Chapter 12: Township of Tay

Table of Contents

List of Tables

List of Figures

Rope Subdivision Water Treatment Plant

Victoria Harbour Water Treatment Plant

12 Township of Tay

12.1 Introduction

This chapter contains information on two drinking water systems for the Township of Tay. 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 Source Protection Committee~~. In this chapter, each of the 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 TA) 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 Tay operates surface water based supplies in two (2) communities and does not have any groundwater based water supplies. As shown in Table 12--1 and Figure 12-1, both 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 Supplies in the Township of Tay.

Local Municipality	Community Water Supply	Drinking Water Information System (DWIS) #	Source Water Body	Number of Intakes	Source Protection Region / Lead Source Protection Authority (SPA)
Township of Tay	Rope Subdivision Water Treatment Plant	220011323	Severn Sound/ Georgian Bay	1	SGBLS SPR & Severn Sound SPA
Township of Tay	Victoria Harbour Water Treatment Plant	220001076	Severn Sound/ Georgian Bay	1	SGBLS SPR & Severn Sound SPA

In addition, IPZs from the Rope Subdivision intake slightly extend across from the Township of Tay into the District Municipality of Muskoka (Table 12--2).

Table 12--2: IPZs that cross into and out of the Township of Tay in the SGBLS SPR.

Local Municipality that IPZ extends into	Municipality where wellhead is located	Name of Water Supply	Source Protection Region / Lead Source Protection Authority (SPA)	Location where entire Assessment can be obtained
District Municipality of Muskoka	Township of Tay	Rope Subdivision WTP	SGBLS SPR & Severn Sound SPA	This Chapter

12.3 Surface Water Vulnerability Methods and Uncertainties

12.3.1 Surface Water Vulnerability

The following section describes the methods used to assess vulnerability of the Rope Subdivision and Victoria Harbour Water Treatment Plants. IPZ-1 delineation for the Rope Subdivision and Victoria Harbour WTPs were delineated by the Severn Sound Environmental Association; the in-water IPZ-2 delineation and uncertainty was completed by SNC-Lavalin, 2009, while the on-land IPZ-2 delineation, Vulnerability Scoring and associated Uncertainty Analysis were completed by Baird (2010h). The Issues and Threats Assessment is based on the Genivar 2010a report.

IPZ-3 delineation and potential significant threats identification was undertaken by Genivar (identification of threats and spill scenarios), Baird (2011c) (event selection, tributary spill and final reporting), and SNC Lavalin (2011) (hydrodynamic and spill modelling).

Both the Rope Subdivision and Victoria Harbour intakes are located in a Great Lake and by default would be classified as Type A intakes (Rule 55; MOE, 2008a), however, because the intakes are located in Severn Sound, which in many respects is more like a Type D water body in terms of potential exposure to threats, and considering the intake offset from shore and depth, a request (under Technical Rule 15.1 (MOE, 2008a)) was submitted January 20, 2010 to the Director for these systems to be classified as Type-D intakes. The rationale for requesting a change to the intake type classification is because as Type A intakes, these two drinking water systems are restricted to a maximum Source Vulnerability Factor of 0.7. However, due to the unique location of these intakes the SPC and other experts are of the opinion that the maximum Source Vulnerability Factor of 0.7 leads to an underestimate of the final Vulnerability of these two intakes due to following reasons:

- Both intakes are located in very close proximity to shore; Victoria Harbour intake is approximately 100m from the shoreline, and Rope Subdivision is approximately 315m from the shoreline.
- Both intakes are located in shallow water; Victoria Harbour intake is approximately 4 meters from the surface and Rope Subdivision is approximately 2m from the surface.
- Both intakes have IPZ-1s that extend onto land, however maximum Vulnerability Score for these systems based on Type A, is 7 and hence there is no potential for Significant Threats even for activities within close proximity to these shallow intakes.
- Both intakes are located in a protected sound, and therefore are not subject to hydrological conditions of typical great lake currents and water movement.

Reclassifying these two intakes, to Type D would enable Source Vulnerability Factor to range between 0.8 and 1, values that are much more applicable to the situations for these intakes. Further, the Source Vulnerability and final Vulnerability Scores would end up being similar to other intakes in the SGBLS Source Protection Region, including Lake Couchiching and Lake Simcoe, which are in very similar situation in terms of intake depth, distance off shore and exposure to threats. The Vulnerability Scores of Port Severn/Little Lake also highlights the disparity in the Vulnerability Scores. Port Severn/Little Lake intake is located approximately 2km from Rope Subdivision, however because this intake is separated from Lake Huron by a dam, it is classified as a Type D intake.

As described above, changing the Intake type from A to D will result in Source Vulnerability and Vulnerability Scores that are within a range more applicable to these shallow and near shore intakes. The change in Vulnerability Scores would enable potential Significant Threats to be identified that would otherwise not occur. This departure would also lead to greater consistency in application of the rules to very similar intakes situations within the SGBLS SPR.

Director's Approval was given on May 6, 2010 to classify the Rope Subdivision and Victoria Harbour as Type D intakes based on the rationale provided above (See Appendix TA for approval letter).

For Type D intakes, three zones are to be delineated: the IPZ-1 is based on a fixed radius around the intake crib; the IPZ-2 acts as a secondary protection zone around the IPZ-1. If modelling

demonstrates that a contaminant released during an extreme event is transported to the intake, and will lead to a deterioration of water for the use as a source of drinking water, then an IPZ-3 may also need to be delineated. While these intakes have been reclassified as a Type D intake, for the purposes of delineating IPZ-3, the Director has approved the use of the Technical Rules applying to Type-A intakes (See Appendix TA for approval letter).

As the process of delineating and assessing significant threats for IPZ-1 and -2s, is very different from that for IPZ-3s, they are presented in two distinct subsections of this chapter.

12.3.2 Delineating IPZ-1 and IPZ-2

IPZ-1 was delineated by SSEA according to the Technical Rules and as outlined in Chapter 5. The IPZ-1 was based on the 1km radius and a setback of not more than 120 m from the high water mark (HWM) and was prepared using GIS.

It must be noted however that the definition of HWM used in this assessment differs to that provided by the MOE[1]. 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 in this study was based on the MNR[2] LIO water polygon data layer, as insufficient data exists to define HWM according to the proposed MOE method. Analysis of shoreline properties within the IPZ-1 showed that the approach used to delineate HWM (i.e. MOE recommended, or that used in this study), would have little or no effect on the properties identified as being partially or wholly within the IPZ-1. For this reason, the method applied is considered equal or better than the MOE recommended approach.

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). For both the intakes the in-lake portion of the IPZ-2 was delineated by SNC-Lavalin (2009), while the on-land portion was delineated by Baird (2010h). The two hour minimum response time was used for the Township of Tay intakes, as the operator response time to shut-down the intake for both the Rope Subdivision and Victoria Harbour intakes was 30 minutes upon 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;

[1] Now, the MECP (The Ministry of the Environment, Conservation and Parks)

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.

12.3.2.1 In-lake IPZ-2 delineation

In-lake IPZ-2 delineation was completed by SNC-Lavalin, 2009. Delineation of a source water protection zone requires a rigorous analysis which includes the withdrawal zone for the intake itself and the regional circulation patterns. Circulation in a region is a complex function of bathymetry, meteorological conditions, river discharges, intake operations and other similar factors. The process which was followed to study the combined effect of these aspects first involved the analysis of the currents at the intake point. Speeds and directions at that point were used to provide a preliminary estimate of the withdrawal zone and, hence, an estimate of the probable region of interest for more detailed modelling. This larger region was then simulated in the transient three-dimensional hydrodynamic model (GEMSS-SPM) to give a much more refined delineation of the source water protection zones.

Due to the typical extent of the region of interest at each intake and the high model grid resolutions, the Lagrangian method was adopted to increase computational efficiency. The time of travel for any contaminant to the intake was set at two-hours and the target dilution of 1000 was adopted for defining contact with the intake. A cluster of 1000 particles were released at each individual model cell lying within the region of interest and a target number of 1 or more particles reaching the intake in two hours was defined as a potential threat for contamination. The flow in Georgian Bay is mostly wind driven which leads to surface velocities being higher than the layers below it. Because of this, the modelled particles were only released at the surface. Releasing the particles at the surface with higher velocities will result in a larger withdrawal zone (source water protection zone) making the study conservative. Also, the target zone was defined at the intake location with an extent of 50 m in all directions (as well as extending from the water surface to the bottom).

The near-field hydrodynamic and transport model suggested that the flow is mostly wind driven and influenced by the local bathymetry. Also, the bulk transport within Severn Sound is directly influenced by the water surface elevations and exchange between Georgian Bay and the Sound in the exchange channel (between Beausoleil Island and the mainland at Clearwater Beach/Pinery Point). In the shallow areas, the combined effect of wind and bathymetry mostly results in along shore currents. This was seen for the Collingwood intake (Chapter 11 of the Nottawasaga Valley Assessment Report) and is again evident for the Rope Subdivision and Victoria Harbour intakes.

Rope Subdivision Intake

The velocity attributable to the intake at the Rope subdivision is exceptionally small (~0.4 cm/s based on average flow rate). Unlike other intakes, the Rope intake is in close proximity to a major river, the Severn River, where the flow rates average over 50 m^3/s and reach peaks

exceeding 200 m^3/s. As a result, the near-field region is dominated by the discharge from both the Severn River and local currents.

The flow from the Severn River is directed southward by the shoreline and bottom contours which cause an alongshore circulation pattern close to the intake. Since there is an absence of any withdrawal zone developed by the intake alone, the flow direction is almost always towards the SSE. The alongshore currents indicate that the intake withdrawal zone will be elongated along the shore as there are no other discharges close to the intake that could result in some cross shore currents. It also suggests that the upstream limit of the IPZ-2 would progressively move toward Port Severn with increasing discharge from the river.

The preliminary current rose analysis suggested that the focus of the withdrawal zone would be within 250 m of this intake, with the probability of contamination at the intake decreasing beyond this zone. The preliminary analysis also indicated that the zone will be elongated along the shore with elongation particularly towards the north due to the strong currents from the Severn River. The change in the direction of the shoreline also suggested that the withdrawal zone will include some area towards the northeast.

It was further noted that high flow conditions (bank full flow) would elongate the IPZ-2 in an upstream direction. That upstream extent could reach to Severn Falls and, as a result, the upstream extent of the model was set to include this region.

Direct Particle Modelling (DPM)

The withdrawal zone within approximately 400 m of the intake has a 25% probability of contaminating the intake (a 25% probability that lake water within 400 m from the intake structure will arrive at the intake within two-hours). Similarly, the lowest level of probability (0.1 %) extends about 1.1 km to the north and northeast direction and approximately 600 m to the southwest. Beyond these areas, surface water in Severn Sound (essentially that of the Severn River from the north) will have a negligible (< 0.1%) chance of contaminating the intake at a level of 0.1% (1 in 1000) within two-hours. The modelling also suggests that the contamination level, if any, by lake or Severn River water beyond 1.1 km will be less than 0.1 % (1 in 1000) in two-hours. The high probability region (> 75%) extends only about 200 m from the intake and is oriented towards north. The results clearly suggest that the zone of interest for the Rope Subdivision intake is the flow field coming from the Severn River, with some regions in the southern direction. The region south of the intake is a result of wind driven currents that may direct contaminants northward towards the intake.

The two-hour intake protection zone brushes along the shoreline just south of Highway 400 (north of Shields Island) to south of the mobile home park east of Picnic Rock. Shoreline areas in this area will most likely join this IPZ with longer-term current modelling.

The high flow/bankfull flow (1 in 5 year spring flow condition of 215 m^3/s) presents a different IPZ-2. The upstream extent of the IPZ-2 does reach the highway bridges and treatment plant discharge and shows that there is approximately 2% to 5% probability that an upset condition of the plant could reach the intake in 2-hours during high flows. These same high flows prevent wind-driven currents from the south from reaching the intake. Overall, there is good reason to

consider the IPZ-2 for the Rope Subdivision intake to extend from the north near Port Severn to the south approaching Sweet Shoal and Forest Harbour, and include a good portion of the shoreline areas between the intake and slightly north of Highway 400.

Reverse Particle Modelling (RPM)

The reverse particle modelling approach was then initiated to determine the final extent of the 2-hour IPZ-2 for the Rope Subdivision Intake. The same approach was followed for this delineation as described above for the direct particle modelling (i.e., normal conditions meshed with very high flow conditions).

The results were similar to the DPM results for the simple reason that the high flow/bankfull flow (215 m^3/s) condition dominates currents in the area.

The full extent of the in-water/lake portion of the IPZ-2 reaches to approximately 1.4 km to the north/northeast of the intake and 650 m to the south of the intake. It extends approximately 300 m to the west of the intake and contacts the shoreline for an extent of about 750 m in length to the east. This shoreline contact is within the 1.5 to 2-hour time of travel region from the intake.

Victoria Harbour Intake

The inflow velocity immediately at the mouth of the Victoria Harbour intake pipe is comparatively large, but the intake withdraws water from vertically above. This vertical withdrawal zone quickly spreads horizontally, however, which leads to a rapid drop in current momentum and very small horizontal velocities (much smaller than the nearby currents in Severn Sound). The wind and elevation-driven flow from the nearby currents overwhelm any near-field circulation except in the immediate vicinity of the intake. As a result, there is an absence of any withdrawal zone developed by the intake alone.

Again, the alongshore wind driven currents indicate that the intake withdrawal zone will be elongated along the shore. There are also no other large discharges close to the intake that could result in cross shore currents. Thus it can be expected that the dominant direction of flow around the Victoria Harbour intake is along shore.

It is also noteworthy that the shoreline to the east of the intake shelters the nearby water from easterly winds. The effect and the magnitude of shoreline currents here is very small. This intake is also close enough to the shore that storm sewer outlets, roadside drainage or other pathways which speed entry of water to the lake need to be considered in defining the land portion of the IPZ-2.

The preliminary analysis suggested that the withdrawal zone would be elongated along the shore in an east-west direction within 100 m of the intake, and that the probability of contamination would decrease beyond this zone. The SPM module was set up with a region of interest about 1500 m in a north-south and east-west direction from the intake.

Direct Particle Modelling (DPM)

As discussed above, the time of travel criterion was set as two-hours and the target number/concentration of particles defining travel distance for the direct particle modelling was again chosen as 1 or more particles in 1000.

Two other simulations were conducted to assess the influence of strong winds from the east and northwest (which were absent in the simulation time period). These point to only a moderate increase in the size of the lake portion of the IPZ-2 to the northeast. This increase was included in the final definition of the lake portion of the IPZ-2 at Victoria Harbour.

The withdrawal zone within 190 m of the intake has a 25% probability of contaminating the intake (there is a 25% probability that lake water within 190 m from the intake structure will arrive at the intake within two hours). Similarly, the lowest level of probability (0.1 %) extends about 425 m in both the northeast and northwest directions and approximately 200 m northward. Beyond these areas, lake water will have little (< 0.1%) chance of contaminating the intake at a level of 0.1% (1 in 1000) within two-hours based on the regional currents. Likewise, the contamination level, if any, by the lake water beyond 425 m within two hours will be less than 0.1% (1 in 1000). The high probability region (> 75%) extends only about 140 m and it is oriented towards the south where shallower depths exist.

This two-hour direct travel time probability approach indicates that the IPZ-2 contacts the shore from south of Bergie Point to the west, and extends to the east across Crystal Beach into the small bay at MacKenzie's Park. This park marks the change in shoreline direction to the northeast toward McKenzie and Sunset Beaches. It would be expected that surface runoff from Lighthouse Court, Bergie Court, and Juneau Road could enter this two-hour IPZ-2.

Reverse Particle Modelling

The reverse particle modelling (RPM) approach was then used in the final analysis to define the in-water/lake time of travel for areas of Severn Sound near the Victoria Harbour intake. The same hydrodynamic model and storm event results described above were used in the RPM approach.

The results of the RPM modelling show that the in-water/lake extent of the IPZ-2 extends to approximately 450 m to the east of the intake and 450 m to the west. These extents are similar to the DPM results and confirm contact with the shore.

The RPM approach shows that the offshore area of the IPZ-2 extends further outward than the DPM approach. This result is expected at Victoria Harbour because the currents are highly variable and not dominated by river discharge (e.g., the Rope Intake) or strong shoreline flow (e.g., Collingwood). As a result, the full 2-hour IPZ-2 for Victoria Harbour extends approximately 500 m to the east and west from the intake and around the point the southwest. The maximum offshore distance is approximately 600 m to the northwest. It is noteworthy that the shoreline length within the IPZ-2 covers approximately 850 m.

