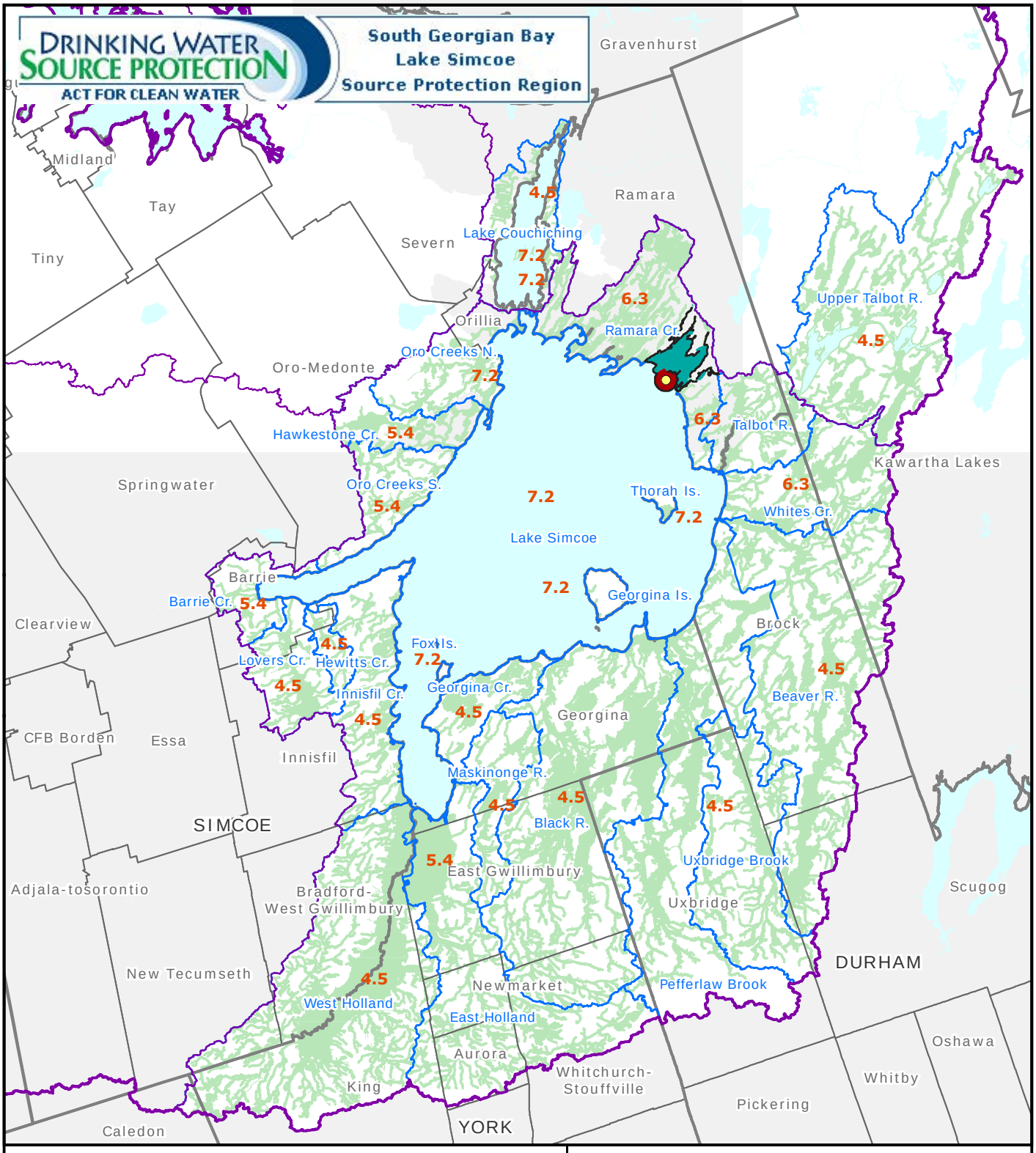
GENIVAR

Ontario

FIGURE 12□-1



- Surface Water Intake
- IPZ-1
- IPZ-2
- IPZ-3 and Vulnerability Score
- SWP Watershed Region
- SWP Watershed Area
- Subwatershed Boundary

Intake Protection Zone 3 and Vulnerability Scores
Lagoon City, Ramara

Created by: LSRCA
Date: 2010-10-20

GENIVAR

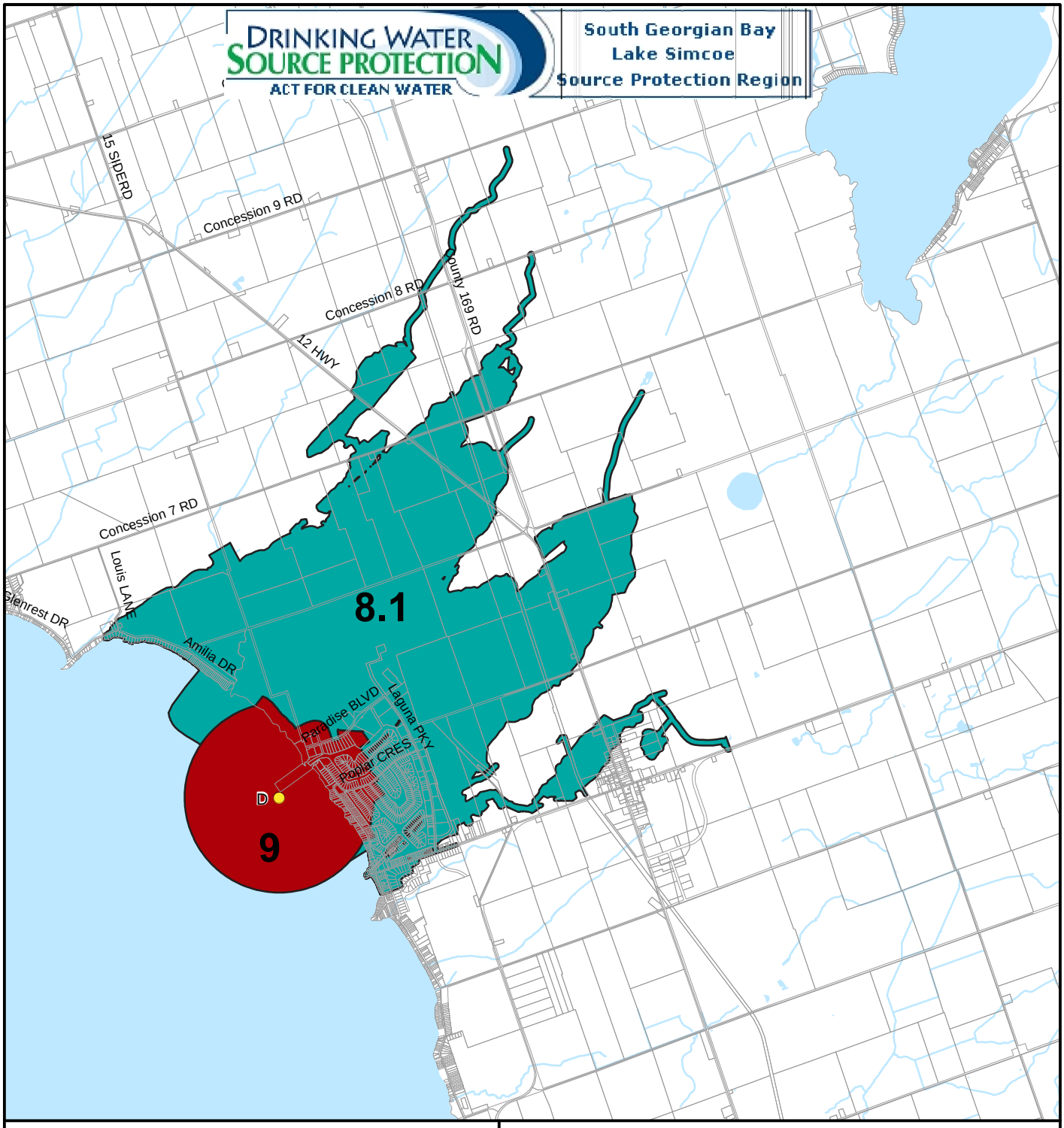
Scale: 1:500,000 0 2 4 6 8 10km

UTM Zone 17N, NAD83

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 12c-2



Legend

- 10 — IPZ 1 AND VULNERABILITY SCORE
- 9 — IPZ 2 AND VULNERABILITY SCORE
- SURFACE WATER INTAKE (TYPE D)

N W E S

500 250 0 500 Metres

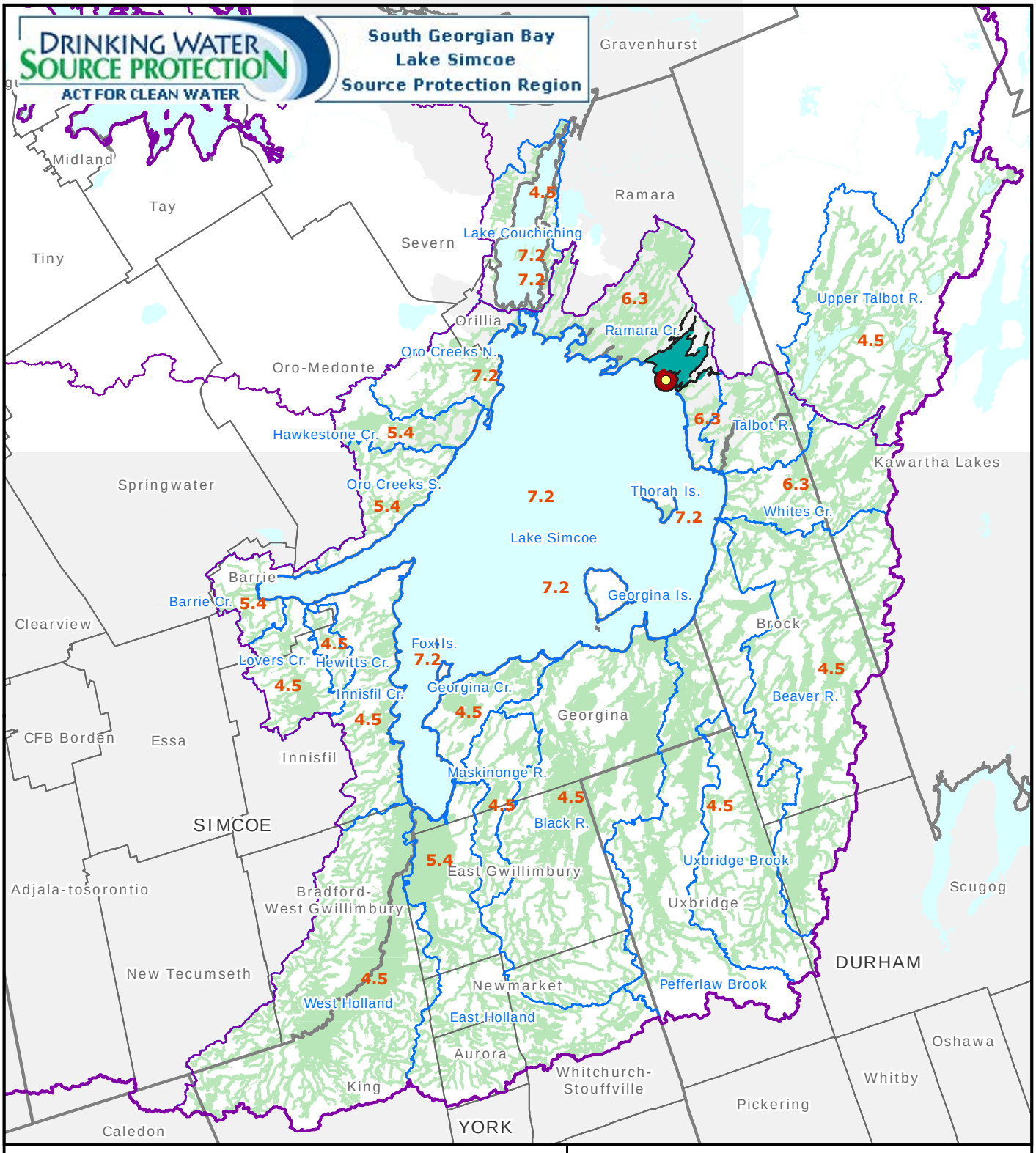
AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - LAGOON CITY