12.3.2.2 Up Tributary

The Rope Subdivision IPZ-2 extends a short distance beyond the IPZ-1, into Little Lake. The IPZ-2 abuts shore in Severn Sound and Little Lake, and the inland extent of the IPZ-2 was delineated by Baird. The IPZ-2 extends on land 120 m (the setback from which the 120 m offset was calculated is described above). There are no tributaries in the IPZ-2.

The Victoria Harbour IPZ-2 abuts shore and the inland extent of the IPZ-2 was delineated by Baird (2010h). The IPZ-2 extends inland 120 m. There are no tributaries in the IPZ-2 and the IPZ-2 (in-water and inland) is also entirely contained within the boundaries of the IPZ-1.

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 80th percentile for the month within which the highest water level occurs, or where a long term record of water levels does not exist as the level at which flood plains are flooded and leave a mark where natural vegetation changes from predominantly aquatic vegetation to terrestrial vegetation. In Severn Sound, the shoreline HWM used to delineate the IPZs is compared to the DFO HWM, defined as being 176.96 m IGLD 1985. As with Lake Simcoe and Couchiching the 176.96 m contour has a high degree of uncertainty due to resolution of the DEM data. 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 (Appendix A). The review found the two shorelines to be comparable.

12.3.2.3 Inland Setback

Where the IPZ-2 abuts land, it includes a setback of not more than 120 m inland along the abutted land measured from the high water mark of the surface water body that encompasses the area where overland flow drains into the surface water body and the area of the Regulation Limit along the abutted land (Rule 65-3; MOE, 2008a). No Conservation Authority Regulation Limit is in effect in the study area.

12.3.2.4 Transport Pathways

Transport pathways were included in the IPZ-2 delineations based on Rules 72 to 74. A complete description of the methodology, analysis and transport pathway delineation is provided in Baird 2010h.

Data were acquired by LSRCA and SSEA from field surveys, in-house development, and from participating municipalities. Datasets included (but were not limited to) Storm sewersheds; Sewershed outfall locations, flows and velocities (where available); Municipal water intake locations; Ditch locations; Road networks; Soils and land use data; and Ortho-imagery.

The sewersheds discharging into the IPZ-2 were identified from SSEA datasets. Residence time and the velocity were then used to estimate a maximum within-sewershed travel distance. A summary of travel distance calculations for Rope Subdivision and Victoria Harbour can be found

in Baird 2010h. In all of the Rope subdivision sewersheds (with the exception of one), 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. Transport Pathways for the Victoria Harbour IPZ-2 are located entirely within the IPZ-2 and do not extend beyond the defined zone.

12.3.3 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.

12.3.3.1 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, 2010h).

The IPZ-2 base Area Vulnerability Factor, modifiers and final Area Vulnerability Factor for the Rope Subdivision WTP intake are listed in Table 12--3.

Table 12--3: Derivation of IPZ-2 Area Vulnerability Factor (B) for Rope Subdivision WTP Intake.

Intake	Base Area Vulnerability Factor	Land-Water Modifier[1]	Drainage Density Modifier[1]	SCS Curve Number Modifier	Land Use Modifier	Relief Length Modifier	Final Area Vulnerability Factor (B)
Rope Subdivision Water Treatment Plant Intake	8	-1	-1	1	1	1	9

[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.

For Victoria Harbour, the IPZ-2 is entirely contained within the IPZ-1. No vulnerability score is therefore applied to the IPZ-2, as the Vulnerability Score for the IPZ-1 is higher. This was confirmed with the MOE.

12.3.3.2 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--4 were taken directly from MDEQ (2004), while the fourth row lists the corresponding Vulnerability Factor assigned for the Rope Subdivision and Victoria Harbour WTPs.

Table 12-4: 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]	<300 m offshore <6 m depth	<300 m offshore >6 m depth	>300 m offshore <6 m depth	>300 m offshore >6 m depth
Vulnerability [1] (MDEQ)	High	High to Moderate	High to Moderate	Moderate
Recommended Factor (C) for Type D Intakes	1.0	0.9	0.9	0.8

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

The Rope Subdivision WTP intake is located 315 m from shore in a water depth of 1.9 m. A Source Vulnerability Factor (C) of 1.0~~0.9~~ was therefore assigned based on the values presented in Table 12-4 (MDEQ, 2004).

12.3.4 IPZ-1 and IPZ-2 Uncertainty Assessment

Uncertainty Assessment for in-lake IPZ-2 delineation is summarized in SNC-Lavalin 2009, see Appendix TA. This Uncertainty Assessment considered factors such as Data Quality (including water levels, current monitoring, wind speed and direction), Model(s) (including 3-D Hydrodynamics, direct and reverse particle tracking), QA/QC Procedures and Calibration/ Verification (including by water levels, by nested model).

This section summarizes some of the uncertainty identified by Baird (2010h) for the work they completed (On-land IPZ-2 delineation, identifying tributary and Transport Pathways and assigning Vulnerability Scores), lack of tributary flow data for small tributaries, estimations and assumptions were required to develop the transport pathways IPZ-2 delineations. The entire discussion of uncertainties is presented in Baird 2010h, Appendix TA. This assessment was used by Baird (2010h) to assign Uncertainty Ratings of either “High” or “Low” for the Vulnerability Scores.

12.3.4.1.1 Data Quality and Gaps:

Data gaps and data quality issues identified during the Vulnerability study (Baird, 2010h) included: intake locations and depths were provided by SGBLS SPR and are assumed to have been confirmed through review of all available data. Further details on the data quality and gaps listed for the Rope Subdivision and Victoria Harbour intake are in Appendix C, Baird 2010h.

12.3.4.1.2 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.

12.3.4.1.3 Area and Source Vulnerability Factors

The factors considered in assigning the area Vulnerability values include: the percentage of the area of the IPZ-2 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. The only subwatershed characteristic that is relatively uncertain is the SCS Curve No, which was estimated from datasets provided by the SGBLS SPR. The uncertainty arises from the fact that the SCS Curve No. is a relativistic estimate of the capability of an area for surface runoff generation, based primarily on land cover and soil hydrologic characterization. There is less uncertainty with the other sub-watershed characteristics (area, length, sum of stream lengths, land use and relief) as they were measured directly from GIS layers.

While there is a relatively low level of uncertainty associated with the datasets used to evaluate the Area Vulnerability Factor, there is a high degree of uncertainty in the methodology used to develop the Area Vulnerability Factor. The methodology developed by Baird is based on assigning a relative rating for each criterion in the rules. Other consultants have derived similar methodologies independently of Baird, but their exact choice of criteria, and the divisions between these may vary.

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. It is the consultants (Baird) understanding that these values have been confirmed based on engineering drawings and the client has indicated a Low level of Uncertainty for these values. A Threats and Issues Analysis was undertaken by Genivar, 2010a and based on the data reviewed, no Issues were identified. A Low level of Uncertainty has therefore been assigned to the Source Vulnerability Factors.

12.3.5 Modelled Threats and IPZ-3 Delineation

The methodology used for modelled threats and IPZ-3 delineation is consistent with the Technical Rules: Assessment Report, Clean Water Act, 2006, amended on November 16, 2009 (MOE, 2009a) and follows the general approach outlined in MOE's Technical Bulletin: Delineation of Intake Protection Zone 3 Using the Event Based Approach (EBA) dated July 2009 (MOE, 2009b). The steps used to identify potential significant threats and delineate IPZ-3 are:

- **Step 1 – Selection of extreme events for threat identification and IPZ-3 delineation:** (Section 12.3.5.1). Analysis of wind speeds and river flows is undertaken to develop an extreme event scenario with a joint probability (considering both wind and flow), of approximately a 1 in 100 year event;
- **Step 2 – Identifying potential significant threats and assigning spill scenarios:** Identification of specific activities that may result in a contaminant being transported to the intake and deterioration of the water as a drinking water source. If an activity was considered to be a potential significant threat then spill scenarios were develop for the purposes of modeling transport to the intake; (Section 12.3.5.2)
- **Step 3 – Lake and Tributary Spill Modeling:** Calculation of the dilution and reduction in spill concentrations in tributary between the spill location and the tributary mouth by analytical means; Calculation of the dilution and reduction in spill concentrations between spill locations or the tributary mouths and the surface water intakes; (Section 12.3.5.3)
- **Step 4 – Significant threat identification and IPZ-3 delineation**. Determining whether the spill constitutes a threat to the drinking water at the intake through comparison of modeled concentrations at the intake, with the Ontario Drinking Water Quality Standard (ODWQS). In this case concentrations exceeding the ODQWS were typically considered to be a deterioration of the drinking water. If identifies activity is not within and existing IPZ (IPZ-1 or 2), then an IPZ-3 is delineated based on location of the significant threat activities (Section 12.3.5.4).

Identifying the extent of the IPZ-3 and the associated significant threats is an iterative process. Upon review of step 3 and 4 results we revisited step 1 to ensure additional activities, that were excluded in the first round because unlikely to be a threat, are still likely not a threat. If the new modeling results indicated that an additional activity should be considered, then we would proceeded with steps 3 and 4.

12.3.5.1 Selection of Extreme Events for Model Runs

The Technical Rules define an extreme event to be used for the delineation of an IPZ-3 as a period of heavy precipitation or up to a 100 year storm event (wind); or a freshet.

The driving forces that would potentially transport a contaminant to the intakes are:

- Wind – wind is the main force driving the circulation in the Sound;
- Flow in the Severn River – part of Trent-Severn Canal with controlled flows; and
- Tributary flows –tributaries transport contaminants from the watershed and upstream to the lake, where they may then be transported to the intakes.

A joint probability analysis (JPA) was undertaken to define the combined 100 year return period event considering the wind on Severn Sound, flow in the Severn River and flow in tributaries flowing into Severn Sound.

Data from the following sources were used for the JPA:

- Hourly wind data from Environment Canada station 6110617 at Beausoleil from 1995 to 2006;
- Daily flow records at the Swift Rapids gauge 02EC003 in the Severn River from 1953 to 2009; and
- Daily flow records at the North River at gauge 02ED024 from 1953 to 2009. The North River (which flows into Matchedash Bay, midway between the Victoria Harbour and Rope Subdivision intakes), was selected to represent tributaries flowing into Severn Sound for use in the JPA and it was assumed that rainfall would be similar over other tributaries in this region, therefore flows would follow a similar distribution.

The data were analyzed to determine the mean, standard derivation, and extreme values for varying return periods. Logarithms of the flow discharge in the Severn River and North River were used in the analysis since a normal distribution of each variable is generally required for a joint probability analysis. A separate statistical analysis was completed on the Beausoleil wind data to determine directional extreme wind speeds.

Using the statistical data, a joint probability analysis was performed to define the combinations of wind and tributary flow with a given return period. Many (infinite) combinations of wind and flow could be found for a given exceedance probability or return period. For this study, a surface which represents 100 year return period scenarios using the joint probability was produced.

Considering the mechanism by which a spill may be transported to the intakes in Severn Sound, wind is the key factor. A spill occurring inland may be transported down a tributary to the lake under the full range of tributary flow conditions. Once it enters the lake, dilution increases due to the size of the water body. If there is not sufficient wind to drive the currents in the lake, the contaminant will not be transported to the intake.

Another consideration in this study was the period of record for which hydrodynamic model runs had been completed using the GEMSS model. This model was used for the IPZ-2 delineation as described in SNC-Lavalin (2009). Modeling was completed for the period from May 1 to August 31, 2006 using time series data. For efficiency, these model runs were also used for the IPZ-3 delineations, and in each case the wind speeds were combined with tributary flow events with a combined return period up to but not exceeding 100 years, based on the JPA analysis.

Where necessary, wind speeds were factored to provide a higher return period wind event for modeling. Historical wind storms were selected from the time series data for the spill scenarios described below. Since the duration for tributary flow events is much longer than wind storm events, the tributary flows for model inputs were selected as constants which were determined from the joint probability analysis, to obtain events with a combined return period of up to but not exceeding the 100 year event.

The following outlines the specific wind and flow events used for the spill modelling. Joint Probability for the majority of the scenarios is close to, but less than a 1 in 100 year event.

Scenario 1: The model was run with a 2-year return period flow in the Severn River and 2-year winds from the NE.

Scenario 2: Average April flow from the Severn River measured at Swift Rapids. This is less than the 2-year return period flow, but April is a high flow month, due to the snow melt and spring runoff.

Scenario 3: A 5-year return period wind was used, initially from the SE and then veering to the S-SW. A mean flow was used in the Severn River and other tributaries.

Scenario 4: A summer storm with 5-year return period winds from the SSW-SW.

Scenarios 5, 6 and 7: Approximate 15 year return period wind from the westerly directions and tributary flow.

Scenario 8 and 10: A 5-year return period wind was used, initially from the S and then veering to the SW and W. Discharge from the Severn River and other tributaries was a 2-year return period flow.

Scenario 9: Peak winds with a 15 year return period were used. While this exceeds the 100 year event based on the JPA, the results still provided information needed to determine if the activity was a significant threat.

Scenario 11: Model was initial run with a 100 year flow that exceeded the combined 100 year return period event. Subsequent modeling was completed for a 2 year return period flow and a 5 year return period wind from the SSE

12.3.5.2 Assessment of Activities for Spill Modeling:

For consistency, the process of identifying activities that may be a Significant Threat followed a similar process as that used for identifying threats in the IPZ-1. Available land use databases and map information were reviewed to identify locations within the catchment that may potentially release contaminants that could reach the intake. As a first step in this process, each land parcel within the contributing area around the intakes was assigned a "LandUseActivityName" consistent with the MOE Look-Up Table Database (this has since been replaced with the MECP Threat Lookup Tool: https://threats.swpip.ca/). A list of potential locations and activities was compiled and prioritized from this exercise. The first priority was to identify land use activities based on a hypothetical risk score. Each activity was assigned a hypothetical vulnerability score of 10 and this was multiplied by a hazard rating that was based on the factors such as the quantity and type of chemical present and how it is being stored (above/below grade). Those activities with a risk score greater than 80 were further included in the initial list of potential threats.

(Note: the hypothetical vulnerability score of 10 was only used as a tool to assist in identification of potential Significant Threats to model. Following the Technical Rules, Vulnerability Scores cannot be used in process of assigning threats levels for Type-A intake IPZ-3s).

Once an initial list of potential threats was established, a process of eliminating activities that were unlikely to be a Significant Threat was undertaken. Firstly, land parcels and activities were selected based on the relative distance from the surface water features. Activities within the 120 m of the surface water feature were given a higher priority. This list of land use activities was subsequently reviewed to assess the potential that a significant release of the identified chemical parameters could occur. As part of this review, staff from the Severn Sound Environmental Association provided assistance through visual inspections and obtaining additional information on the presence of chemicals and the likelihood of release.

Through this process, fuel storage at marinas within Severn Sound and the potential for a sewer by-pass at Victoria Harbour, Port McNicoll or Midland WWTPs were identified as having the greatest likelihood of being a significant threat to the drinking water sources. In addition, one activity within the Hogg Creek subwatershed was identified. All other Industrial land uses within the watershed were not considered to have potential to be a significant threat for release of contaminants to the surface water courses. A list of all activities considered and a justification as to why the activity was, or was not, considered for further investigation through modelling is provided in Baird 2011c (See Appendix TA).

Previous numerical modeling results (described in Appendix B) were reviewed to determine which spill scenarios might be more likely to result in exceedances of the ODWQS at the intakes. Spill scenarios were selected for modeling, commencing with the activities closest to the intake and then moving outward to activities more distant from the intake.

It must also be noted that a fuel spill at intersections between highway 400 and the Trent-Severn was also investigated as a potential threat. The results of this work are presented in Baird 2011c. While it was found that a fuel spill could be a potential Significant Threat to the intake, the Source Protection Committee has previously ruled that threats associated with transport corridors will not be included in the Assessment Report until a defendable consistent approach can be applied across the entire Source Protection Region. Until then, then SPC recommends engaging emergency management / first responders in communication efforts in locations where transport corridors may be a Significant Threat.

Spill Scenarios

Scenarios 1, 2, 3, 5, 7, 8 and 10 are releases from marina fuel tanks. The contaminant of concern was benzene and the fuel contained 2% benzene. The fuel tank volume for Scenarios 1, 2, 3, 5, 7 and 10 was 4,500 L and the tank used in Scenario 8 was 22,500 L. In each case, it was assumed that one third of the tank would be released. The decision to use one third of the volume of the storage tank was based on considerations that a) the storage tanks would not always be full; b) release would typically be stopped before the entire volume was released; and c) the activities and circumstances identified through this approach would also be significant threats for higher release volumes.