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

DATE: JUNE 2010	SCALE: 1:60000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.1-2

GENIVAR Ontario

FIGURE **12c-3**



Surface Water Intake
IPZ-1
IPZ-2
IPZ-3 and Vulnerability Score
SWP Watershed Region
SWP Watershed Area
Subwatershed Boundary

Areas where Pathogens are or would be a Significant, Moderate, or Low Threats
Lagoon City, Ramara

Created by: LSRCA
Date: 2010-10-20

GENIVAR

Scale: 1:500,000 0 2 4 6 8 10km

UTM Zone 17N, NAD83

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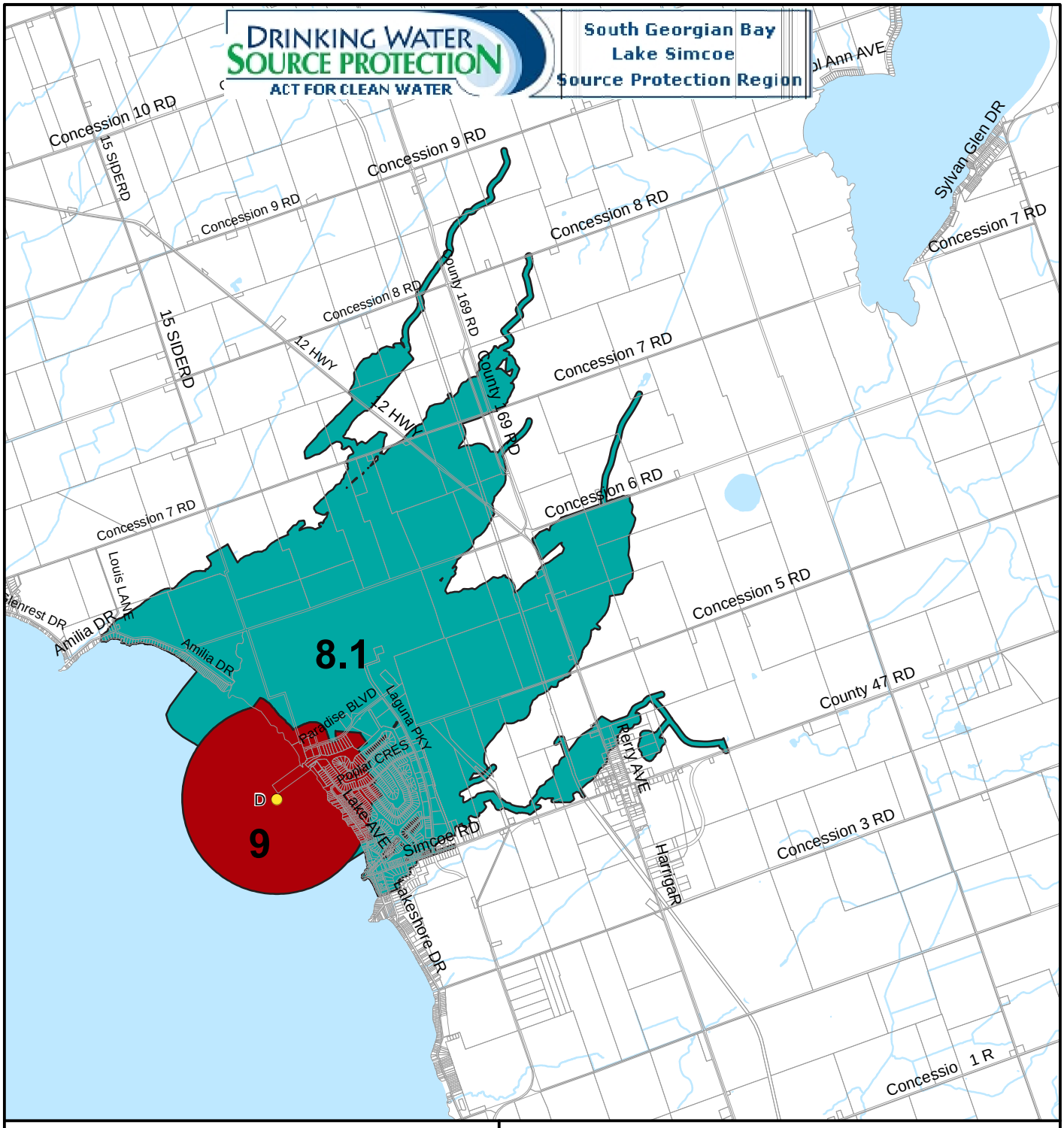
Ontario

Figure 12c-4



Legend

- 10 — IPZ 1 AND VULNERABILITY SCORE
- 9 — IPZ 2 AND VULNERABILITY SCORE
- SURFACE WATER INTAKE (TYPE D)

AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - LAGOON CITY

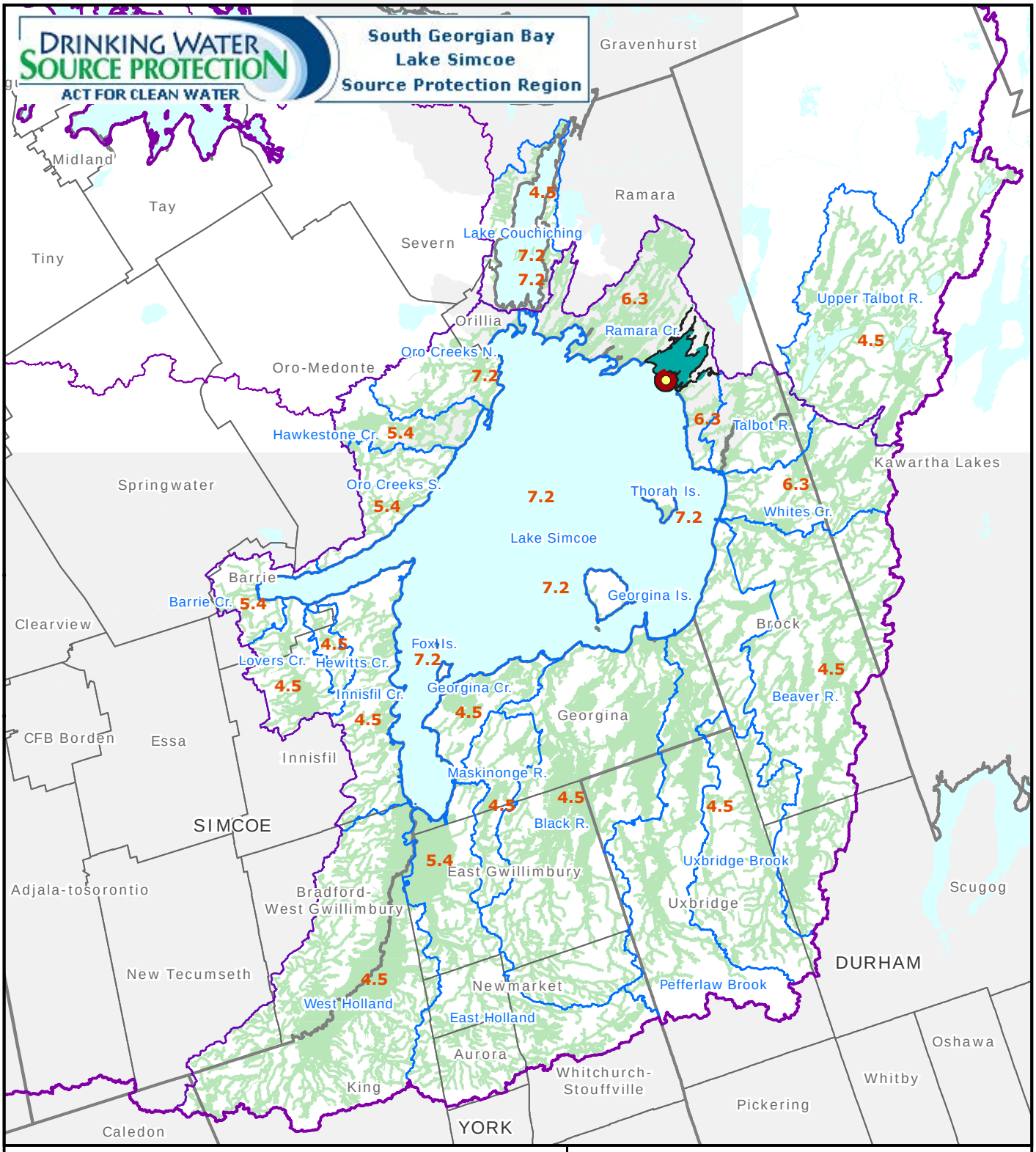
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

DATE: JUNE 2010	SCALE: 1:60000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.1-3

GENIVAR

Ontario

FIGURE 12c-5



- Surface Water Intake
- IPZ-1
- IPZ-2
- IPZ-3 and Vulnerability Score
- SWP Watershed Region
- SWP Watershed Area
- Subwatershed Boundary

Areas where Chemicals are or would be Significant, Moderate or Low Threats
Lagoon City, Ramara