Scenarios 4, 6 and 9 are bypasses at the Victoria Harbour, Port McNicoll and Midland Waste Water Treatment Plants (WWTPs) respectively. The bypass spill at Victoria Harbour and Port McNicoll consisted of 2,000 m^3 of water with an *E. coli* concentration of 130,000 CFUs/100 ml. The spill scenarios were developed through interviews by personnel from SSEA with WWTP

operators, and the *E. coli* count was obtained from interviews conducted by LSRCA with the WWTP operator at Collingwood for the Collingwood IPZ-3 studies. The Midland WWTP bypass consisted of a continuous flow of 40,000 m^3/day. This scenario was modeled previously and the results were used to assess whether or not a bypass would be likely to result in an exceedance. For all bypass scenarios, the *E. coli* was treated as a conservative substance having no decay.

Scenario 11 is a release from a diesel tank located near Hogg Creek. The contaminant of concern was benzene and the fuel contained 0.02% benzene. The fuel tank volume was 15,000 L and as with the marina fuel tank spills, it was assumed that one third of the tank would enter the water.

A summary of spill scenarios in provided in Table 12-5.

Table 12-5: Spill scenarios used to identify potential Significant Threats, and delineate an IPZ-3.

Scenario No.	Spill Scenario	Target Intake	Spill	Release Volume (m3)	Contaminant Concentration	ODWQS (mg/L)
1	Fuel spill from marina in at north end of Little Lake (M1)	Rope	Gasoline	1.5	2% Benzene	0.005
2	Fuel spill from marina at south end Little Lake (M10)	Rope	Gasoline	1.5	2% Benzene	0.005
3	Fuel spill from marina at Waubaushene (M4)	Rope/ Victoria Harbour	Gasoline	1.5	2% Benzene	0 Counts/L
4	WWTP bypass at Victoria Harbour (S3/O3)	Rope/ Victoria Harbour	Waste water	2000	130,000 CFU/100 ml E. coli	0 Counts/L
5	Fuel spill from marina at Port McNicoll (M8)	Victoria Harbour	Gasoline	1.5	2% Benzene	0.005
6	WWTP bypass at Port McNicoll (S4/O4)	Harbour	Waste water	2000	130,000 CFU/100 ml E. coli	0 Counts/L
7	Fuel spill from marina north of Port McNicoll (M6)	Victoria Harbour	Gasoline	1.5	2% Benzene	0.005
8	Fuel spill from marina in Tiffin Basin, Midland Bay (M7)	Victoria Harbour	Gasoline	7.5	2% Benzene	0.005
9	WWTP bypass at Midland (O5)	Victoria Harbour	Waste water	40000/day	130,000 CFU/100 ml E. coli	0 Counts/L
10	Fuel spill from marina at Midland (M5)	Victoria Harbour	Gasoline	1.5	2% Benzene	0.005
11	Fuel spill into Hogg Creek 1 km upstream of mouth	Victoria Harbour	Diesel	5	2% Benzene	0.005

12.3.5.3 Lake and Tributary Spill Modelling

Tributary Modelling

Spill Scenario 11 is a spill into Hogg Creek, which flows into Hogg Bay, south of Victoria Harbour. An analytical approach using the methodologies outlined in MOE (2009b) was used to evaluate longitudinal dispersion as the spill was transported from the source to the mouth of the tributary. Concentrations were calculated for a range of flow conditions including mean daily flow (0.3 cms) and the 2-year return period flow (8.4 cms). Results from this analysis were used for the lake spill modelling described below.

Lake Modelling

Assessing whether a spill scenario reached the intake at concentrations leading to deterioration in water quality was completed using the GEMSS 3-dimensional hydrodynamic model – this is the same model used for delineating the Victoria Harbour and Rope Subdivision IPZ-2. The modeling, completed by SNC-Lavalin (2011) is summarized in Section 12.3.2.1.

Additional information describing the model setup, calibration and validation is provided in SNC-Lavalin (2009) (Appendix TA). The spills defined in Section 12.3.5.2 were used as input to the GEMSS model. The model was run for event conditions described in Section 12.3.5.1.

Results of the lake spill modeling summarized in Table 12-6.

Table 12-6: Peak Concentrations at Victoria Harbour and Rope Subdivision for Spill Scenarios.

Scenario No.	Spill Scenario	Contaminant	Release Volume (m^3)	Max Conc. Victoria Habour - Surface	Max Conc. Victoria Habour - Lakebed	Max Conc. Rope Subdivision - Surface	Max Conc. Rope Subdivision - Lakebed	ODWQS (mg/L)
1	Fuel spill from marina in at north end of Little Lake (M1)	Benzene	1.5	-	-	<0.001 mg/L	<0.001 mg/L	0.005
2	Fuel spill from marina at south end Little Lake (M10)	Benzene	1.5	-	-	**0.06 mg/L**	**0.06 mg/L**	0.005
3	Fuel spill from marina at Waubaushene (M4)	Benzene	1.5	0.0002 mg/L	0.0002 mg/L	0.0001 mg/L	0.0001 mg/L	0.005
4	WWTP bypass at Victoria Harbour (S3/O3)	E. coli	2000	5-10 CFUs/ 100 ml	5-10 CFUs/ 100 ml	-	-	0 Counts/L
5	Fuel spill from marina at Port McNicoll (M8)	Benzene	1.5	**0.01 mg/L**	**0.01 mg/L**	-	-	0.005
6	WWTP bypass at Port McNicoll (S4/O4)	E. coli	2000	50- 100 counts +	50- 100 counts +	-	-	0 Counts/L
7	Fuel spill from marina north of Port McNicoll (M6)	Benzene	1.5	**0.02 mg/L**	**0.02 mg/L**	-	-	0.005
8	Fuel spill from marina in Tiffin Basin, Midland Bay (M7)	Benzene	7.5	0.00001 mg/L	0.00001 mg/L	<0.00001 mg/L	<0.00001 mg/L	0.005
9	WWTP bypass at Midland (O5)	E. coli	40000/day	13-Jan CFUs/ 100 ml	1- 13 CFUs/100 ml	-	-	0 Counts/L
10	Fuel spill from marina at Midland (M5)	Benzene	1.5	<0.00001 mg/L	<0.00001 mg/L	<0.00001 mg/L	<0.00001 mg/L	0.005
11	Fuel spill into Hogg Creek 1 km upstream of mouth	Benzene	5	0.001 mg/L	0.001 mg/L	-	-	0.005

~~Exceedances of ODWQS are denoted in red.~~

Commented [MTx361]: I don't think this is AODA complaint, but deleting it seems to be removing important info. Thoughts?

Commented [BTx362R1]: I think better to remove the red and use an asterix instead.

In fact, with the ODWS in the final column the red is a bit redundant, so if the asterix is an AODA problem, we can just leave it to the reader to compare to the final column

12.3.5.4 Significant Threat Identification and IPZ-3 Delineation.

Victoria Harbour

The modeling predicted that a spill from a fuel tank at marinas in Port McNicoll and north of Port McNicoll would result in exceedances of the ODWQS for benzene at the Victoria Harbour intake. The fuel tank considered in Scenarios 5 and 7 is 4.5 m^3 in size and it was assumed that a volume equal to one third of the tank would spill. The results may be extrapolated to include designation of smaller fuel tanks up to the size of the spill modeled, i.e. 1.5 m^3 tanks, as significant threats (the fuel spills modeled were 4.5 m^3 tanks with a spill equal to one third the tank size)

The modeling also predicted that a bypass at the Port McNicoll WWTP consisting of a 2,000 m^3 bypass with *E. coli* counts of 130,000/100 ml would result in *E. coli* levels of 50 to 100 CFUs/100 ml at the Victoria Harbour intake (Scenario 6). This is within the range of the typical raw water quality routinely treated at the Victoria Harbour Water Filtration Plant (WFP). It was concluded that the Port McNicoll WWTP is not a significant threat to the Victoria Harbour WFP. The modeling and analyses for the other scenarios listed in Table 12-6 did not result in exceedances of the ODWQS.

The MOE memorandum (Nov. 15, 2010) directs that an IPZ-3 is to be delineated if a spill can be shown to result in deterioration of the water supply. For this purpose and in accordance with other aspects of the Technical Rules (i.e. Issues Evaluation), deterioration of the water supply is typically considered to be an exceedance of the ODWQS. Based on the activities evaluated, the IPZ-3 has been extended to include areas where the two marina activities are a potential significant threat. If additional activities are identified in the future, including larger fuel storage tanks, the IPZ-3 may be adjusted.

The final number of potential Significant Threats resulting from the spill modeling and the resulting IPZ-3 is presented in the following results section.

Rope Subdivision

The modeling predicted that a spill from a fuel tank at a marina in Tug Channel would result in exceedances of the ODWQS for benzene at the Rope Subdivision intake. The fuel tank considered in Scenario 2 is 4.5 m^3 in size and it was assumed that a volume equal to one third of the tank would spill. The fuel tank modeled is located within the IPZ-2 for Rope Subdivision. The desk top analysis also indicates that spills from fuel tanks at marinas located at the south end of Little Lake, immediately upstream of the dam could also result in exceedances of the ODWQS for benzene. These marinas are located within the IPZ-1 for the Port Severn intake, located in Little Lake and based on the vulnerability scoring, they are significant threats. It was therefore not necessary to extend the IPZ-3 for Rope Subdivision to include them.

The modeling did not predict exceedances of the ODWQS for the spill scenarios located south of Rope Subdivision as shown in Table 12-6. This was largely due to flow from the Severn River,

which impedes transport of contaminants northward toward the Rope Subdivision intake, the shallow bathymetry in the area and the sheltered location. Because the modeling did not identify any significant threats located beyond the IPZ-1 and IPZ-2, it is not necessary to delineate an IPZ-3 for the Rope Subdivision.

At this time, transport corridors have not been considered in the IPZ-3 delineation. The Source Protection Committee (SPC) may wish to consider requesting Director's approval to extend the IPZ-3 to include transport corridors in the future. A fuel spill from a tanker truck on Highway 400 would likely be a significant threat and should be evaluated at that time.

The modeling predicted exceedances of the ODWQS for benzene, at the Rope Subdivision intake for Spill Scenario 2. This provides justification for designating the activity as a "significant threat". The results may be extrapolated to include designation of smaller fuel tanks up to the size of the spill modeled, i.e. 1.5 m^3 tanks, as significant threats (the fuel spills modeled were 4.5 m^3 tanks with a spill equal to one third the tank size).

The final number of potential Significant Threats resulting from the spill modeling and the resulting IPZ-3 is presented in the following results section.

12.3.5.5 IPZ-3 Uncertainty Assessment

An analysis of the uncertainty, characterized by "high" or "low" is required in respect of the delineation of surface water intake protection zones Rule 13 (MOE, 2009a). The factors to be considered in this analysis are listed in Rule 14 (MOE, 2009a):

(1) Distribution, variability, quality and relevance of data;

(2) Ability of models to predict the processes;

(3) Quality assurance and quality control procedures applied; and

(4) Extent and level of calibration and validation achieved for model used.

Baird (2011c) details the main limitations and uncertainty's associated with the work undertaken IPZ-3 delineation and threats identification for the Rope and Victoria Harbour intakes. Here we summarize a few key limitations identified in the Baird (2011c) report.

<u>Data Quality and Gaps</u>

- The MPAC and TSSA data were found to be not consistently up to date. These data bases were used to identify threats for spill modeling, as required for the IPZ-3 delineation. Ground truthing was undertaken to help improve the certainty of some activities;
- Tributary flow data were available for the Pretty River; the Batteaux River is not gauged and flows were developed from the Pretty River data. Flow return periods were based on a peak over threshold (POT) analysis of Environment Canada gauge data. Cross-section data were taken from the HEC-RAS model

- The in-water extent of the IPZ-3 was estimated based on the modeling. The precise route that a spill would take to reach the intake would vary with the events modeled.

Model Limitations - Longitudinal Dispersion Analysis in Tributaries

The longitudinal dispersion analysis (LDA) provides a first-order estimate of the likely dispersion of a spill of a contaminant into a tributary channel, for the purposes of delineating the IPZ-3. There are several sources of uncertainty associated with this approach including:

- The LDA assumes an instantaneous spill that is fully-mixed with the flow in the river;
- The cross-section of the river is assumed to be constant throughout its course (a weighted mean approach was used in this analysis);
- The LDA uses the empirical equations outlined in the Technical Bulletin. These equations were developed for different regions with different watershed characteristics than the study area, and they are uncalibrated to the study area;
- Physical and chemical changes to the contaminant as it moves downstream were not considered;
- The saturation concentration of benzene was assumed to be 10 mg/l where this value will vary in reality.

Model Limitations - *GEMSS*

- A limited number of events (defined as up to the 100 year return period) were simulated based on time and budget. The selected events may not cover the full range of spills and plume dispersion that may occur in the lake. If different events were selected, the concentrations at the intakes would be different.
- Decay due to physical and chemical processes has not been considered in this analysis. This is a conservative approach.
- It is important to recognize that modeling is a tool that has been used in this study to improve our understanding of the vulnerability of the intakes to specific activities.

12.4 Rope Subdivision Water Treatment Plant

The Rope Subdivision Water Treatment Plant is located in the eastern part of Severn Sound, between Port Severn and Waubaushene. It is approximately 1.1 km south of the Trans Canada Highway Bridge downstream of Port Severn and serves a population of approximately 70 people. The intake pipe is 100mm in diameter and extends approximately 315 m off shore, in a water depth of 1.9 m CD.

The intake structure is a small, capped riser pipe which draws water from 0.4 m above the lake bottom. The top is capped so that inflow is horizontal and the water depth above the cap is normally about 2.2 m.

The navigational chart and engineering drawings show that depths in the vicinity are shallower than 2 m throughout most of the area. This and the relatively protected aspect of the area result in slow moving currents, aquatic plant growth and warm water temperatures. The operator of this treatment plant notes that bottom sediments are drawn in following storms. Treatment of the water being taken up includes membrane filtration and ultraviolet light disinfection.

Lake ice at this intake would normally form in late December or early January and clear by early April. However, the area is affected by high discharge from the Severn River which causes earlier clearing in some years.

12.4.1.1 Intake Protection Zones (IPZ)

The Intake Protection Zones for the Rope Subdivision WTP are shown in Figure 12a-1. IPZ-1 consists of a 1 km radius centered on the crib of the intake. The IPZ-2, shown in Figure 12a-1, extends northward to approximately 200 m north of the Highway 400 crossing at Port Severn (1.4 km northeast of the intake). Its southern extent reaches 650 m south of the intake and contacts the shoreline from north of Highway 400 to just south of Bluff Point.

As described in the previous section, a number of activities were modeled to determine if they are potential significant threat during an extreme event. For the Robe Subdivision intake only one activity was identified as a potential significant threat (a marina in Tug Channel), as this marina is located in the IPZ-2 it was not necessary to delineate an IPZ-3.

12.4.1.2 Intake Protection Zone (IPZ) Vulnerability Scores

The vulnerability factors and scores for the IPZ-1 and IPZ-2 are summarized below in Table 12--7 and Figure 12a-1. IPZ-3s, using the event based approach are not assigned a vulnerability Score, and no IPZ-3 was delineated for this intake.

Table 12--7: Summary of Vulnerability Factors and Scores for Rope Subdivision WTP Intake.

IPZ	Area Vulnerability Factor (B)	Source Vulnerability Factor (C)	Vulnerability Score (V)
IPZ-1	10	~~0.9~~1.0	~~9.0~~10
IPZ-2	9	~~0.9~~1.0	~~8.1~~9

12.4.1.3 Uncertainty for IPZ Delineation and Vulnerability

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)).

IPZ-1 and IPZ-2 Uncertainty

Based on the factors discussed above, Baird (2010h) recommended an IPZ delineation Uncertainty Rating for the IPZ-1 as Low. In-lake IPZ-2 delineation uncertainty as assigned by SNC Lavalin 2009, is Low. The Uncertainty Rating for the IPZ-1 and -2 Vulnerability Scores are all High (Table 12-8).

The IPZ-1 delineation was completed by others and reviewed by Baird. The SGBLS SPR has stated that there is a Low level of Uncertainty in the location of the intake. It is noted that the shoreline used in the delineation differs from the HWM defined in MOE (2009d). This is not expected to have a large impact on the IPZ-1 delineation. There is a Low level of Uncertainty in QA/QC. No modeling was required and the overall Uncertainty Rating for IPZ-1 delineation is therefore Low.

Table 12-8: Summary of Uncertainty Ratings for IPZ delineation and Vulnerability Scores for Rope Subdivision WTP.

IPZ	Uncertainty For IPZ Delineation: Evaluation Factor	Uncertainty For IPZ Delineation: Rating	Uncertainty for Vulnerability Scores: Evaluation Factor	Uncertainty for Vulnerability Scores: Rating
IPZ-1	Data	Low	Data	High
IPZ-1	QA/QC	Low	QA/QC	Low
IPZ-1	QA/QC	Low	Accuracy of Vuln. Factors	High
IPZ-1	**Overall:**	**Low**	**Overall:**	**High**
IPZ-2 (in-lake)	Multiple factors	Low	n/a	n/a
IPZ-2 (In-land, transport pathways & vulnerability)	Data	High	Data	High
IPZ-2 (In-land, transport pathways & vulnerability)	Modeling	High	Data	High
IPZ-2 (In-land, transport pathways & vulnerability)	QA/QC	Low	QA/QC	Low
IPZ-2 (In-land, transport pathways & vulnerability)	Calibration/Validation	High	Accuracy of Vuln. Factors	High
IPZ-2 (In-land, transport pathways & vulnerability)	**Overall:**	**High**	**Overall:**	**High**
IPZ-3	Data and data gaps	High	-	-
IPZ-3	Modeling	High	-	-
IPZ-3	QA/QC	Low	-	-
IPZ-3	Model calibration/validation	High	-	-
IPZ-3	Overall	High	-	-

There was a High level of Uncertainty in the data used to delineate the Transport Pathways for the IPZ-2 as described in Baird, 2010h (Appendix TA). Velocities in the Transport Pathways were estimated and there was no calibration of the methodologies used to estimate the velocities. An overall Uncertainty Rating of High is therefore assigned to the delineation of the IPZ-2.

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 due to the limited data available to determine a history of water quality concerns. The Source Vulnerability Factor applies to both the IPZ-1 and the IPZ-2. The level of uncertainty for the Area Vulnerability Factor for the IPZ-1 is also Low, as it is defined in MOE (2009b) as 10. The level of uncertainty for the Area Vulnerability for the IPZ-2 is High. There is a High degree of Uncertainty in the methodology used to develop the Area Vulnerability Factor. An overall rating of High was assigned to the Uncertainty for the IPZ-2 Vulnerability Score.

IPZ-3 Uncertainty

While it was not necessary to delineate and IPZ-3 for the modeled threats associated with the Rope Subdivision intake, it is still important to record uncertainty of the work to investigate the potential need for an IPZ-3.

An assessment of the IPZ-3 delineation uncertainty was completed by Baird (2011c) (Appendix TA). Because of the multidisciplinary nature of the work being undertake, uncertainty of other consultant tasks was also considered, this included threat identification by Genivar, and hydrodynamic modelling by SNC Lavalin (2011). Uncertainty analysis considered factors such as data quality and gaps, model limitations, QA/QC and model calibration/validation.

The overall Uncertainty for the IPZ-3 delineation approach was rated as High (Table 12-8).

Although the IPZ-3 delineation approach received an overall high uncertainty rating, the methodologies used are consistent with the Technical Rules. The high rating reflects data limitations, as well as limitations of the modeling undertaken. It is noted that the modeling approach is consistent with the Technical Rules and the level of effort permitted based on schedule and budget. The intent of this work is to provide a better understanding of the vulnerability of the intake and this has been accomplished.

12.4.2 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 Rope Subdivision Water Treatment Plant 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 the Township of Tay surface water systems are provided in Technical Memorandum P1 – Drinking Water Issues Evaluation – Tay Surface Water (Appendix TA).

No Drinking Water Issues were identified for the Rope Subdivision Water Treatment Plant

Concentrations of colour, alkalinity, organic nitrogen, and aluminum were occasionally observed to exceed the aesthetic or operational guidelines of the Ontario Drinking Water Quality Standards (ODWQS). These parameters are considered to be naturally occurring.

Some organic chemical parameters were observed in trace concentrations on rare occasions in treated water samples. The observed concentrations are typically close to the method detection limits and substantially less than the corresponding Ontario Drinking Water Quality Standard (ODWQS). These parameters are not observed on a persistent basis.

Surface water in Severn Sound 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

Various trihalomethane compounds were present in trace concentrations in the treated water. Trihalomethanes are considered to be by-products of disinfection by chlorination. The Trihalomethane concentrations are typically well below the ODWQS values and increasing trends of concentration were not observed.

12.4.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Rope Subdivision WTP was undertaken based on both the Vulnerability Score approach in accordance with the detailed methodology presented in Technical Memo – A5 (Appendix MO) and the event based modeling approach specified in Technical Rule 130. 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 Rope Subdivision 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.

12.4.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Rope Subdivision 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.

12.4.3.2 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 Rope Subdivision 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 with staff from the Township of Tay to identify potential conditions within the identified IPZs for the drinking water supply.

No confirmed Conditions have been identified for the Rope Subdivision 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 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 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~~

12.4.3.3.1 Pathogen Parameters

The MECP table of drinking water threats can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 12a-2 ~~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 Rope Subdivision 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 8.1.

12.4.3.3.2 Chemical Parameters

The MECP table of drinking water threats can be used in conjunction with the Vulnerability Scores~~The Key Table~~ on Figure 12a-3 ~~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 Rope Subdivision 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 8.1.

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 Rope Subdivision 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 12a-1 illustrates the Vulnerability Score map for Rope Subdivision WTP 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 Identifying threats and circumstances that could be a Significant Threat within the IPZ-3

According to the Technical Rules, activities with circumstances the same as those used to delineate the IPZ-3 need to be identified in the Assessment Report. The purpose of this table is to highlight what future potential activities may be a significant threat to the quality of drinking water based on the delineated IPZ-3 and the associated modelling.

As the two Significant Threats identified through modeling were within the IPZ-2 it was not necessary to delineate an IPZ-3 for the Rope Subdivision Intake. Therefore for the purpose of identifying future threat activities it would be necessary to model activities that are outside of the IPZ-1 and IPZ-2, and consider fuel handling and storage activities with circumstances according to ~~Table 12-9~~the Technical Rules as a potential Significant Threat within the IPZ-1 and IPZ-2.

~~**Table 12-9: Threats and circumstances that are or could be a potential Significant Threat within the IPZ-1 and IPZ-2 based on modeled threats.**~~

~~Chemicals~~		
~~Circumstances in Table of Drinking Water Threats[1]~~		
~~152-153~~	~~155-158~~	~~160-163~~
~~165-168~~	~~170-173~~	~~175-178~~
~~180-183~~	~~185-188~~	~~190-191~~
~~1349-1350~~	~~1352-1355~~	~~1357-1360~~
~~1362-1365~~	~~1367-1370~~	~~1372-1375~~
~~1377-1380~~	~~1382-1385~~	~~1387-1390~~
~~1392-1395~~	~~1397-1400~~	~~1402-1405~~
~~1407-1408~~		

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~~Chemicals~~ ~~Circumstances in Table of Drinking Water Threats~~[1]
~~[1]The circumstance numbers were determined from information contained within the MOE Table of Drinking Water Threats (November 2009).~~

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12.4.3.6 *Enumerating Drinking Water Threats*

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The number of Significant Drinking Water Threats for the Rope Subdivision WTP has been determined using the Vulnerability Score methodology outlined in Technical Memorandum A5 (Appendix MO). Based on the vulnerability Score approach, no Activities that are considered to be potential Significant Drinking Water Threats were identified for the IPZ of the Rope Subdivision Water Treatment Plant.

Two potential Significant Threat activities were however identified through the event based modelling approach. The activities have been identified as potential Significant Threats for the handling and storage of fuel. The activities are located in the IPZ-2, therefore it was not necessary to delineate and IPZ-3 for these threats.

Number of threats for Rope Subdivision Surface Water intake is summarized in Table 12-10. Location of the potential significant threats is presented in Figure 12a- 7. There are no Significant Threats associated with Conditions or Drinking Water Issues.

12.4.3.7 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 and -2. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a threat in the Table of Drinking Water Threats.

Managed Lands were identified and the Managed Lands proportions were determined for IPZ-1 and IPZ-2 for the Rope Subdivision 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 12.4.3.6). The Managed Lands is used in the identification of Threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material and commercial fertilizer.

Figure 12a-4 illustrates the location and proportion of Managed Lands within the delineated IPZ-1 and IPZ-2 for the Rope Subdivision Water Treatment Plant. In accordance with the Technical Rules, maps of Managed Lands have not been generated for the IPZ-3 as there is no associated Vulnerability Score.

12.4.3.8 Livestock Density

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

The Livestock Density was determined for IPZ-1 and IPZ-2 for the Rope Subdivision 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 12.4.3.6). 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-5 illustrates the distribution of Livestock Density within the delineated IPZ-1 and IPZ-2 for the Rope Subdivision WTP where Vulnerability Scores were greater than 4. In accordance with the Technical Rules, Livestock Density has not been mapped within the IPZ-3 as there is no associated Vulnerability Score.

12.4.3.9 Impervious Surfaces

Technical Rule 16(11) ~~(December 2021August 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 and -2. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in ~~Part XII of~~ the Technical Rules ~~(December 2021)~~~~the Table of Drinking Water Threats~~.

The proportion of impervious surfaces within the delineated IPZ-1 and IPZ-2 for the Rope Subdivision 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~~WHPA~~ Z~~z~~ones using the 2021 Technical Rules. The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.4.3.6). The Impervious Surfaces are used in the identification of Threat activities associated with the application of winter de-icing agents (salt).

Figure 12a-6 illustrates the distribution of Impervious Surfaces within the delineated IPZs ~~-1~~ for the Rope Subdivision Water Treatment Plant where Vulnerability Scores were greater than 4.5 for IPZ -1, -2, and -3. ~~In accordance with the Technical Rules, maps of Impervious Surfaces have not been generated for the IPZ-3 as there is no associated Vulnerability Score.~~

Table 12-910: Number of Significant Drinking Water Threats for the Rope Subdivision Surface Water Drinking 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.	770
3.	The application of agricultural source material to land.	0
4.	The storage of agricultural source material to land.	0
5.	The management of agricultural source material.	0
6.	The application of non-agricultural source material to land.	0
7.	The handling and storage of non-agricultural source material.	0
8.	The application of commercial fertilizer to land.	0
9.	The handling and storage of commercial fertilizer to land.	0
10.	The application of pesticide to land.	0
11.	The handling and storage of pesticide.	0
12.	The application of road salt.	0
13.	The handling and storage of road salt.	0
14.	The storage of snow.	0
15.	The handling and storage of fuel.	2
16.	The handling and storage of dense non-aqueous phase liquid.	0

Threat Number	Threat	Significant threat counts Number of threats
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.	0
22.	The establishment and operation of a liquid hydrocarbon pipeline	0
-	**Totals:**	**79~~2~~*** significant threats (on **79** properties)

*2 potential Threat that require further verification (2015)

12.5 Victoria Harbour Water Treatment Plant

The Victoria Harbour Water Treatment Plant draws water from Hog Bay off Bergie Point, in Severn Sound, which is a protected embayment at the southern end of Georgian Bay. The system is a large municipal residential system serving most of the urban serviced area of the Township. The capacity of the plant is 7,800m^3/d. The intake pipe is 400mm in diameter and extends approximately 100 m from shore, in a water depth of about 4.1 m below CD.

The intake itself is a grouted, ballast stone-filled timber crib which protects the intake pipe and riser. This riser elevates the intake point 1.23 m above the bottom of the bay which is described as mucky in this area. The intake point is normally about 4.3 m below the water surface but the extreme high and low lake levels give a range of approximately 5.7 m to 3.1 m. Treatment consists of chemically assisted coagulation-flocculation, sedimentation and filtration using dual-media filters of sand and anthracite coal.

Lake ice conditions at the intake are similar to those for Beausoleil Island – because of the shallow sheltered region around the intake, it is not likely affected by frazil ice and it is expected that the first solid ice forms about the intake in late December or Early January, remaining in place until mid-April. Hog Bay is slightly more exposed, however, and the ice cover normally forms in early January and clears by early April.

12.5.1.1 Intake Protection Zones (IPZ)

The Intake Protection Zones for the Victoria Harbour WTP are shown in Figure 12b-1. IPZ-1 consists of a 1 km radius centered on the crib of the intake. The IPZ-2, (in-water and inland) is entirely contained within the boundaries of the IPZ-1. IPZ-3 was delineated based on location of modeled potential significant threats. The IPZ-3 includes approximately 7 km of shoreline along Port McNicoll, including a 120m setback and all in-lake areas between the Port McNicoll shoreline and the IPZ-1.

12.5.1.2 Intake Protection Zone (IPZ) Vulnerability Scores

The Vulnerability Factors and Scores for the IPZ-1 and IPZ-2 sub-zones are summarized below in Error! Reference source not found. and Figure 12b-1. IPZ-3s, using the event based approach are not assigned a vulnerability Score.

Table 12-~~10~~11: Summary of Vulnerability Factors and Scores for Victoria Harbour WTP Intake.

IPZ	Area Vulnerability Factor (B)	Source Vulnerability Factor (C)	Vulnerability Score (V)
IPZ-1	10	1.0	10.00
IPZ-2	The IPZ-2 is contained within the IPZ-1	The IPZ-2 is contained within the IPZ-1	The IPZ-2 is contained within the IPZ-1

12.5.1.3 Uncertainty for IPZ Delineation and Vulnerability

IPZ-1 and IPZ-2 Uncertainty

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)).

Based on the factors discussed above, Baird (2010h) recommended an IPZ delineation Uncertainty Rating for the IPZ-1 as low. The Uncertainty Rating for the IPZ-1 Vulnerability Score was High, and was not applicable as IPZ-2 is contained within the IPZ-1 (Table 12-12).

The IPZ-1 delineation was completed by others and reviewed by Baird. The SGBLS SPR has stated that there is a low level of uncertainty in the location of the intake. There is a Low level of Uncertainty in QA/QC. It is noted that the shoreline used in the delineation differs from the HWM defined in MOE (2009d). This is not expected to have a large impact on the IPZ-1 delineation. No modeling was required and the overall Uncertainty Rating for IPZ-1 delineation is therefore Low.

In-lake IPZ-2 delineation uncertainty as assigned by SNC Lavalin 2009, is Low. There was a High level of Uncertainty in the data used to delineate the Transport Pathways for the IPZ-2 as described in Baird, 2010h (Appendix TA). Velocities in the Transport Pathways were estimated

and there was no calibration of the methodologies used to estimate the velocities. An overall Uncertainty of High is therefore assigned to the delineation of the IPZ-2 (inland extent and Transport Pathways). It is noted that the IPZ-2 is entirely within the IPZ-1, and this High rating is therefore of less significance.

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 due to the limited data available to determine a history of water quality concerns. The Source Vulnerability Factor applies to both the IPZ-1 and the IPZ-2. The level of uncertainty for the Area Vulnerability Factor for the IPZ-1 is also Low, as it is defined in MOE (2009b) as 10. A Vulnerability Factor was not assigned to the IPZ-2, because it is within the IPZ-1. Therefore no Uncertainty Score was assigned to the Vulnerability Score.

IPZ-3 Uncertainty

An assessment of the IPZ-3 delineation uncertainty was completed by Baird (2011c) (Appendix TA). Because of the multidisciplinary nature of the work being undertake, uncertainty of other consultant tasks was also considered, this included activity identification by Genivar, and hydrodynamic modelling by SNC Lavalin (2011). Uncertainty analysis considered factors such as data quality and gaps, model limitations, QA/QC and model calibration/validation.

The overall Uncertainty for the IPZ-3 delineation was rated as High (Table 12-12).

Although the IPZ-3 delineation received an overall high uncertainty rating, the methodologies used are consistent with the Technical Rules. The high rating reflects data limitations, as well as limitations of the modeling undertaken. It is noted that the modeling approach is consistent with the Technical Rules and the level of effort permitted based on schedule and budget. The intent of this work is to provide a better understanding of the vulnerability of the intake and this has been accomplished.

Table 12-1112: Summary of uncertainty Ratings for Victoria Harbour WTP Intake IPZs and Vulnerability Scores.

IPZ	Uncertainty for IPZ Delineation		Uncertainty for Vulnerability Scores	
	Evaluation Factor	Rating	Evaluation Factor	Rating
IPZ-1	Data	Low	Data	High
IPZ-1	QA/QC	Low	QA/QC	Low
IPZ-1	QA/QC	Low	Accuracy of Vuln. Factors	High
IPZ-1	**Overall:**	**Low**	**Overall:**	**High**
IPZ-2 (in-lake)	Multiple factors	Low	Not applicable as IPZ-2 is contained within the IPZ-1.	N/A
IPZ-2 (In-land, transport pathways & vulnerability)	Data	High	N/A	N/A
IPZ-2 (In-land, transport pathways & vulnerability)	Modeling	High	N/A	N/A
IPZ-2 (In-land, transport pathways & vulnerability)	QA/QC	Low	N/A	N/A
IPZ-2 (In-land, transport pathways & vulnerability)	Calibration/Validation	High	N/A	N/A
IPZ-2	**Overall:**	**High**	**Overall:**	**High**
IPZ-3	Data and data gaps	High	N/A	N/A
IPZ-3	Modeling	High	N/A	N/A
IPZ-3	QA/QC	Low	N/A	N/A
IPZ-3	Model calibration/validation	High	N/A	N/A
IPZ-3	**Overall**	**High**	N/A	N/A

12.5.2 Drinking Water Issues Evaluation

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

Available data describing raw water quality and treated water quality for the Victoria Harbour 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 the Township of Tay are provided in Technical Memorandum P1 – Drinking Water Issues Evaluation – Tay (Appendix TA).