Created by: LSRCA
Date: 2010-10-20

GENIVAR

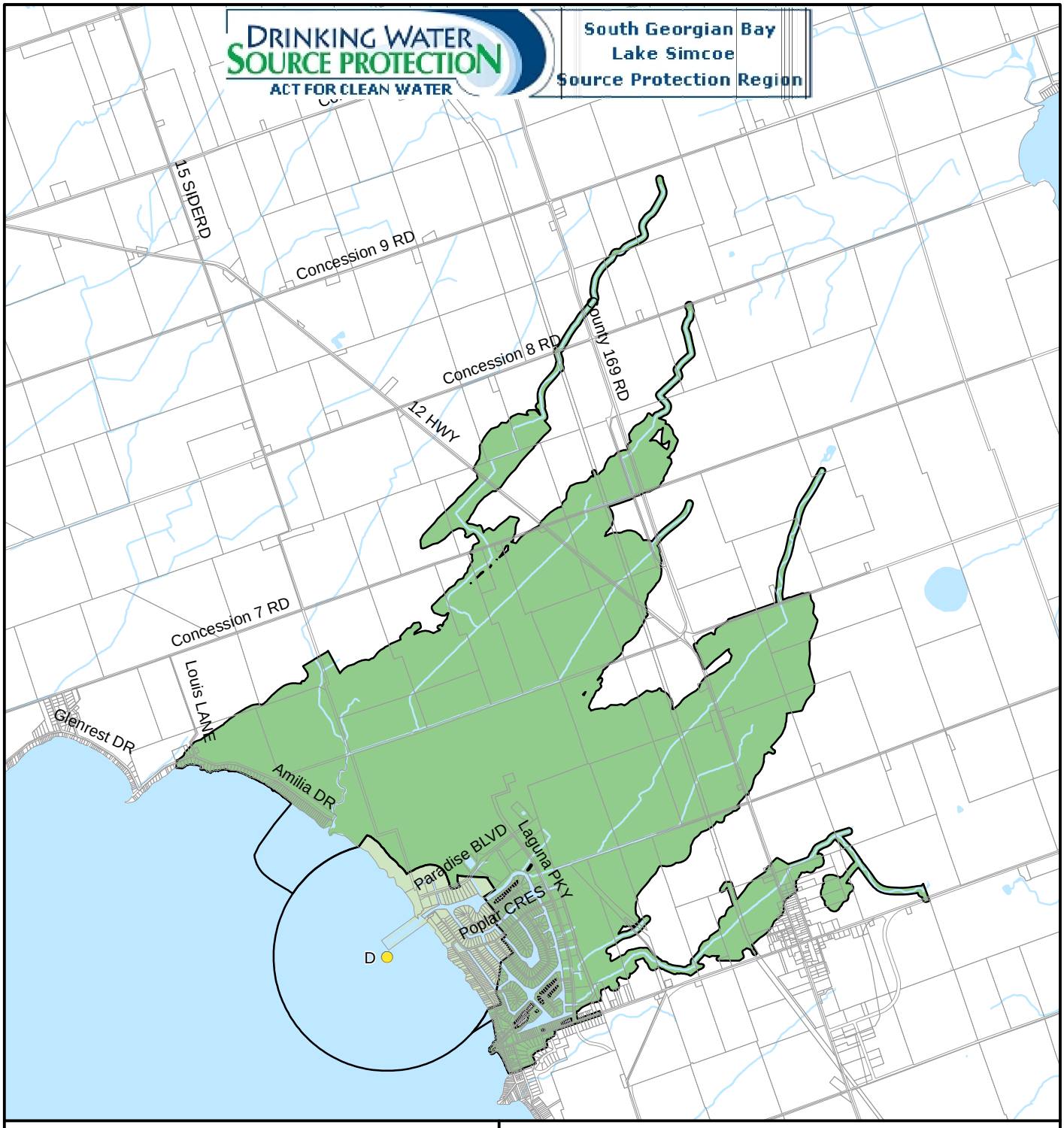
Scale: 1:500,000 0 2 4 6 8 10km

UTM Zone 17N, NAD83

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 12c-**6**



Legend

- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)
- SURFACE WATER INTAKE (TYPE D)

N
W E
S

500 250 0 500 Metres

MANAGED LANDS - LAGOON CITY

The Managed Land proportion proportion is illustrated for the parts of IPZ 1 and 2 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010

SCALE: 1:50000

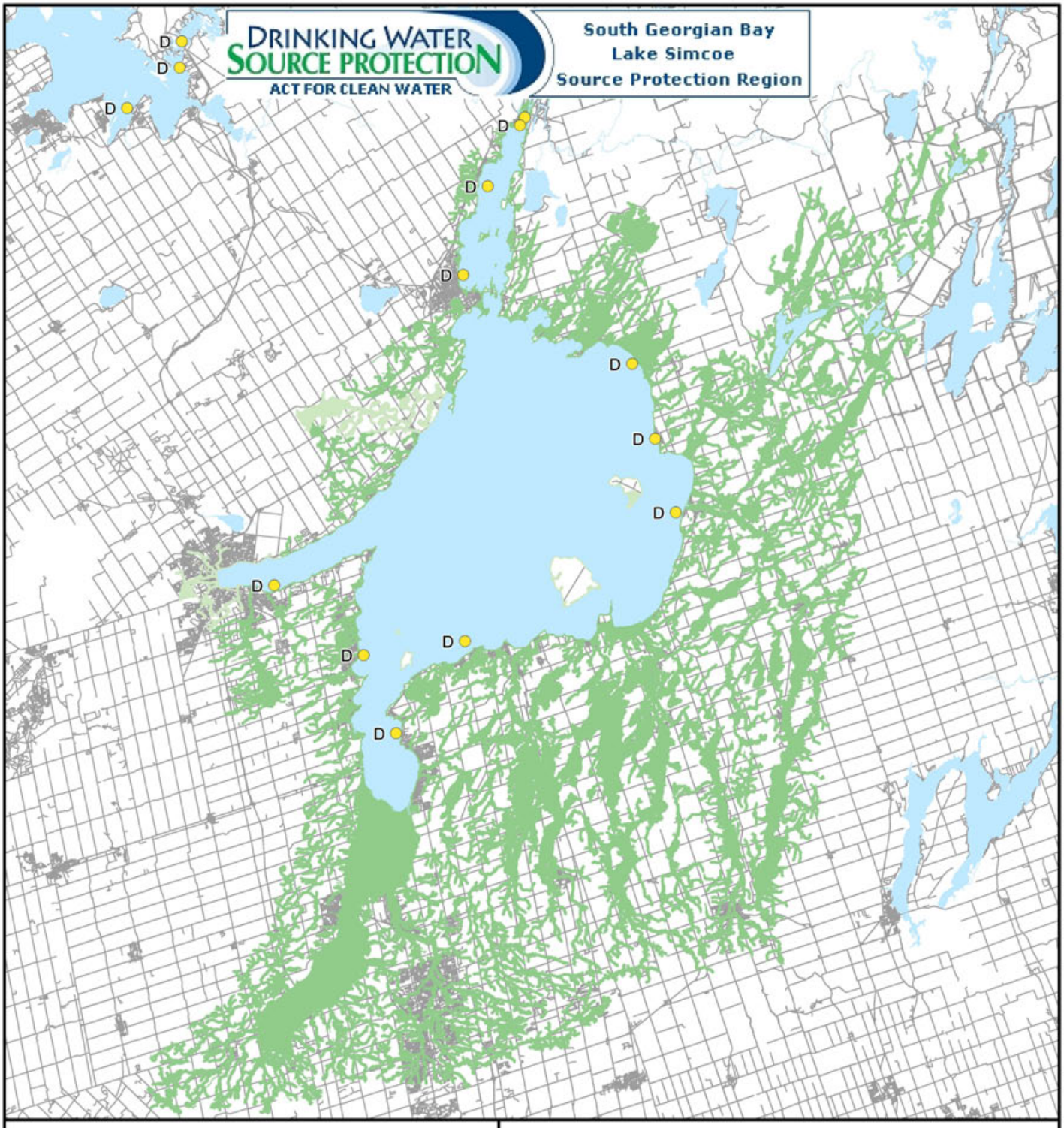
PROJECT: 0-071948.08

FILE. NO.:0-07194808F14.1-4

GENIVAR

Ontario

FIGURE 12□-□



Legend

- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)
- SURFACE WATER INTAKE (TYPE D)

N W E S

5,300 2,650 0 5,300 Metres

MANAGED LANDS - INTAKE PROTECTION ZONE 3

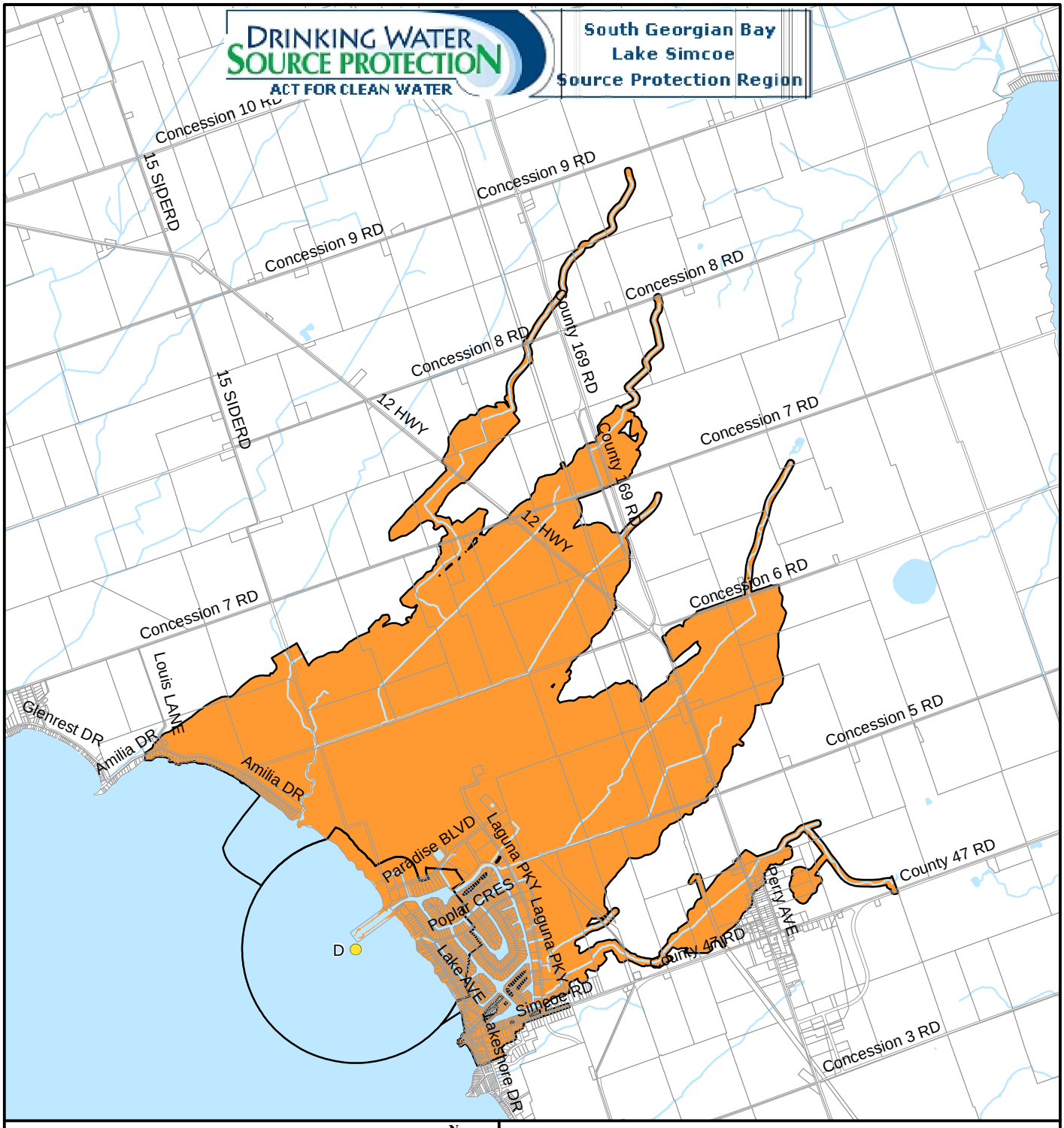
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Managed Land proportion is illustrated for the parts of IPZ 3 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010	SCALE: 1:505000
PROJECT: 0-071948.00	FILE. NO.:0-07194800F3.3-4