No Drinking Water Issues were identified for the Victoria Harbour WTP.

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).

Concentrations of colour, dissolved organic carbon (DOC), hardness, organic nitrogen, and turbidity were occasionally observed to exceed the aesthetic or operational guidelines of the Ontario Drinking Water Quality Standards (ODWQS). These parameters are considered to be naturally occurring.

One organic chemical parameter was observed in trace concentrations on rare occasions in treated water samples. The observed concentrations are typically close to the method detection limits and are substantially less than the corresponding Ontario Drinking Water Quality Standard (ODWQS). This parameter is not observed on a persistent basis.

Surface water in Severn Sound 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

Various trihalomethane compounds were present in trace concentrations in the treated water. Trihalomethanes are considered to be by-products of disinfection by chlorination. The

Trihalomethane concentrations are typically well below the ODWQS values and increasing trends of concentration were not observed.

12.5.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Victoria Harbour WTP was undertaken based on both the Vulnerability Score approach in accordance with the detailed methodology presented in Technical Memo – A5 (Appendix MO) and the event based modeling approach specified in Technical Rule 130. 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 Victoria Harbour 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.

12.5.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Victoria Harbour WTP 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.

12.5.3.2 List of Drinking Water Threats – Conditions

Methods used to assess Conditions are described in Technical Memorandum A5 (Appendix MO). The following information sources were consulted to identify existing Conditions that could affect the Victoria 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 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 with staff from the Township of Tay to identify potential conditions within the identified IPZs for the drinking water supply.

No confirmed Conditions have been identified for the Victoria Harbour WTP. No potential Conditions have been identified for consideration at this time.

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

The areas where Activities are or would be Drinking Water Threats are illustrated on a series of maps based on the Vulnerability Scores and Vulnerable Area delineations. The maps combined with the 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~~

12.5.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 12b-2 ~~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 within IPZ-1 for the Victoria Harbour WTP. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 10.

12.5.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 12b-3 ~~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 Victoria Harbour WTP. Activities that are or would be Significant Drinking Water Threats for chemical threats can be observed within the areas where the Vulnerability Score is 10.

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

Further to Section 12.5.3.2, no Conditions have been confirmed within the WHPA for the Victoria Harbour 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 12b-1 illustrates the Vulnerability Score map for Victoria Harbour WTP that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

12.5.3.5 Identifying threats and circumstances that could be a significant threat within the IPZ-3

According to the Technical Rules, activities with circumstances the same as those used to delineate the IPZ-3 need to be identified in the Assessment Report. The purpose of this table is to highlight what future potential activities may be a Significant Threat to the quality of drinking water based on the delineated IPZ-3 and the associated modelling. ~~Table 12-13 lists~~The Technical Rules list the threats and circumstances that are or would be identified as a Significant Threat within the IPZ-3, such as the handling and storage of fuel.

~~**Table 12-13: Threats and circumstances that are or could be a potential significant threat within the IPZ-1 and IPZ-2 based on modeled threats. Numbers in table refer to the circumstance with the Table of Drinking Water Threats (MOE 2009).**~~

~~Chemicals~~

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Circumstances in Table of Drinking Water Threats*		
152-153	155-158	160-163
165-168	170-173	175-178
180-183	185-188	190-191
1349-1350	1352-1355	1357-1360
1362-1365	1367-1370	1372-1375
1377-1380	1382-1385	1387-1390
1392-1395	1397-1400	1402-1405
1407-1408		
*The circumstance numbers were determined from information contained within the MOE Table of Drinking Water Threats (November 2009).		

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12.5.3.6 *Enumerating Drinking Water Threats*

The number of Significant Drinking Water Threats for the Victoria Harbour Water Supply has been determined using the methodology outlined in Technical Memorandum A5 (Appendix MO) and refined using the methodology outlined in Chapter 5 (Section 5.5.6.4) of this Assessment Report. There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 12-14 documents the refined enumeration of existing and potential activities that are considered to be Significant Drinking Water Threats within the IPZ for the Victoria Harbour Water Treatment Plant. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is 10 in IPZ-1.

A total of six (6) activities that are considered to be Significant Drinking Water Threats were identified in association with five (5) land parcels in the IPZ for the Victoria Harbour Water Supply. Two (2) of the Significant Threat activities identified relate to discharges from stormwater management facilities. Three (3) Significant Threat activities were identified related to handling and storage of fuel. One (1) potential Significant Threat activity was identified for handling and storage of DNAPLs.

Table 12-1214: Number of Significant Drinking Water Threats for the Victoria Harbour Surface Water Drinking 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.	2
3.	The application of agricultural source material to land.	0
4.	The storage of agricultural source material to land.	0
5.	The management of agricultural source material.	0
6.	The application of non-agricultural source material to land.	0
7.	The handling and storage of non-agricultural source material.	0
8.	The application of commercial fertilizer to land.	0
9.	The handling and storage of commercial fertilizer to land.	0
10.	The application of pesticide to land.	0
11.	The handling and storage of pesticide.	0
12.	The application of road salt.	0
13.	The handling and storage of road salt.	0
14.	The storage of snow.	0
15.	The handling and storage of fuel.	3
16.	The handling and storage of dense non-aqueous phase liquid.	1
17.	The handling and storage of an organic solvent.	0

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:	6* significant threats (on 5 properties)

*3 verified existing Threats and 3 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

~~12.5.3.6~~12.5.3.7 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 and -2. 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~~Table of Drinking Water Threats~~.

Managed Lands were identified and the Managed Lands proportions were determined for the Victoria Harbour IPZ-1 as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.5.3.6). The Managed Lands is used in the identification of Threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material and commercial fertilizer.

Figure 12b-4 illustrates the location and proportion of Managed Lands within the delineated IPZ-1 for the Victoria Harbour WTP. In accordance with the Technical Rules, maps of Managed Lands have not been generated for the IPZ-3 as there is no associated Vulnerability Score.

~~12.5.3.7~~12.5.3.8 Livestock Density

Technical Rule 16(10) ~~(August 2009)~~ requires the Assessment Report to include maps showing the livestock density within including IPZ-1 and -2. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the ~~Table of~~ Technical Rules~~Drinking Water Threats~~.

The Livestock Density was determined for the Victoria Harbour IPZ-1 as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.5.3.6). 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-5 illustrates the distribution of Livestock Density within the delineated IPZ-1 for the Victoria Harbour Water Treatment Plant where Vulnerability Scores were greater than 6. In accordance with the Technical Rules, Livestock Density has not been mapped within the IPZ-3 as there is no associated Vulnerability Score.

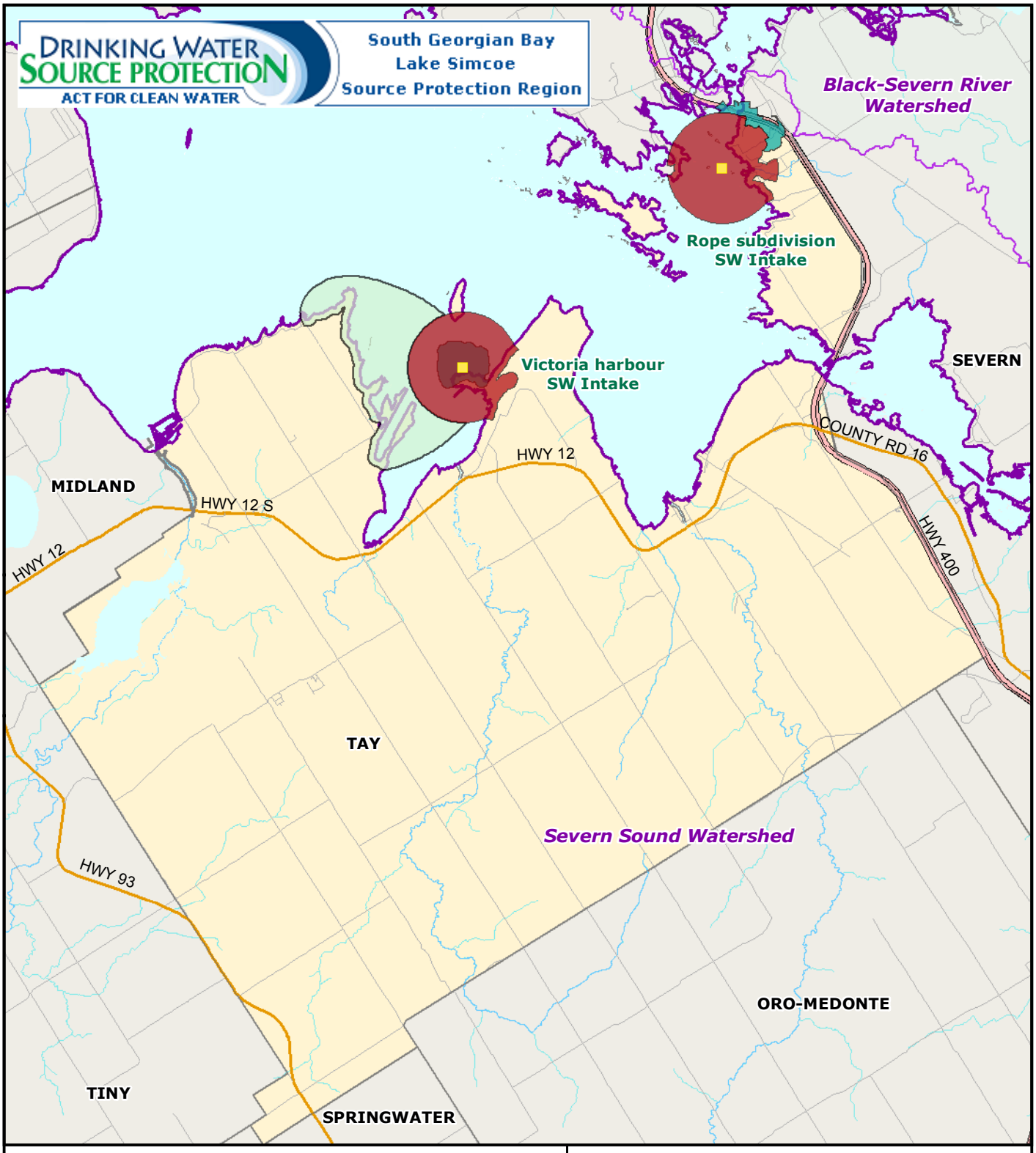
~~12.5.3.8~~12.5.3.9 Impervious Surfaces

Technical Rule 16(11) ~~(August 2009~~December 2021~~)~~ 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 ~~Part XII of~~ the Technical Rules ~~(December 2021)~~~~the Table of Drinking Water Threats~~.

The proportion of Impervious Surfaces within the delineated IPZ-1 for the Victoria Harbour WTP 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 ~~WHPA z~~Zones using the 2021 Technical Rules. The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 12.5.3.6). The Impervious Surfaces are used in the identification of Threat activities associated with the application of winter de-icing agents (salt).

~~In accordance with the Technical Rules, maps of Impervious Surfaces have not been generated for the IPZ-3 as there is no associated Vulnerability Score.~~

Figure 12b-6 illustrates the distribution of Impervious Surfaces within the delineated IPZ-~~1~~s for the Victoria Harbour Water Treatment Plant where Vulnerability Scores were greater than 4.5 for IPZ -1, -2, and -3~~6~~.



- Municipal Surface Water Intakes
- IPZ-1 (1000m on water or 120m inland)
- IPZ-2 (2 hr time of travel)
- IPZ-3
- SWP Watershed Region
- SWP Watershed Area
- Upper Tier Municipality
- Lower Tier Municipality

Drinking Water System Vulnerable Areas in Township of Tay

Created by: LSRCA
Date: 2011-05-13

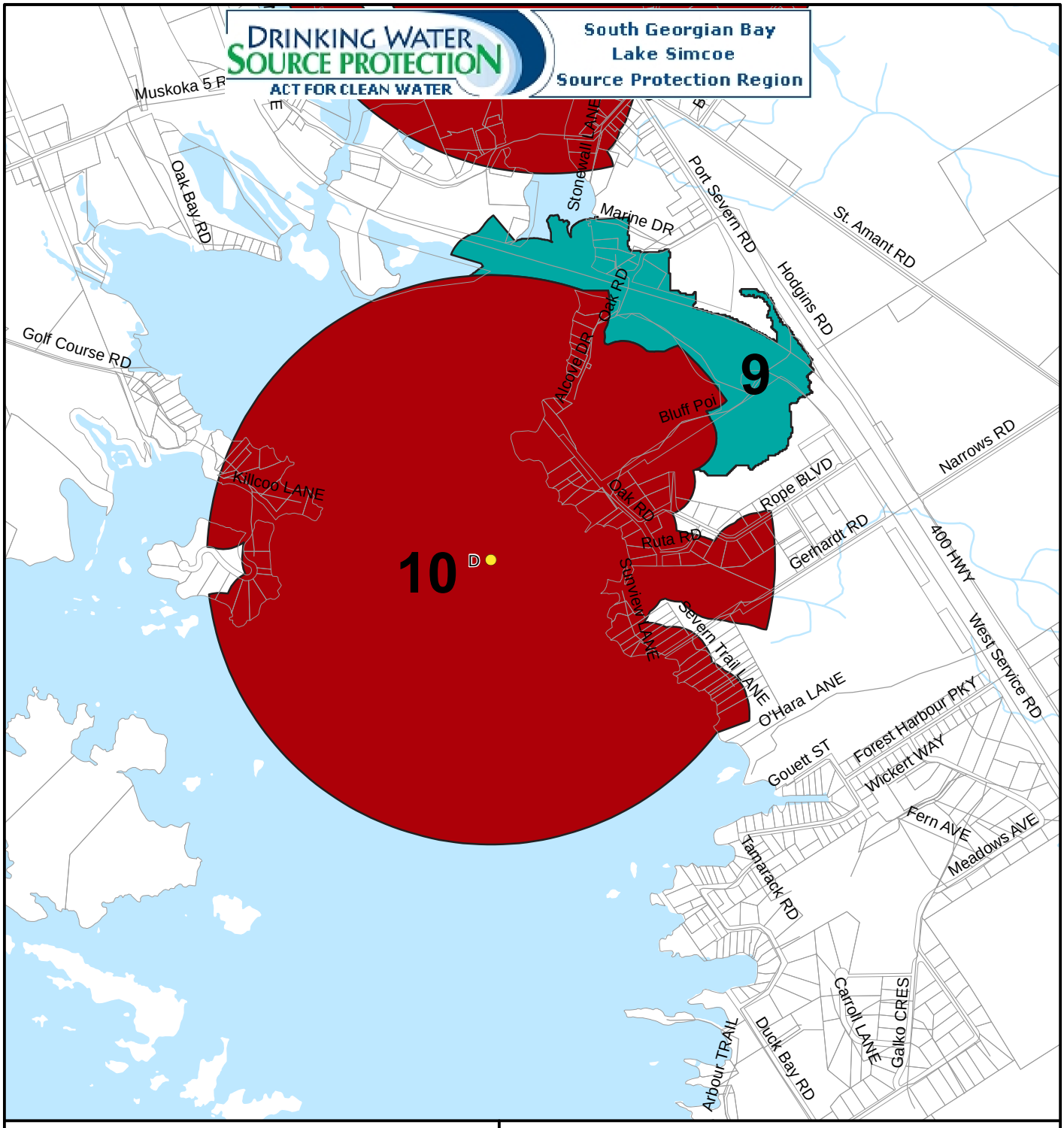
Scale: 1:100,000
0 1 2km
UTM Zone 17N, NAD83

Severn Sound Environmental Association

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

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

N
W E
S

200 100 0 200 Metres

INTAKE PROTECTION ZONE AND VULNERABILITY SCORES - ROPE SUBDIVISION, TAY

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

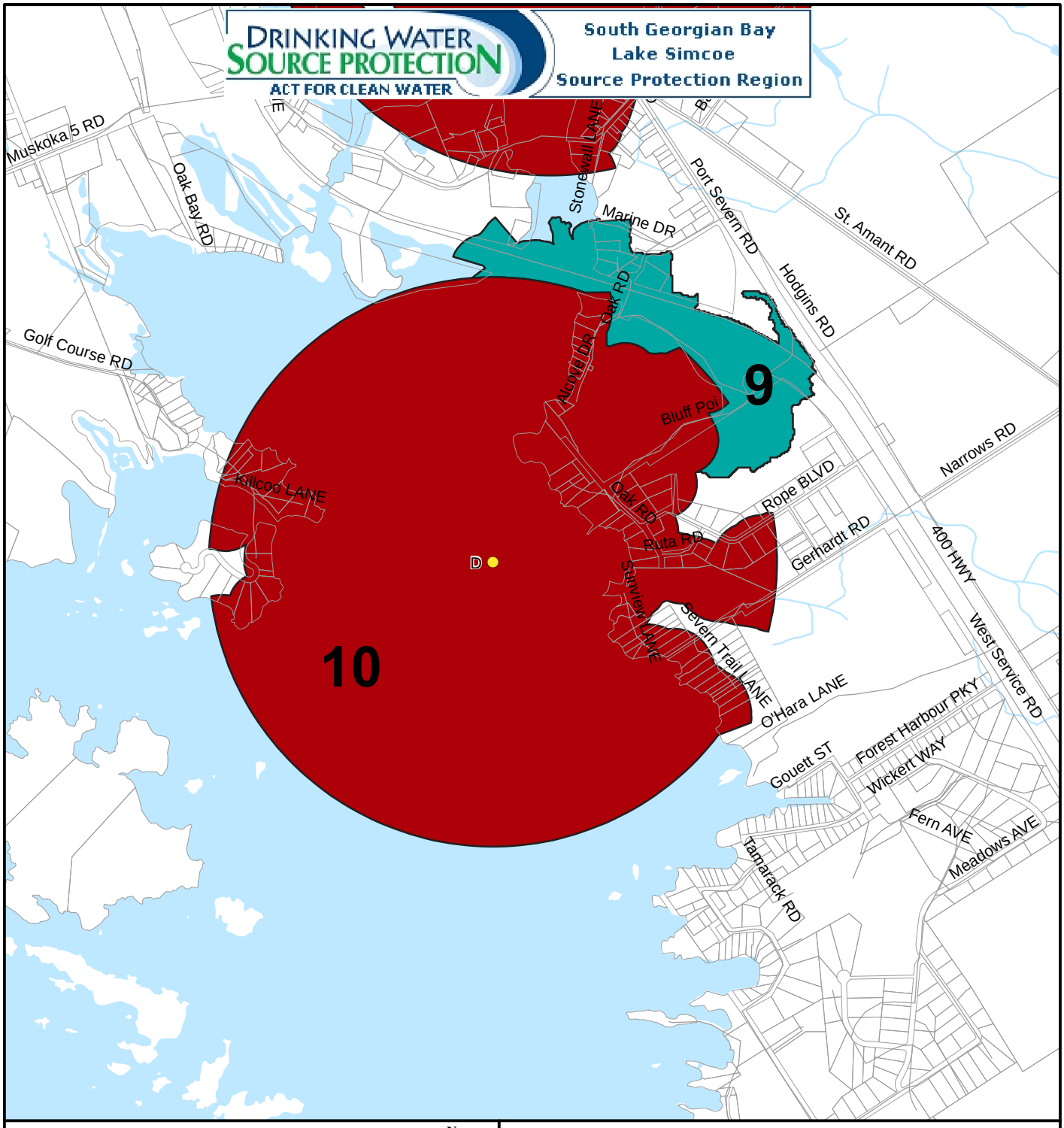
DATE: JUNE 2010	SCALE: 1:20000
PROJECT: 0-071948.11	FILE. NO.:0-07194811F17.1-1

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

GENIVAR Ontario

FIGURE **12a-1**

nt



Legend

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

N W E S

200 100 0 200 Metres

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

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

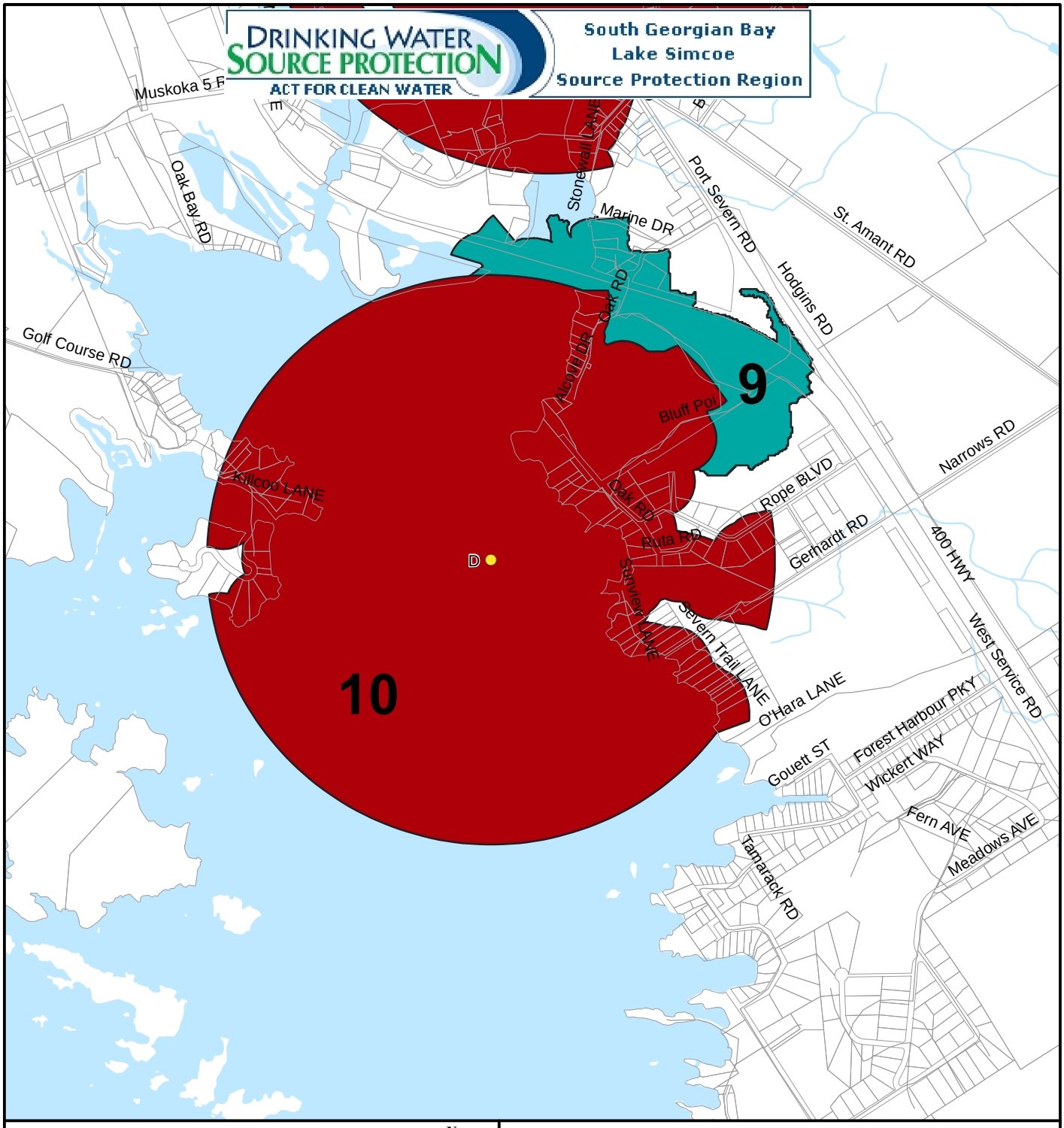
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water 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: 1:20000
PROJECT: 0-071948.11	FILE. NO.:0-07194811F17.1-2

GENIVAR Ontario

FIGURE **12a-2**

nt



Legend

10 IPZ 1 AND VULNERABILITY SCORE

9 IPZ 2 AND VULNERABILITY SCORE

SURFACE WATER INTAKE (TYPE D)

N W E S

200 100 0 200 Metres

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

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

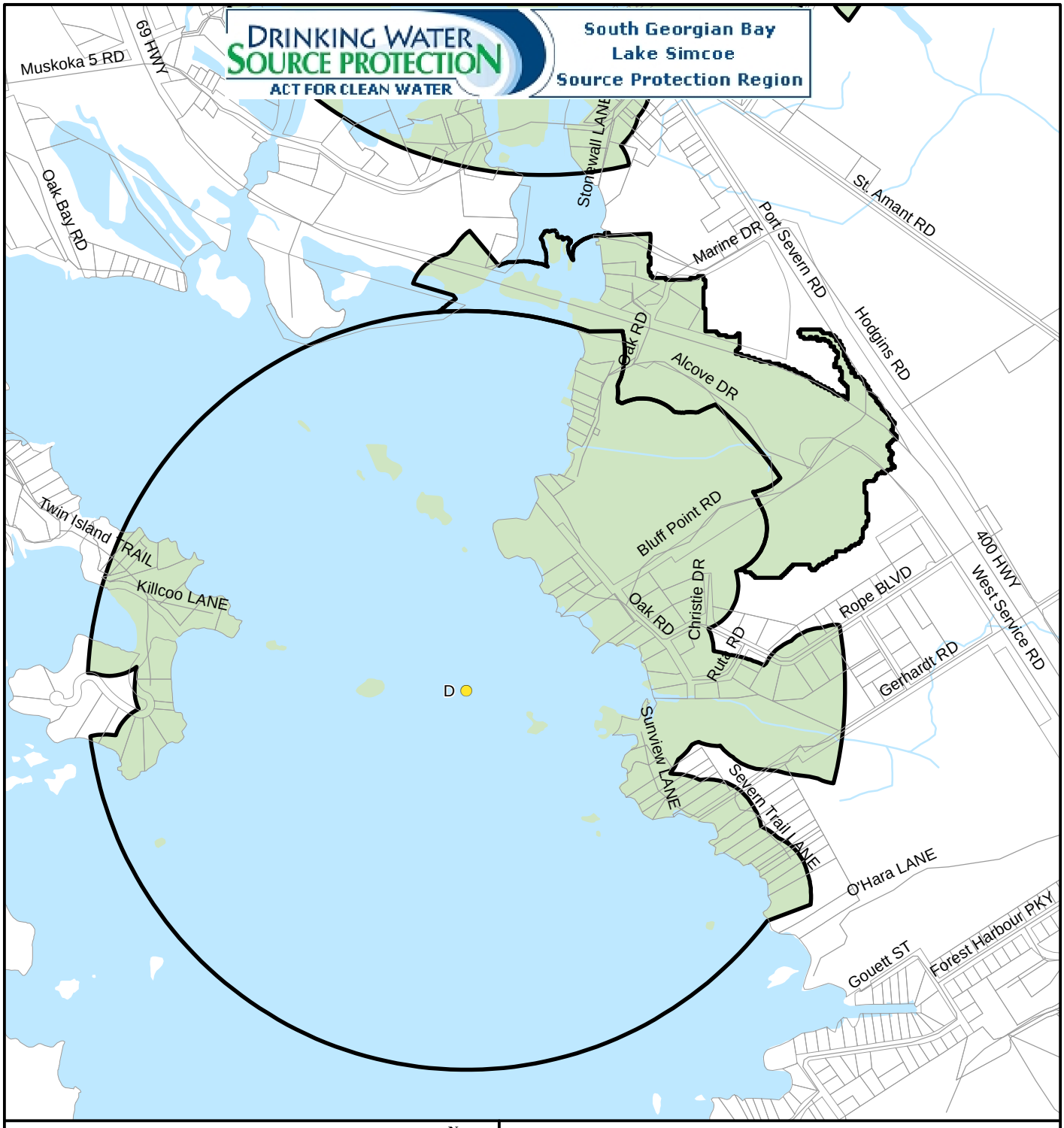
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water 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: 1:20000
PROJECT: 0-071948.11	FILE. NO.:0-07194811F17.1-3

GENIVAR Ontario

FIGURE **12a-3**

nt



Legend

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

N W E S

150 75 0 150 Metres

MANAGED LANDS - ROPE SUBDIVISION

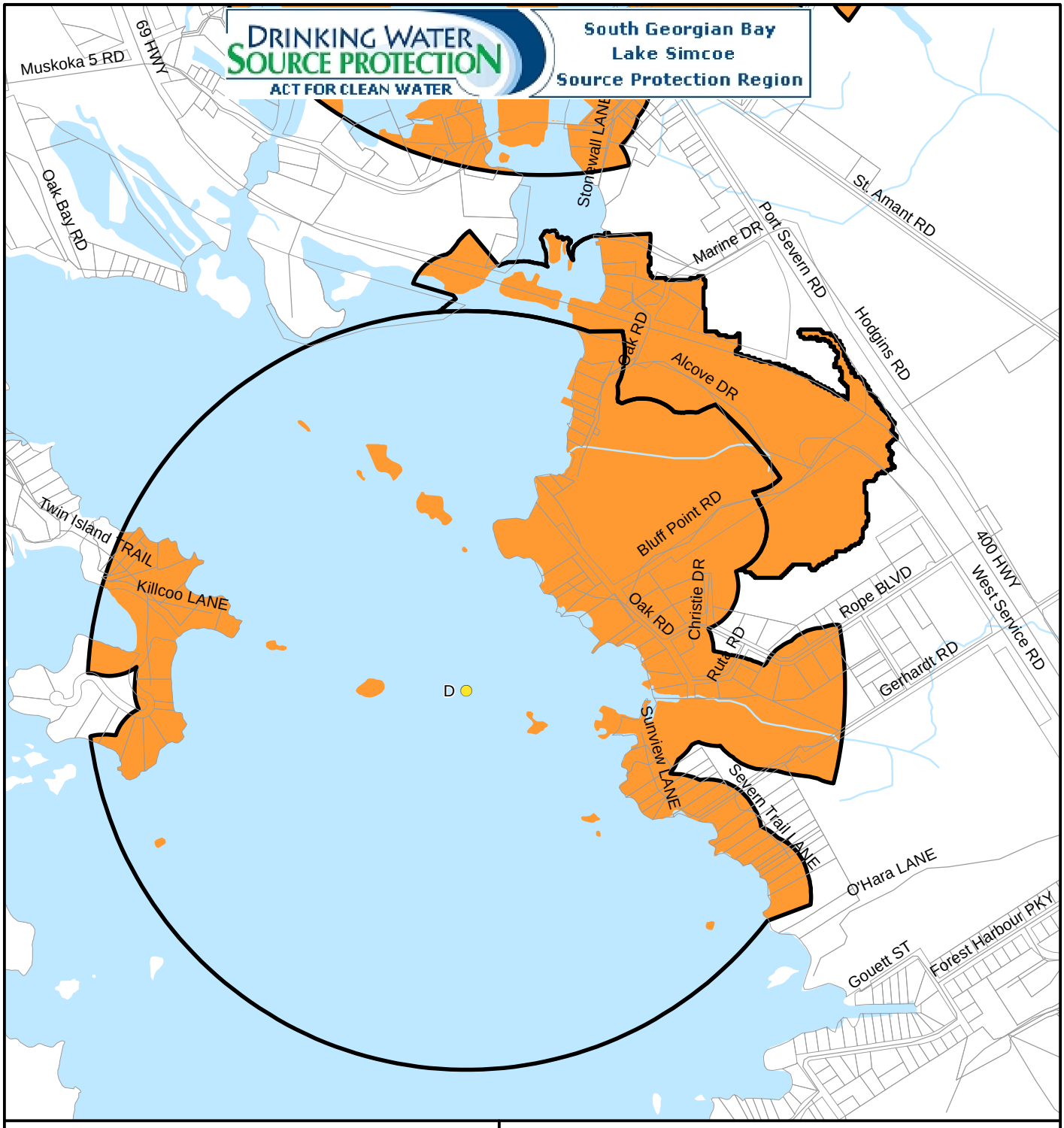
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

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: 1:15000
PROJECT: 0-071948.11	FILE. NO.:0-07194811F17.1-4