GENIVAR Ontario

FIGURE 12□-□



Legend

- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)
- SURFACE WATER INTAKE (TYPE D)

N W E S

500 250 0 500 Metres

LIVESTOCK DENSITY - LAGOON CITY

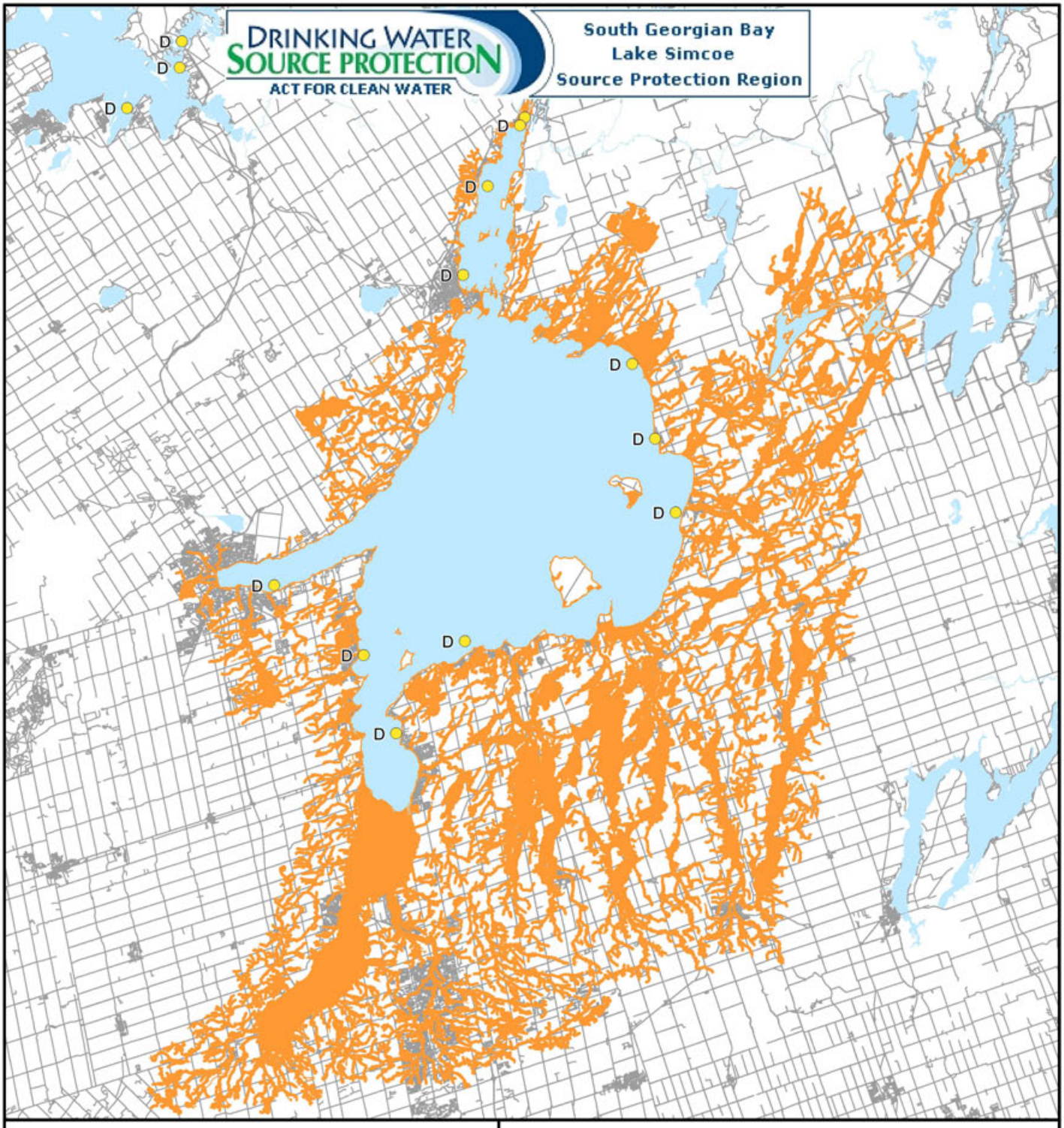
The Livestock Density proportion is illustrated for the parts of IPZ 1 and 2 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010 | SCALE: 1:50000

PROJECT: 0-071948.08 | FILE. NO.:0-07194808F14.1-5

GENIVAR Ontario

FIGURE 12□-□



Legend

- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)
- SURFACE WATER INTAKE (TYPE D)

N W E S

5,300 2,650 0 5,300 Metres

LIVESTOCK DENSITY - INTAKE PROTECTION ZONE 3

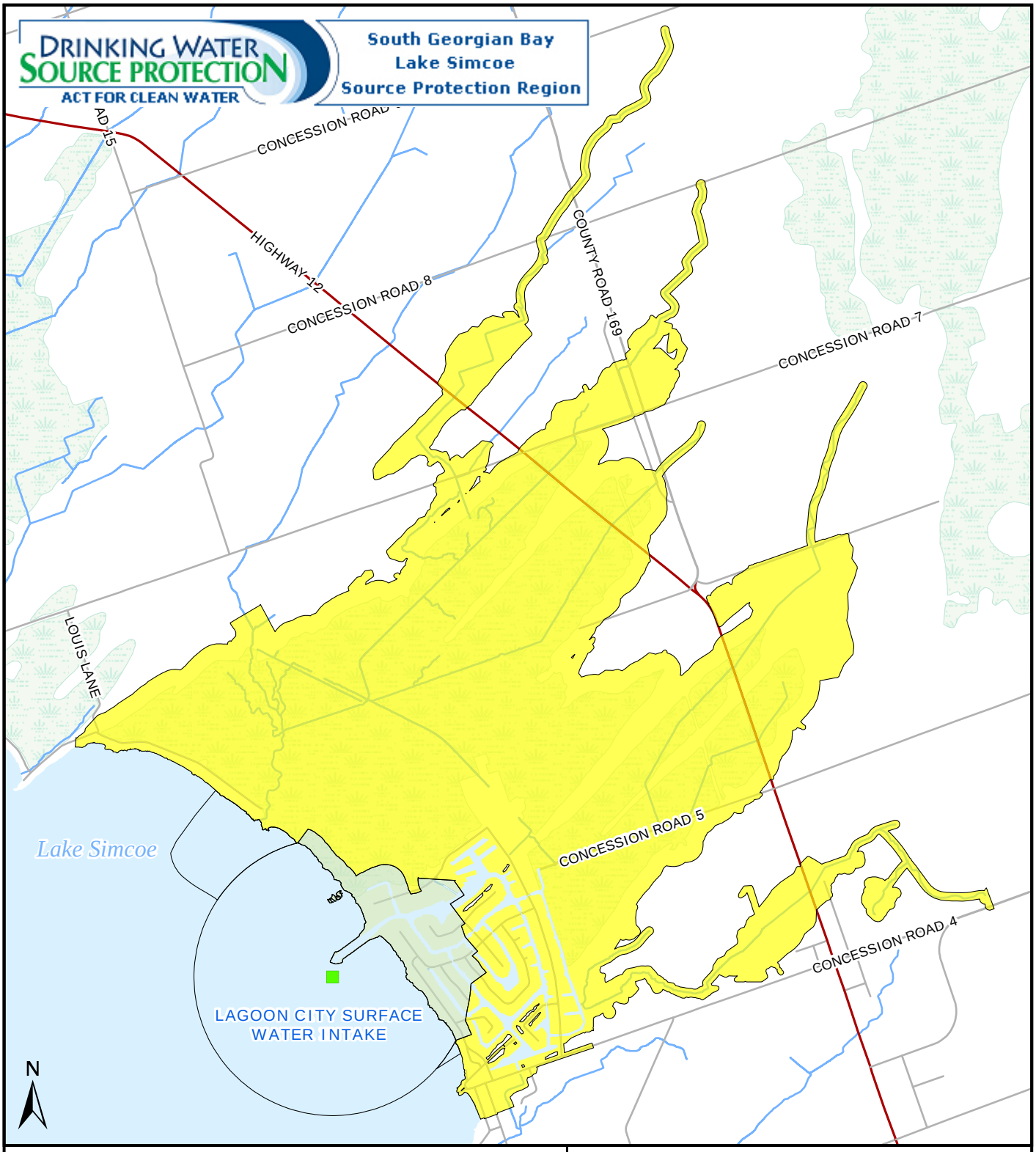
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Livestock Density proportion is illustrated for the parts of IPZ 3 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010	SCALE: 1:505000
PROJECT: 0-071948.00	FILE. NO.:0-07194800F3.3-5