GENIVAR Ontario

FIGURE 12a-4



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

150 75 0 150 Metres

LIVESTOCK DENSITY - ROPE SUBDIVISION

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

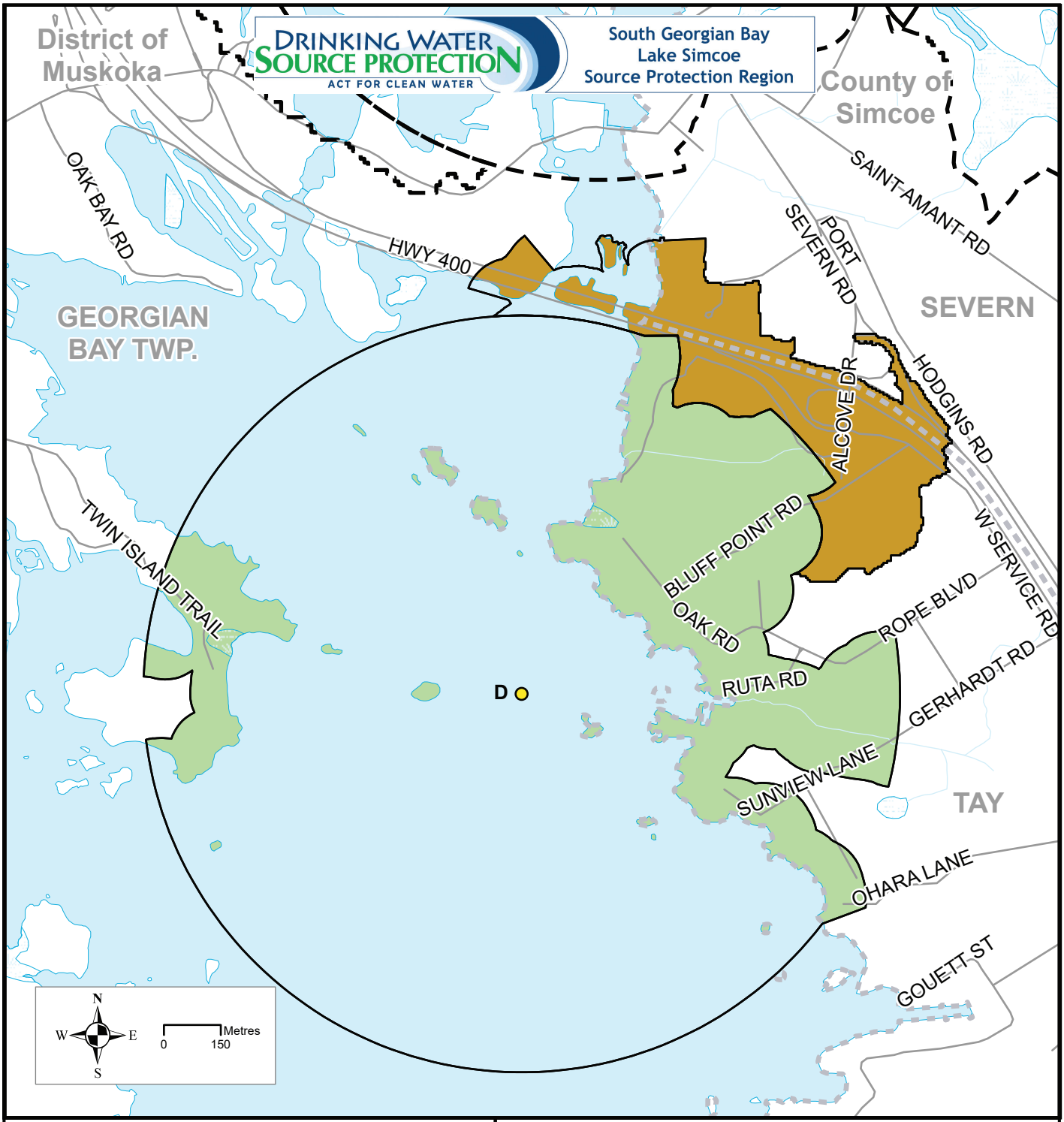
The Livestock Density proportion is illustrated for the parts of IPZ 1 and 2 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010 | SCALE: 1:15000

PROJECT: 0-071948.11 | FILE. NO.:0-07194811F17.1-5

GENIVAR Ontario

FIGURE 12a-5



Legend

Surface Water Intake (Type D)

IMPERVIOUS SURFACE

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

- IPZ Boundary
- Road
- Watercourse
- Water Area, Permanent
- Wetland, Permanent
- Municipal Boundary
- Adjacent IPZ

IMPERVIOUS SURFACES - ROPE SUBDIVISION, TAY TOWNSHIP

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL SURFACE WATER SUPPLIES

South Georgian Bay Lake Simcoe
Source Protection Region

DATE: AUGUST 2025

SCALE: 1:15,000

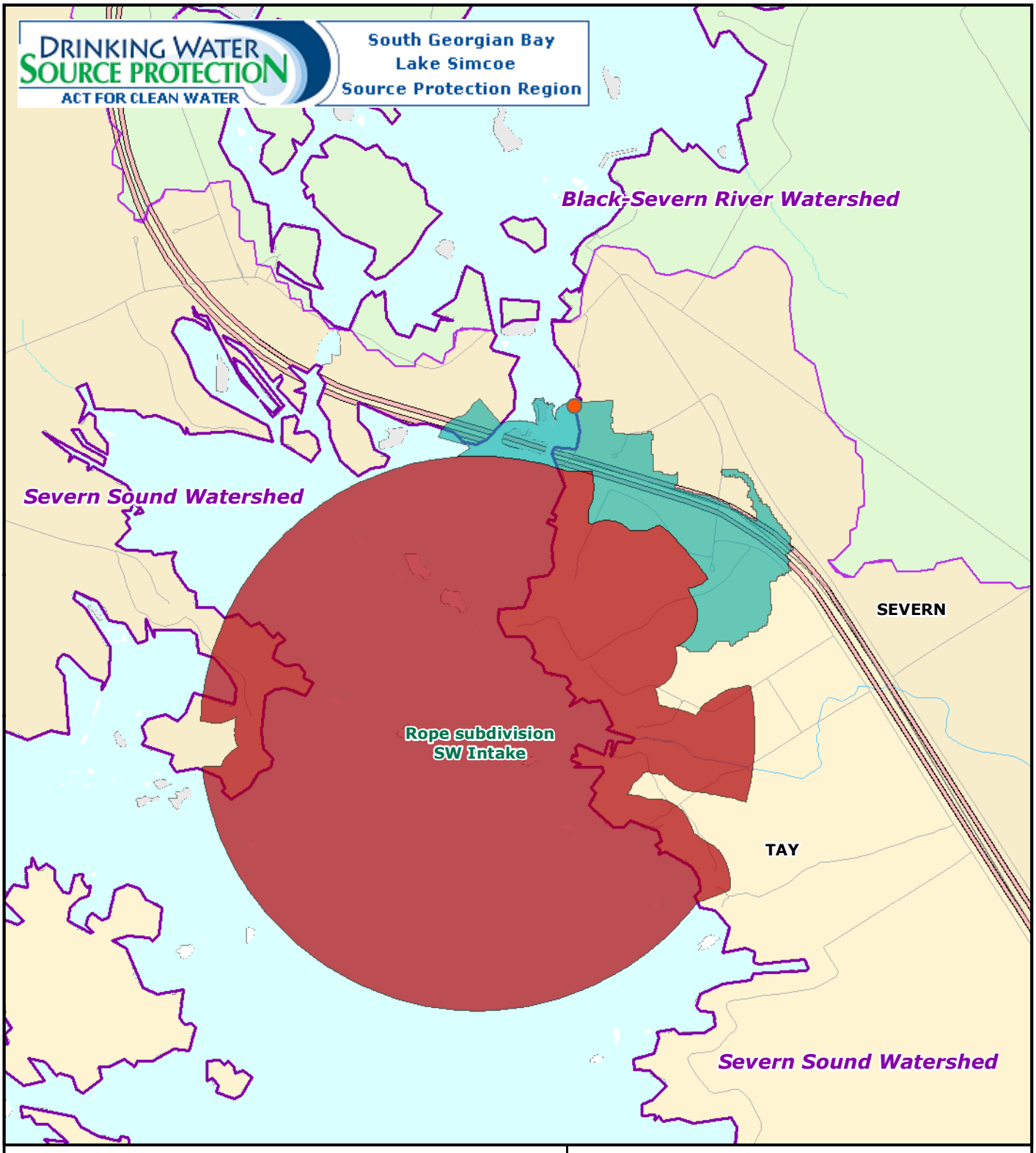
The Impervious Surfaces are illustrated for IPZ 1 and 2 where the vulnerability score is > 4.5.

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

Severn Sound Environmental Association

Ontario

FIGURE 12a-6



Potential Significant Threat
Intake Protection Zone 1 (IPZ-1)
Intake Protection Zone 2 (IPZ-2)

Potential Significant Threats to Rope Subdivision Surface Water Intake

Created by: LSRCA
Date: 2011-05-12

Scale: 1:20,000
0 0.25 0.5km
UTM Zone 17N, NAD83

Severn Sound Environmental Association

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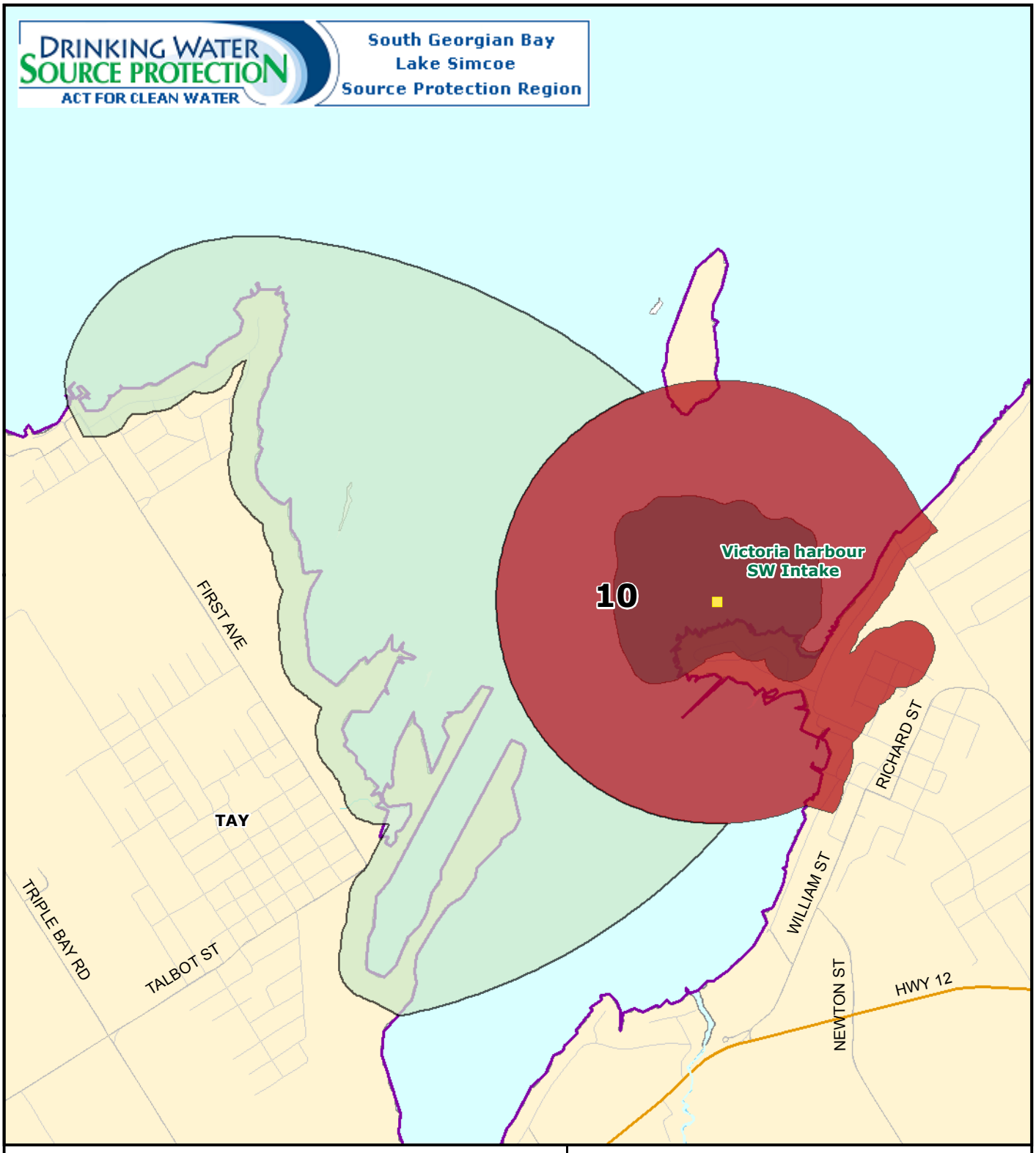
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 12a-7



Municipal Surface Water Intakes
IPZ-1 and Vulnerability Score
IPZ-2 (within IPZ-1)
IPZ-3

Intake Protection Zones And Vulnerability Scores Victoria Harbour, Tay

Created by: LSRCA
Date: 2011-05-12

Scale: 1:25,000
0 0.25 0.5 0.75km
UTM Zone 17N, NAD83

Severn Sound Environmental Association

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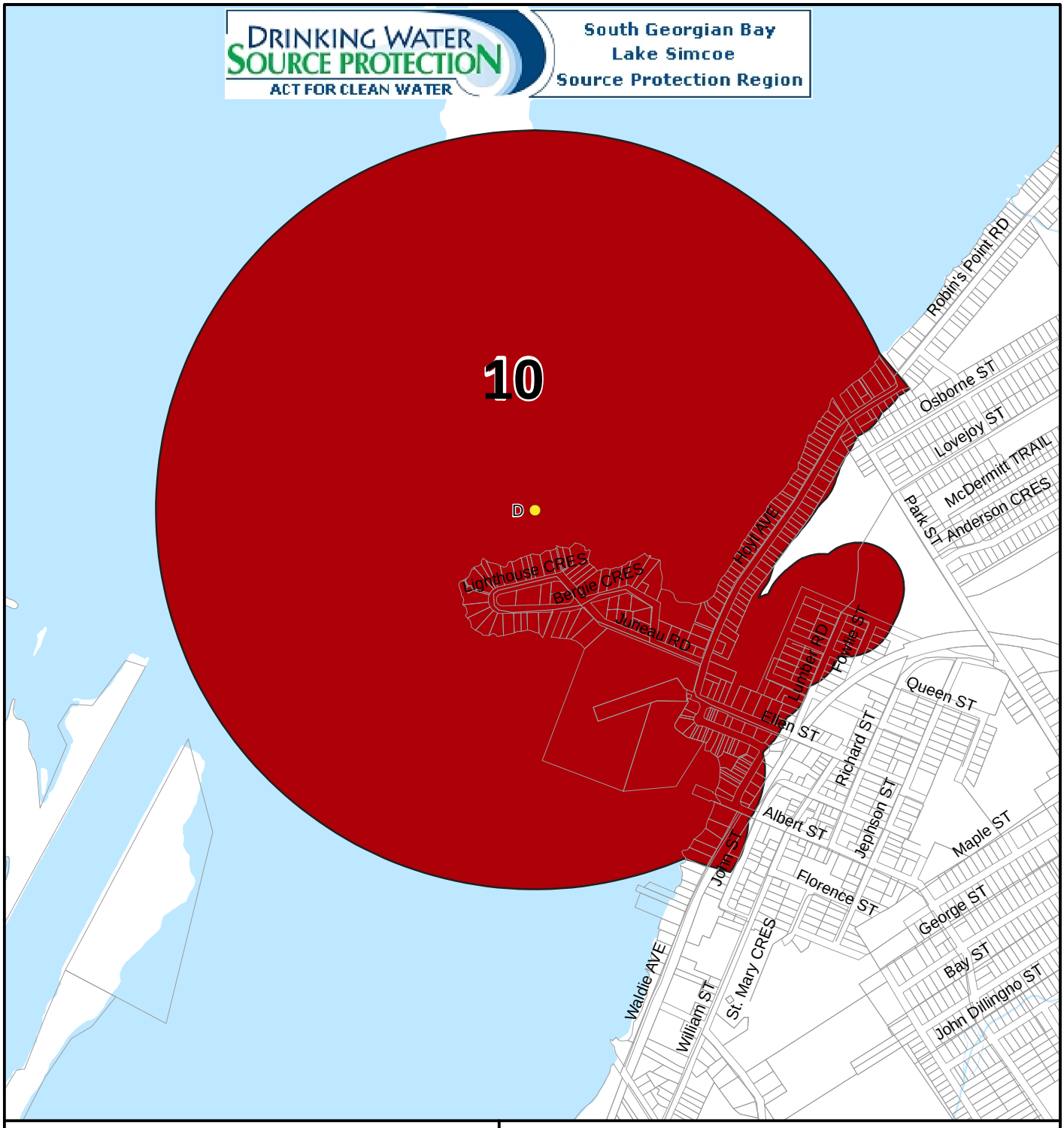
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 12b-1



Legend

10 IPZ 1 AND VULNERABILITY SCORE

SURFACE WATER INTAKE (TYPE D)