GENIVAR Ontario

FIGURE 12□-1□



Surface Water Intake

Impervious Surfaces in IPZ 1 & 2

- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- >=30%

Impervious Surfaces - Lagoon City Intake Protection Zone 1 & 2

Created by: LSRCA, 2025-08-05

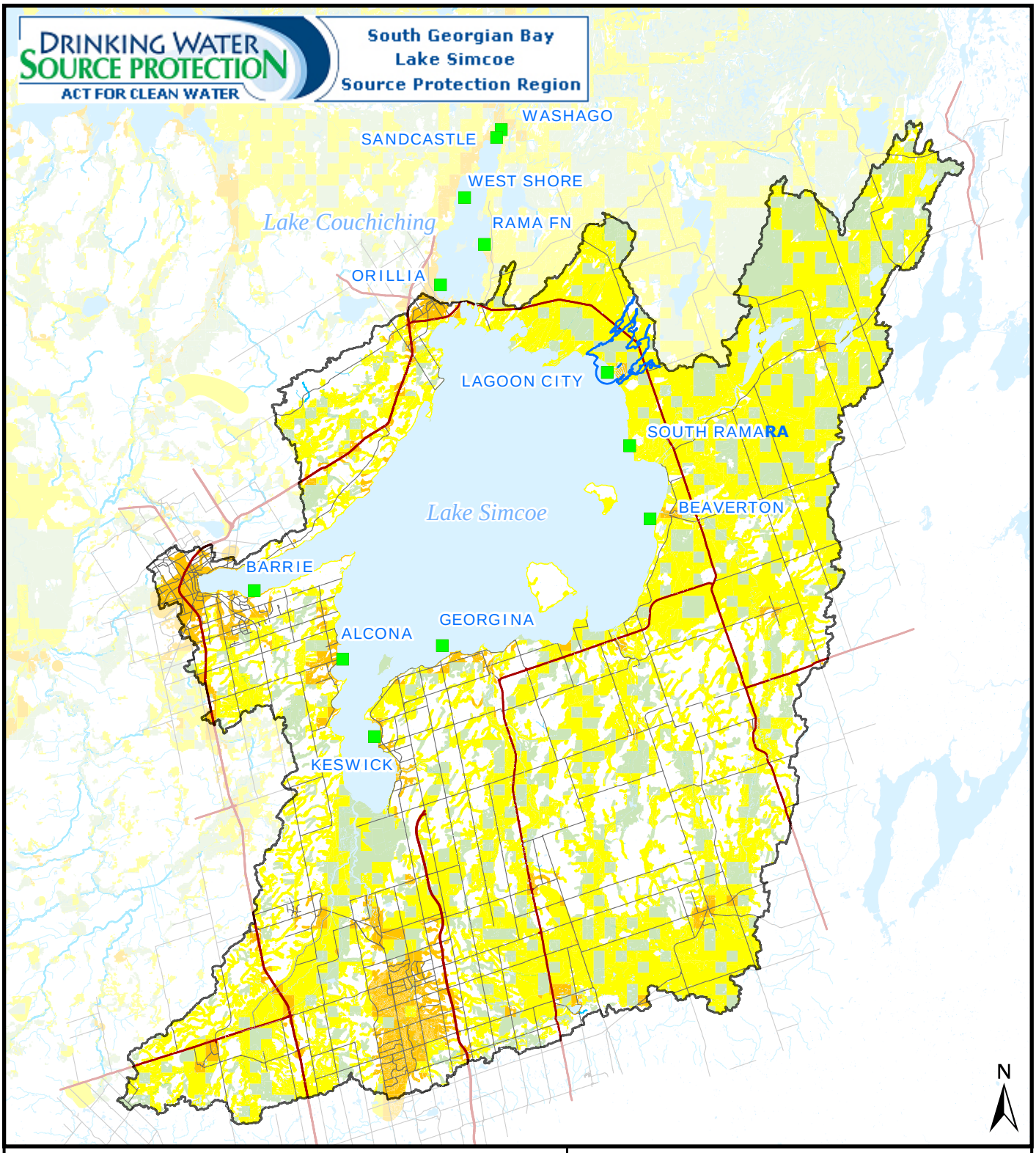
Scale 1:40,000

0 0.33 0.65 1.3 km

UTM Zone 17N, NAD83

Ontario

Figure 12c-11



Surface Water Intake

Impervious Surfaces in IPZ 3

- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- >=30%

Impervious Surfaces - Lagoon City Intake Protection Zone 3

Created by: LSRCA, 2025-08-05

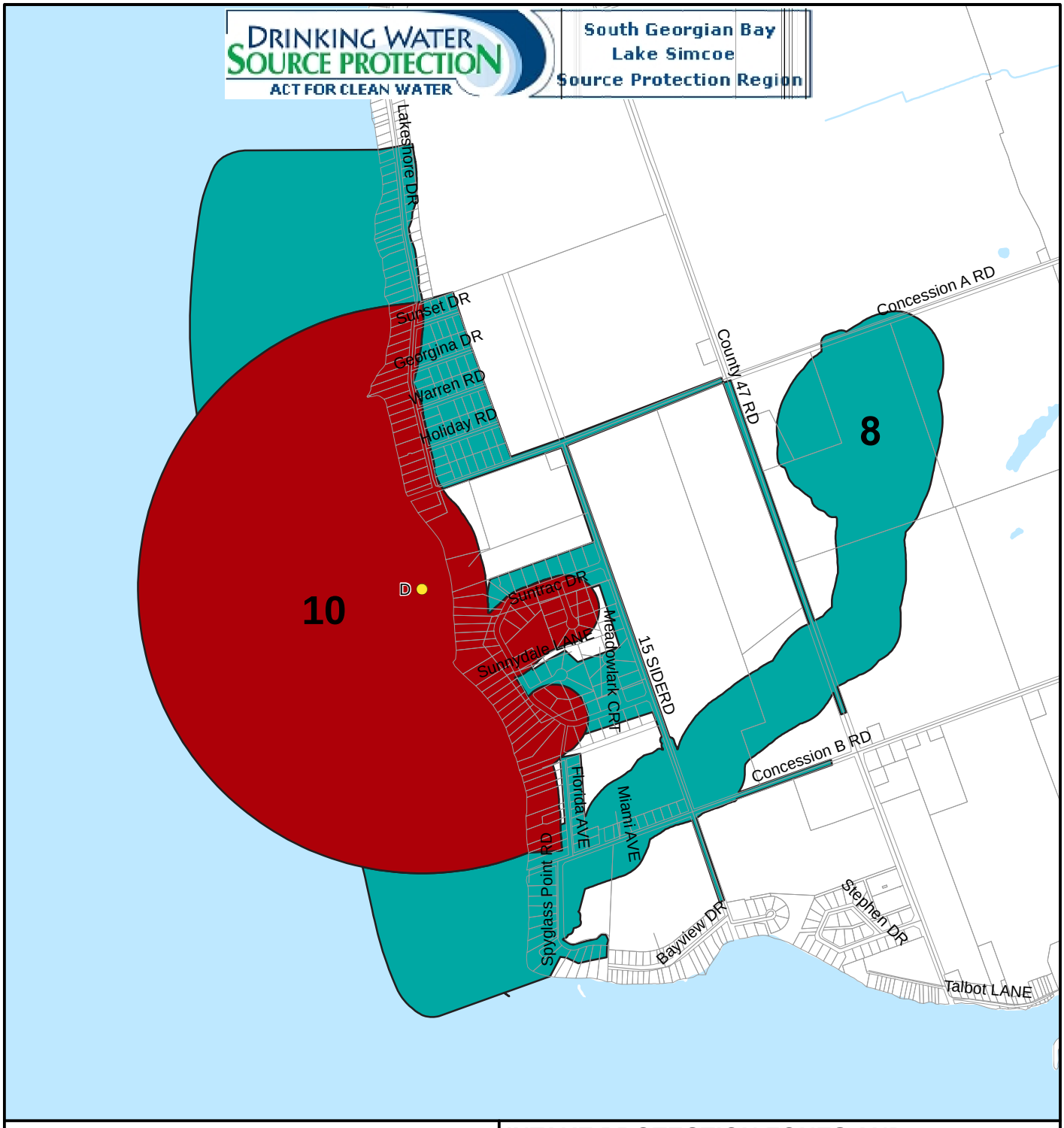
Scale 1:500,000

0 5 10 15 20km

UTM Zone 17N, NAD83

Ontario

Figure 12c-12



Legend

- 10 — IPZ 1 AND VULNERABILITY SCORE
- 8 — IPZ 2 AND VULNERABILITY SCORE
- SURFACE WATER INTAKE (TYPE D)

N W E S

210 105 0 210 Metres

INTAKE PROTECTION ZONES AND VULNERABILITY SCORES - SOUTH RAMARA, RAMARA

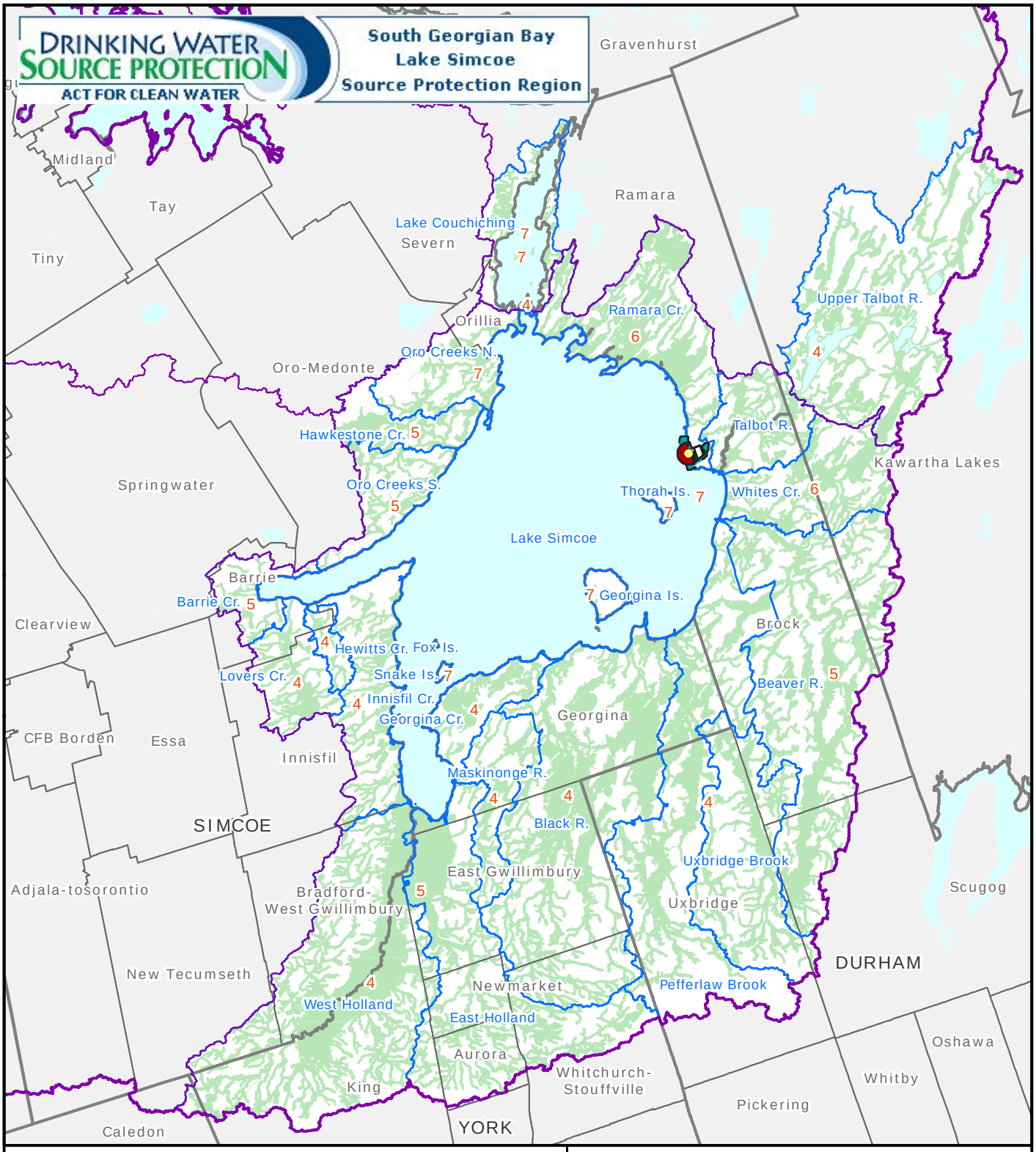
DATE: JUNE 2010	SCALE: 1:20000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.2-1

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

GENIVAR

Ontario

FIGURE 12d-1



- Surface Water Intake
- IPZ-1
- IPZ-2
- IPZ-3 and Vulnerability Score
- SWP Watershed Region
- SWP Watershed Area
- Subwatershed Boundary

Intake Protection Zone 3 and Vulnerability Scores
South Ramara, Ramara

Created by: LSRCA
Date: 2010-10-20

GENIVAR

Scale: 1:500,000 0 2 4 6 8 10km

UTM Zone 17N, NAD83

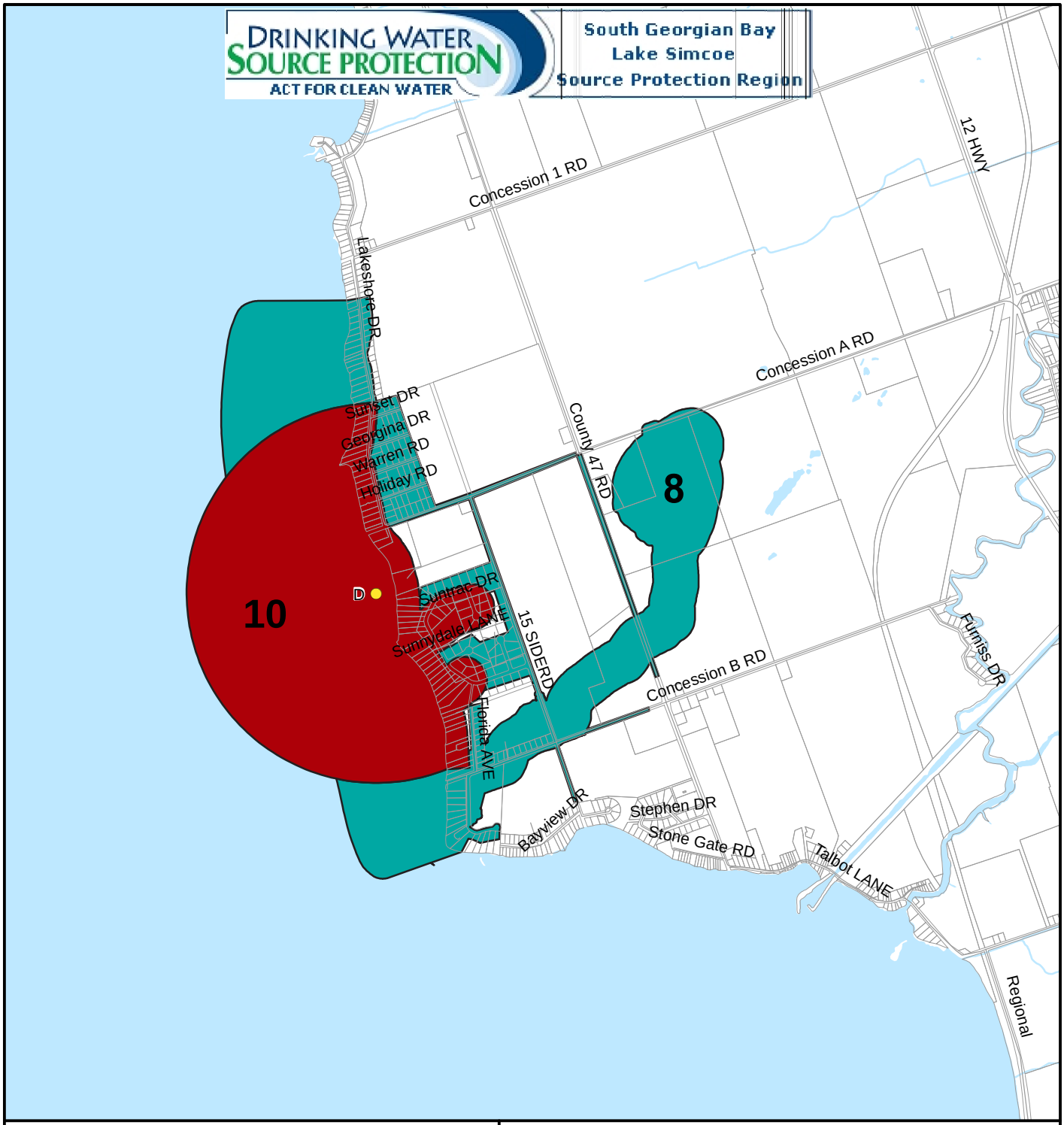
This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 12d-2

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Legend

- 10 — IPZ 1 AND VULNERABILITY SCORE
- 8 — IPZ 2 AND VULNERABILITY SCORE
- SURFACE WATER INTAKE (TYPE D)

N W E S

300 150 0 300 Metres

AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - SOUTH RAMARA

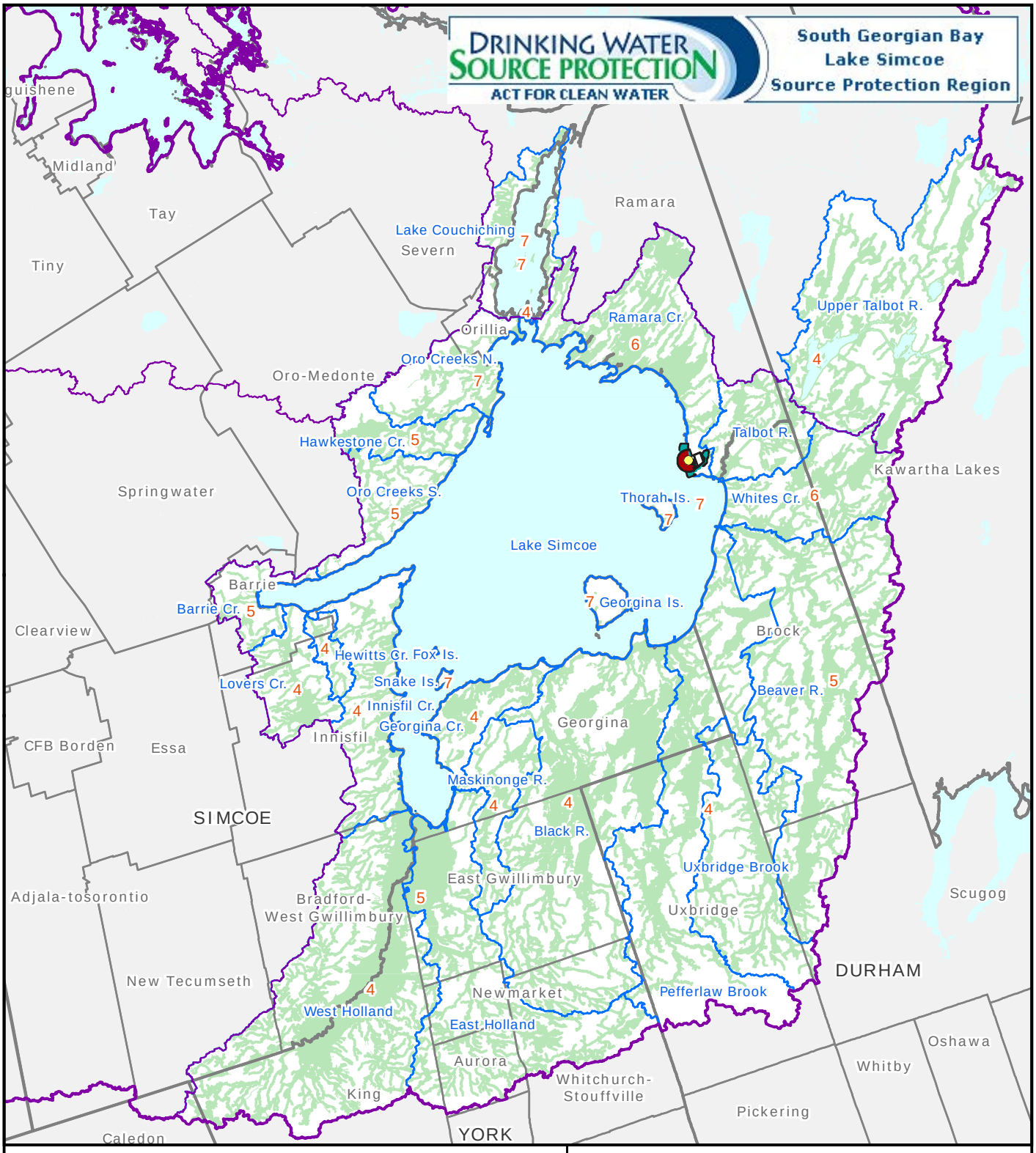
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

DATE: JUNE 2010	SCALE: 1:30000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.2-2

GENIVAR

Ontario

FIGURE 12d-3



Surface Water Intake
IPZ-1
IPZ-2
IPZ-3 and Vulnerability Score
SWP Watershed Region
SWP Watershed Area
Subwatershed Boundary

Areas Where Pathogens Are Or Would Be Significant, Moderate, Or Low Threats South Ramara, Ramara

Created by: LSRCA
Date: 2010-10-20

GENIVAR

Scale: 1:500,000 0 2 4 6 8 10km

UTM Zone 17N, NAD83

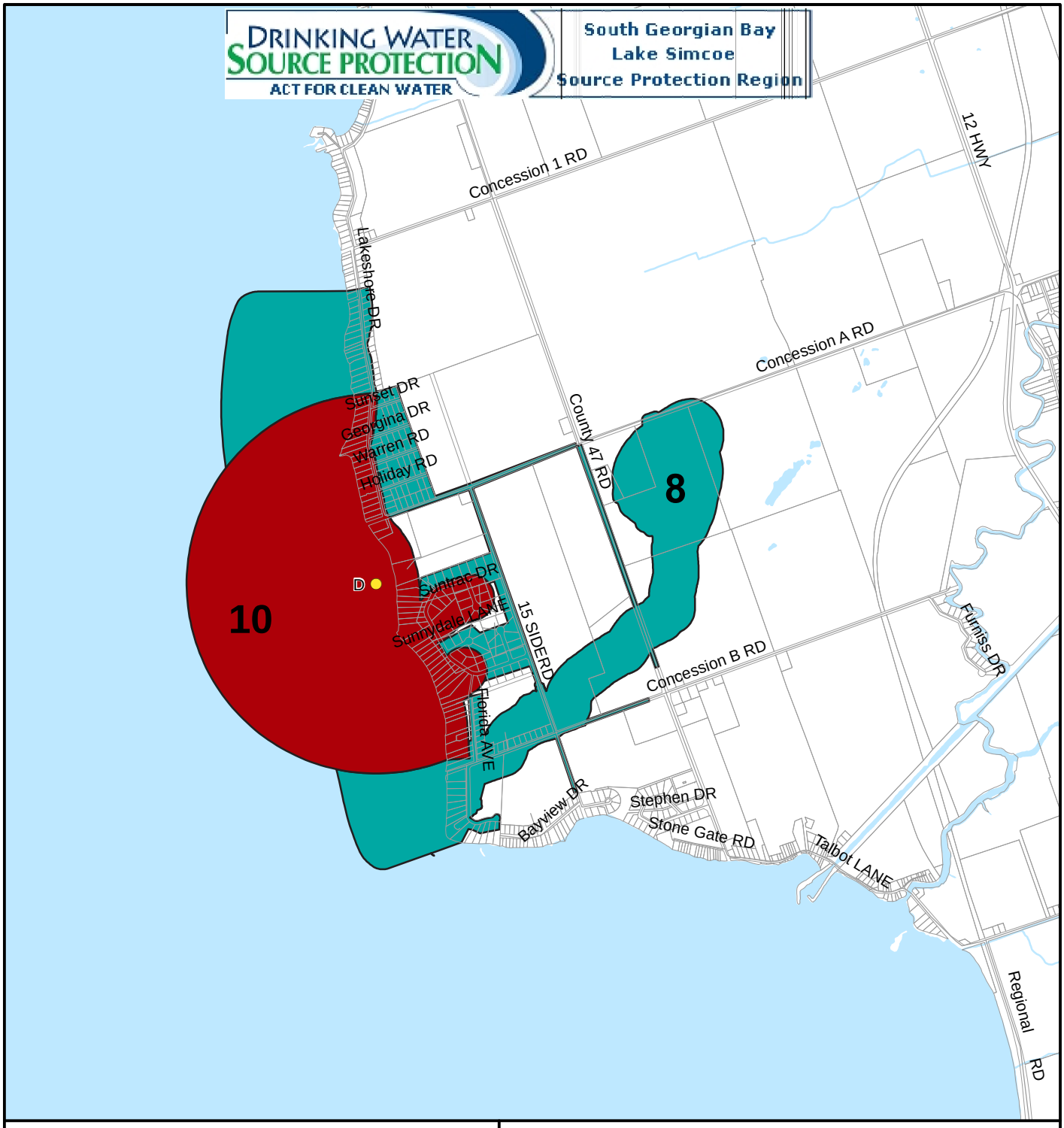
This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 12d-4

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Legend

- 10 — IPZ 1 AND VULNERABILITY SCORE
- 8 — IPZ 2 AND VULNERABILITY SCORE
- SURFACE WATER INTAKE (TYPE D)

N W E S

300 150 0 300 Metres

AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - SOUTH RAMARA

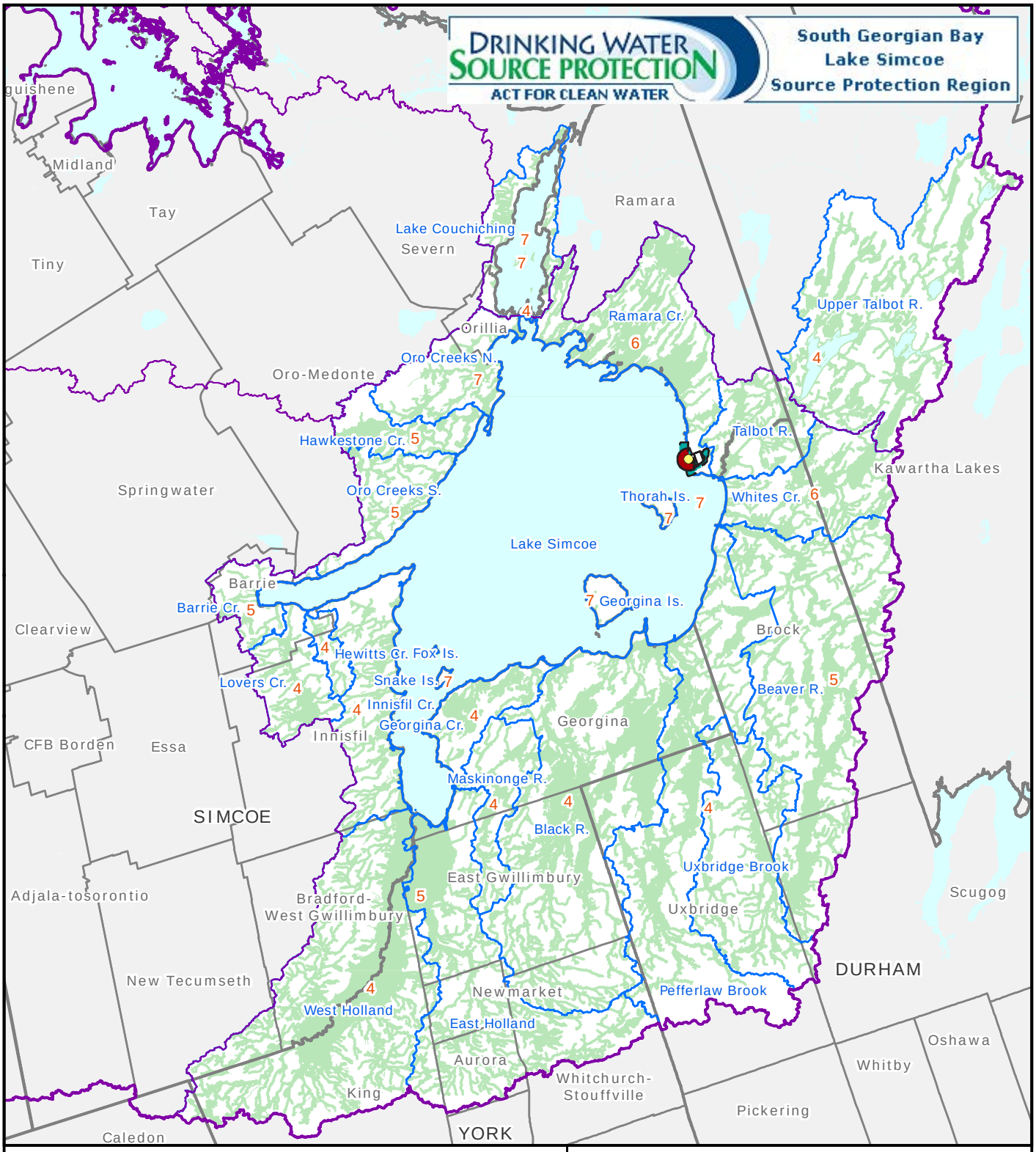
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

DATE: JUNE 2010	SCALE: 1:30000
PROJECT: 0-071948.08	FILE. NO.:0-07194808F14.2-3

GENIVAR

Ontario

FIGURE 12d-5



Surface Water Intake
IPZ-1
IPZ-2
IPZ-3 and Vulnerability Score
SWP Watershed Region
SWP Watershed Area
Subwatershed Boundary

Areas Where Chemicals Are Or Would Be Significant, Moderate, Or Low Threats
South Ramara, Ramara

Created by: LSRCA
Date: 2010-10-20

GENIVAR

Scale: 1:500,000 0 2 4 6 8 10km

UTM Zone 17N, NAD83

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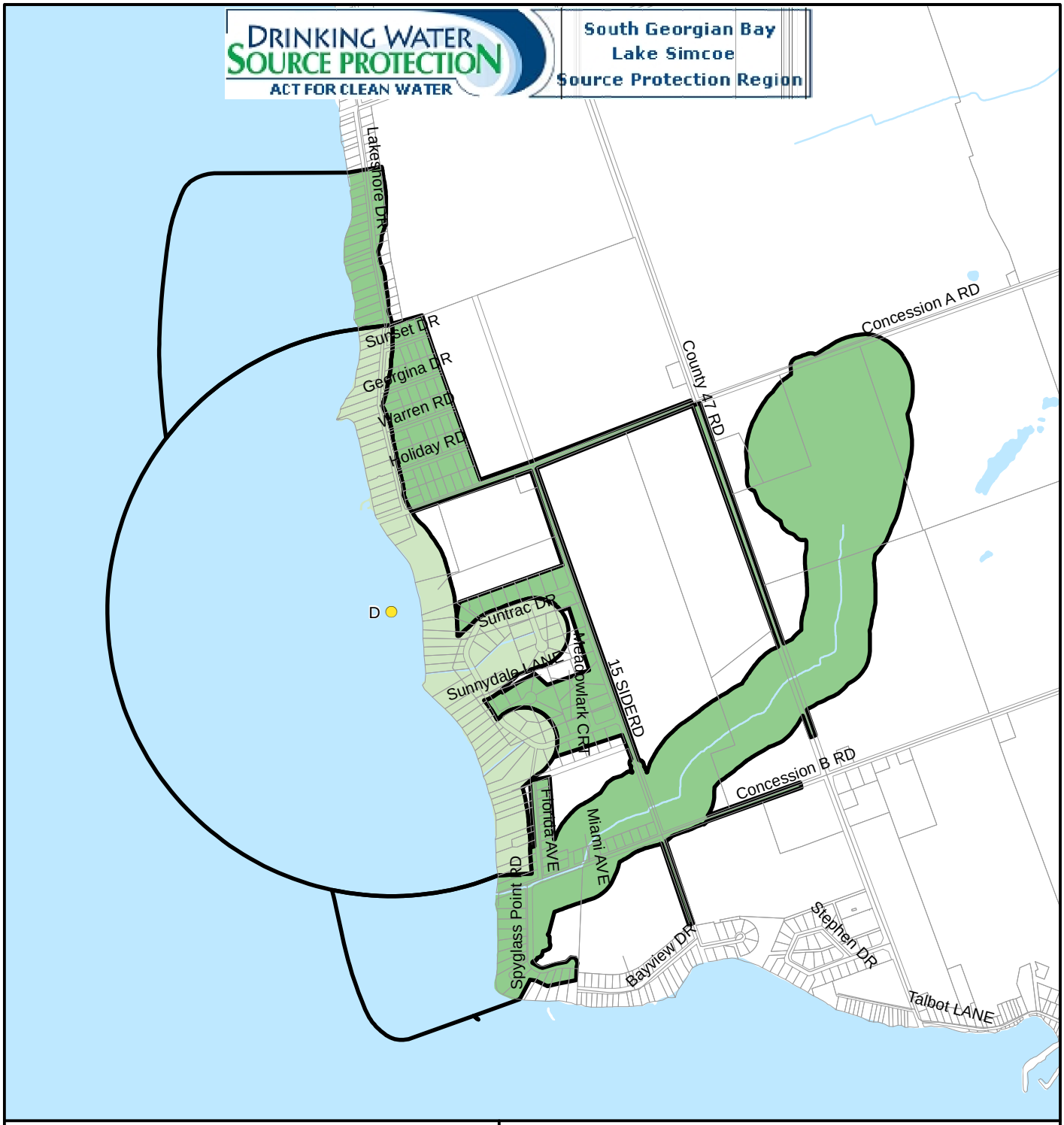
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 12d-6



Legend

- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)
- SURFACE WATER INTAKE (TYPE D)

N W E S

200 100 0 200 Metres

MANAGED LANDS - SOUTH RAMARA

The Managed Land proportion proportion is illustrated for the parts of IPZ 1 and 2 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010

SCALE: 1:20000

PROJECT: 0-071948.08

FILE. NO.:0-07194808F14.2-4

GENIVAR

Ontario

FIGURE 12d-7

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region

Legend

- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)
- SURFACE WATER INTAKE (TYPE D)

N W E S

200 100 0 200 Metres

LIVESTOCK DENSITY - SOUTH RAMARA

The Livestock Density proportion is illustrated for the parts of IPZ 1 and 2 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010

SCALE: 1:20000

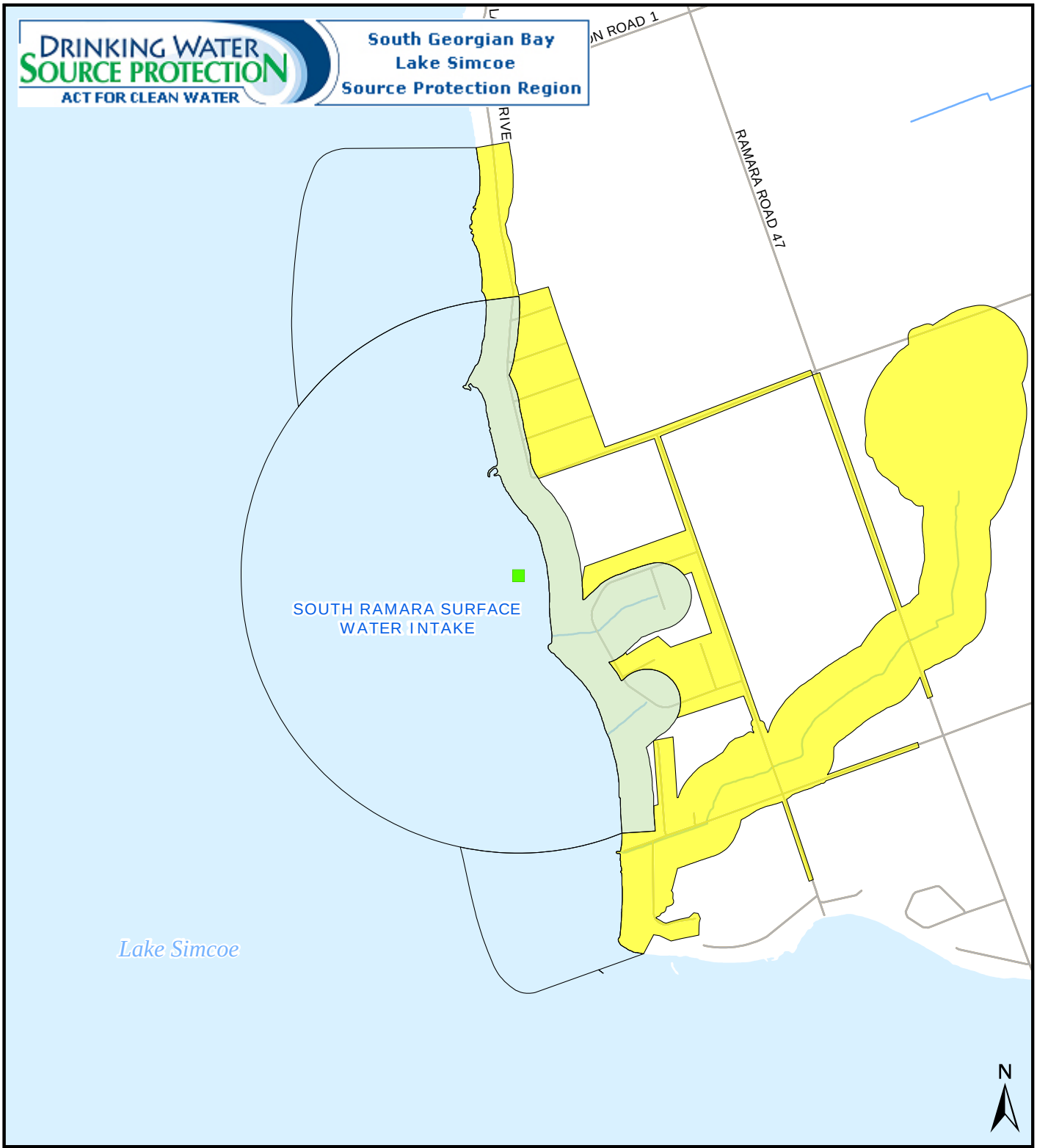
PROJECT: 0-071948.08

FILE. NO.:0-07194808F14.2-5

GENIVAR

Ontario

FIGURE 12d-8



Surface Water Intake

Impervious Surfaces in IPZ 1 & 2

- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- >30%

Impervious Surfaces - South Ramara Intake Protection Zone 1 & 2

Created by: LSRCA, 2025-08-05

Scale 1:20,000

0 0.15 0.3 0.6 km

UTM Zone 17N, NAD83

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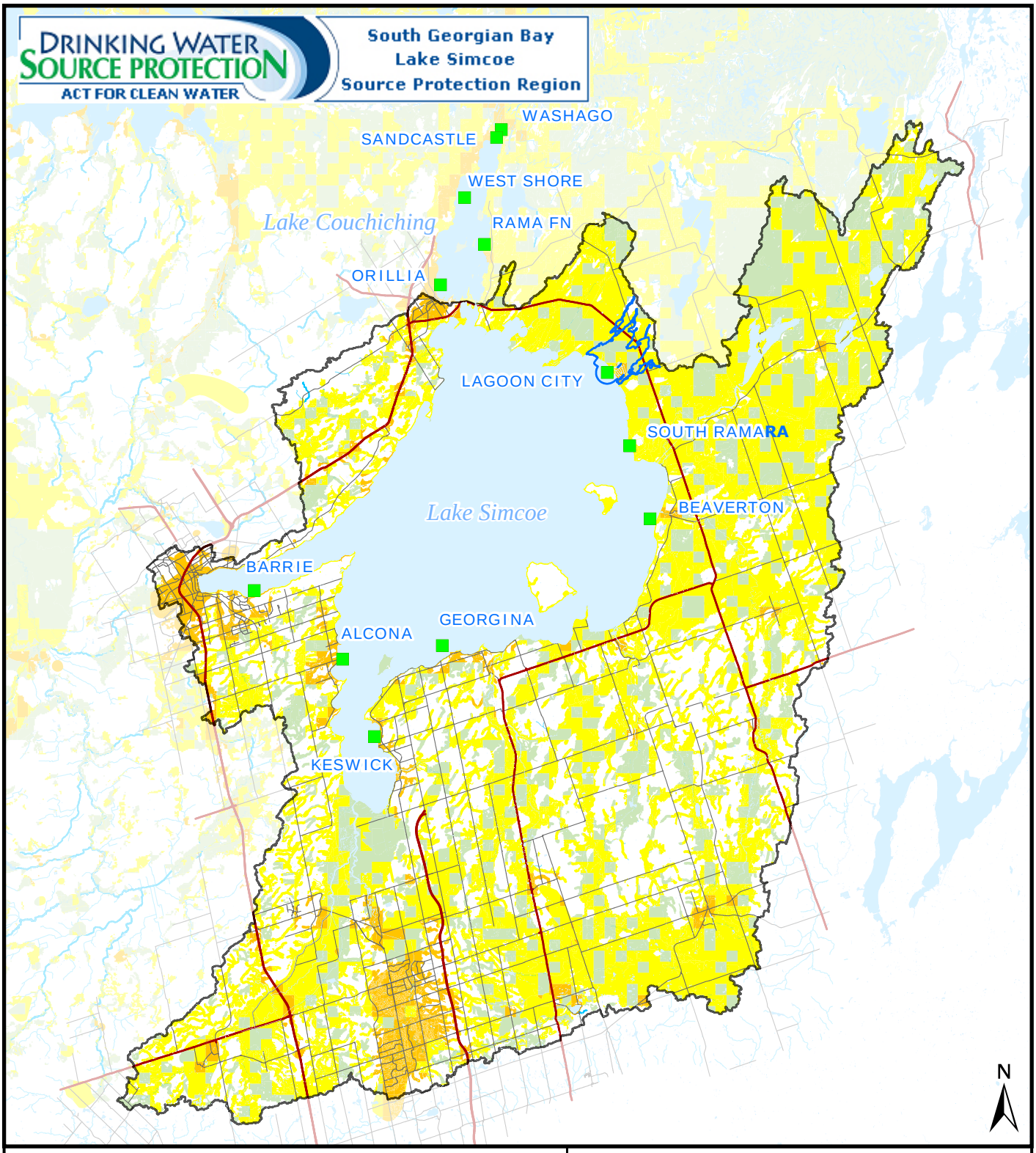
Ontario

Figure 12d-9



Surface Water Intake

Impervious Surfaces in IPZ 3

- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- >=30%

Impervious Surfaces - **South Ramara** Intake Protection Zone 3

Created by: LSRCA, 2025-08-05

Scale 1:500,000

0 5 10 15 20km

UTM Zone 17N, NAD83

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

Ontario

Figure 12**d**-**10**