N W E S

150 75 0 150 Metres

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

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

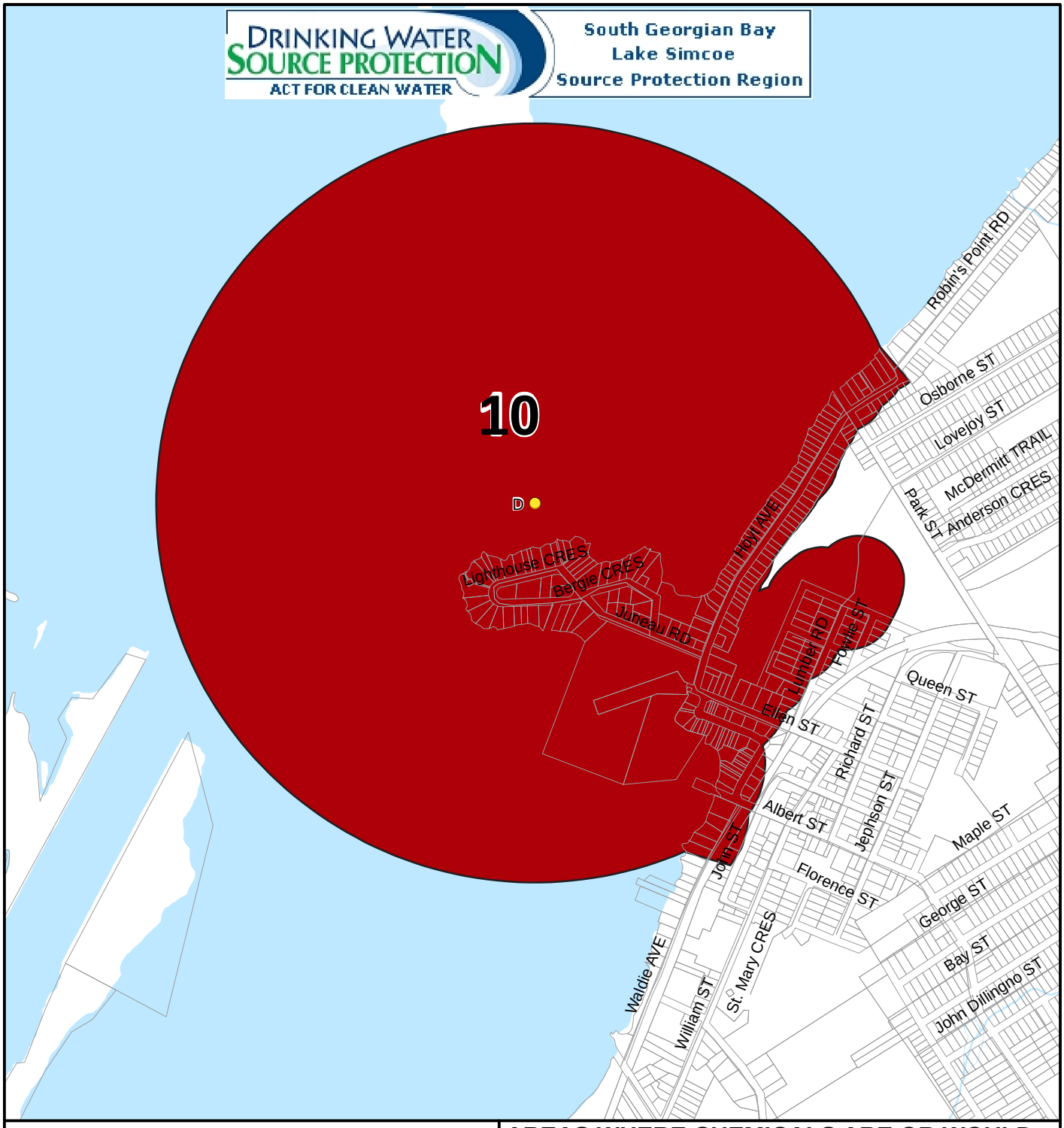
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water 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: 1:15000
PROJECT: 0-071948.11	FILE. NO.:0-07194811F17.2-2

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

GENIVAR Ontario

FIGURE **12b-2**



Legend

10 IPZ 1 AND VULNERABILITY SCORE

SURFACE WATER INTAKE (TYPE D)

N W E S

150 75 0 150 Metres

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

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

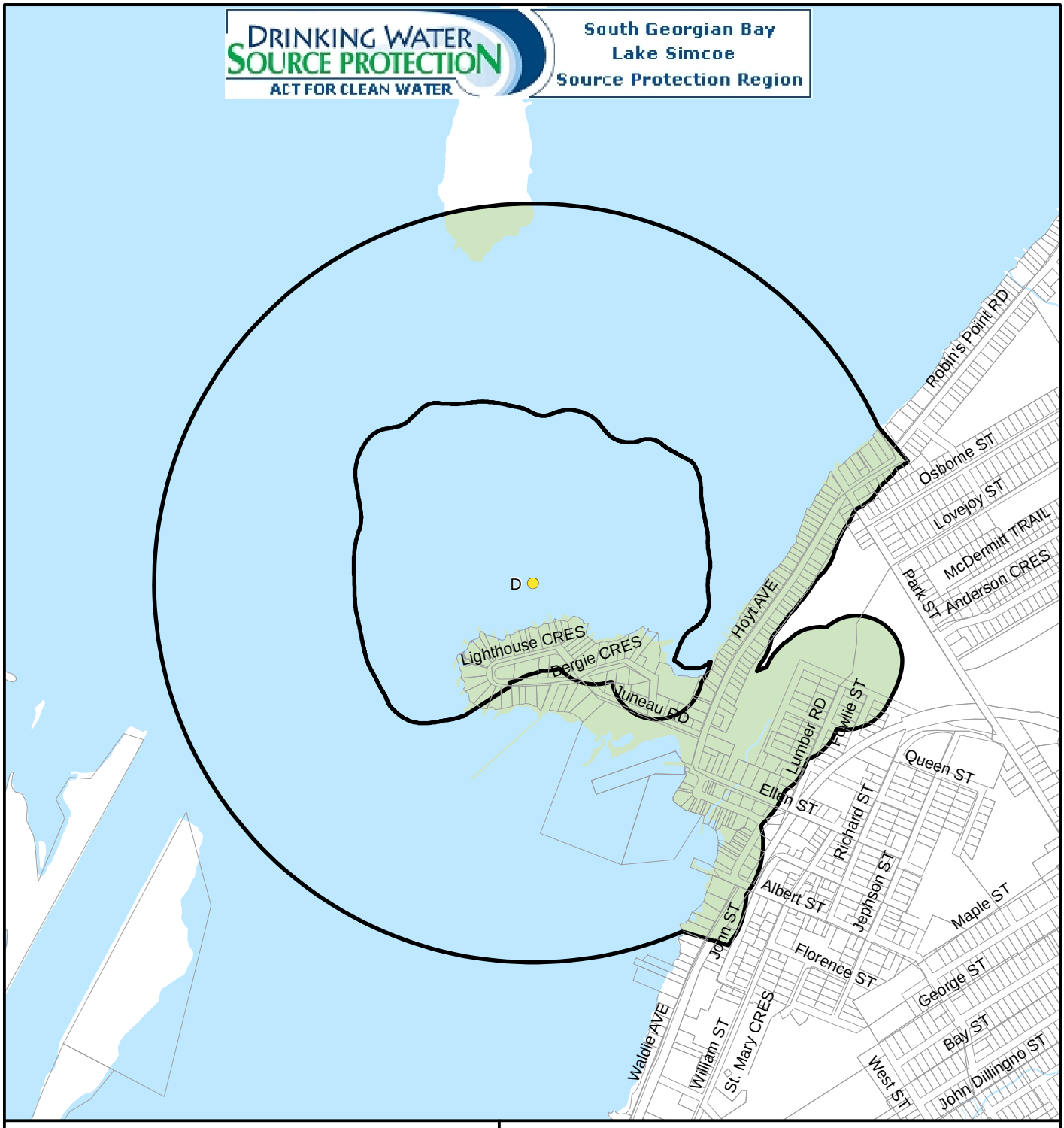
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water 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: 1:15000
PROJECT: 0-071948.11	FILE. NO.:0-07194811F17.2-3

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

GENIVAR Ontario

FIGURE **12b-3**



Legend

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

N W E S

150 75 0 150 Metres

MANAGED LANDS - VICTORIA HARBOUR

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

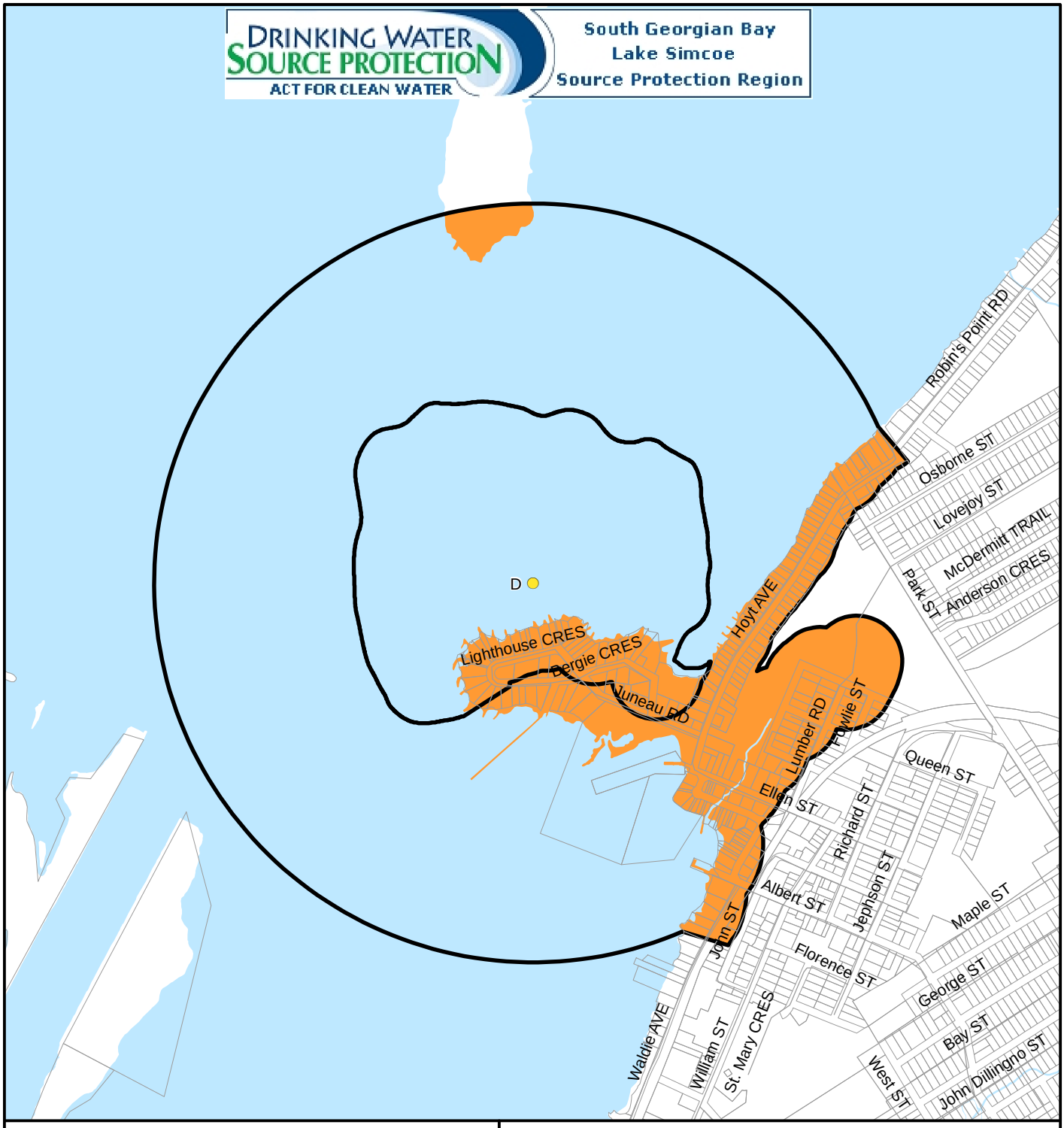
The Managed Land proportion proportion is illustrated for the parts of IPZ 1 and 2 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010 | SCALE: 1:15000

PROJECT: 0-071948.11 | FILE. NO.:0-07194811F17.2-4

GENIVAR Ontario

FIGURE 12b-4



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

150 75 0 150 Metres

LIVESTOCK DENSITY - VICTORIA HARBOUR

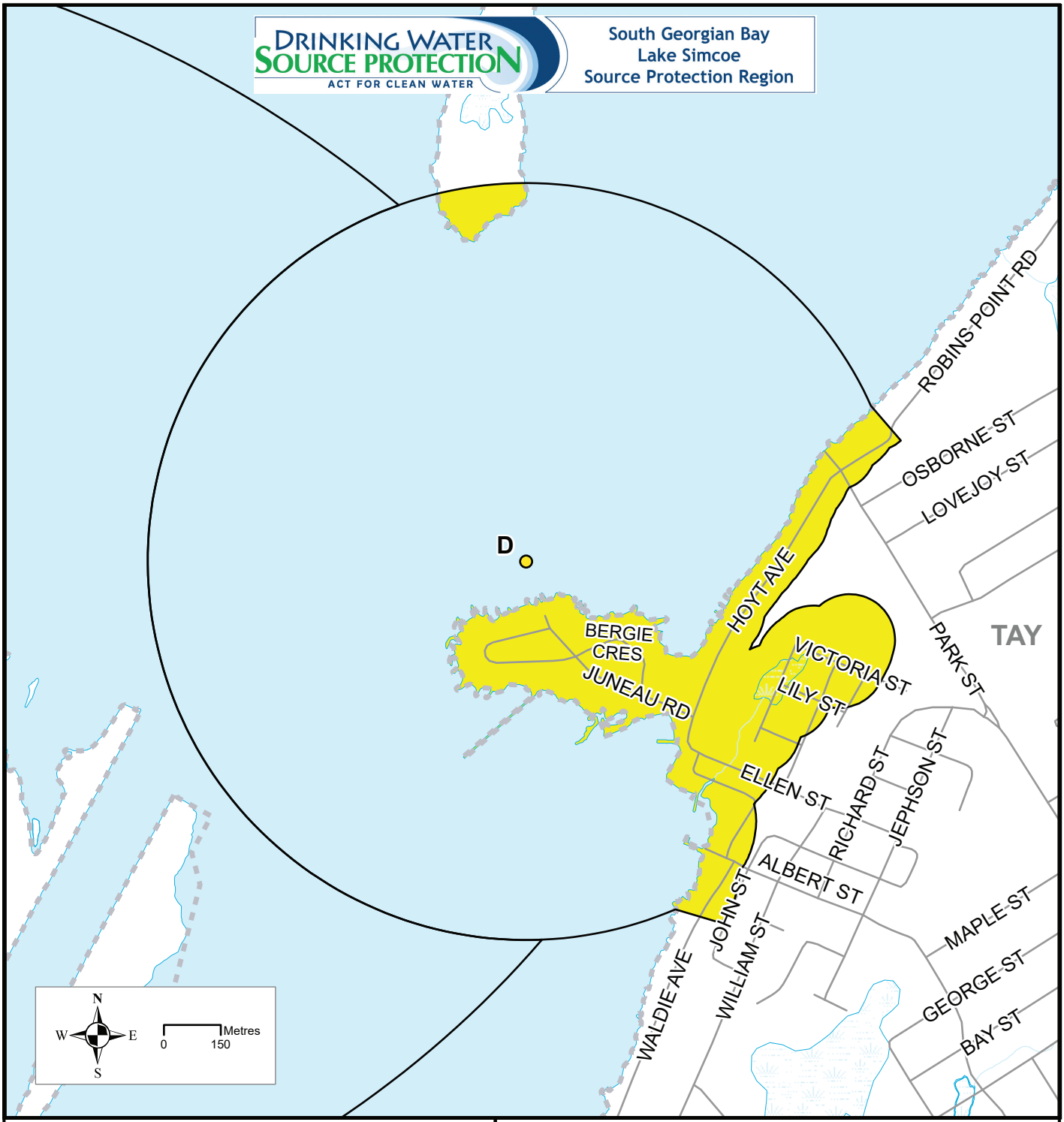
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

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

DATE: JUNE 2010	SCALE: 1:15000
PROJECT: 0-071948.11	FILE. NO.:0-07194811F17.2-5

GENIVAR Ontario

FIGURE **12b-5**



Legend

Surface Water Intake (Type D)

IMPERVIOUS SURFACE

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

- IPZ Boundary
- Road
- Watercourse
- Water Area, Permanent
- Wetland, Permanent
- Municipal Boundary
- Adjacent IPZ

IMPERVIOUS SURFACES - VICTORIA HARBOUR, TAY TOWNSHIP

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL SURFACE WATER SUPPLIES

South Georgian Bay Lake Simcoe
Source Protection Region

DATE: AUGUST 2025

SCALE: 1:15,000

The Impervious Surfaces are illustrated for IPZ 1 and 2 where the vulnerability score is > 4.5.

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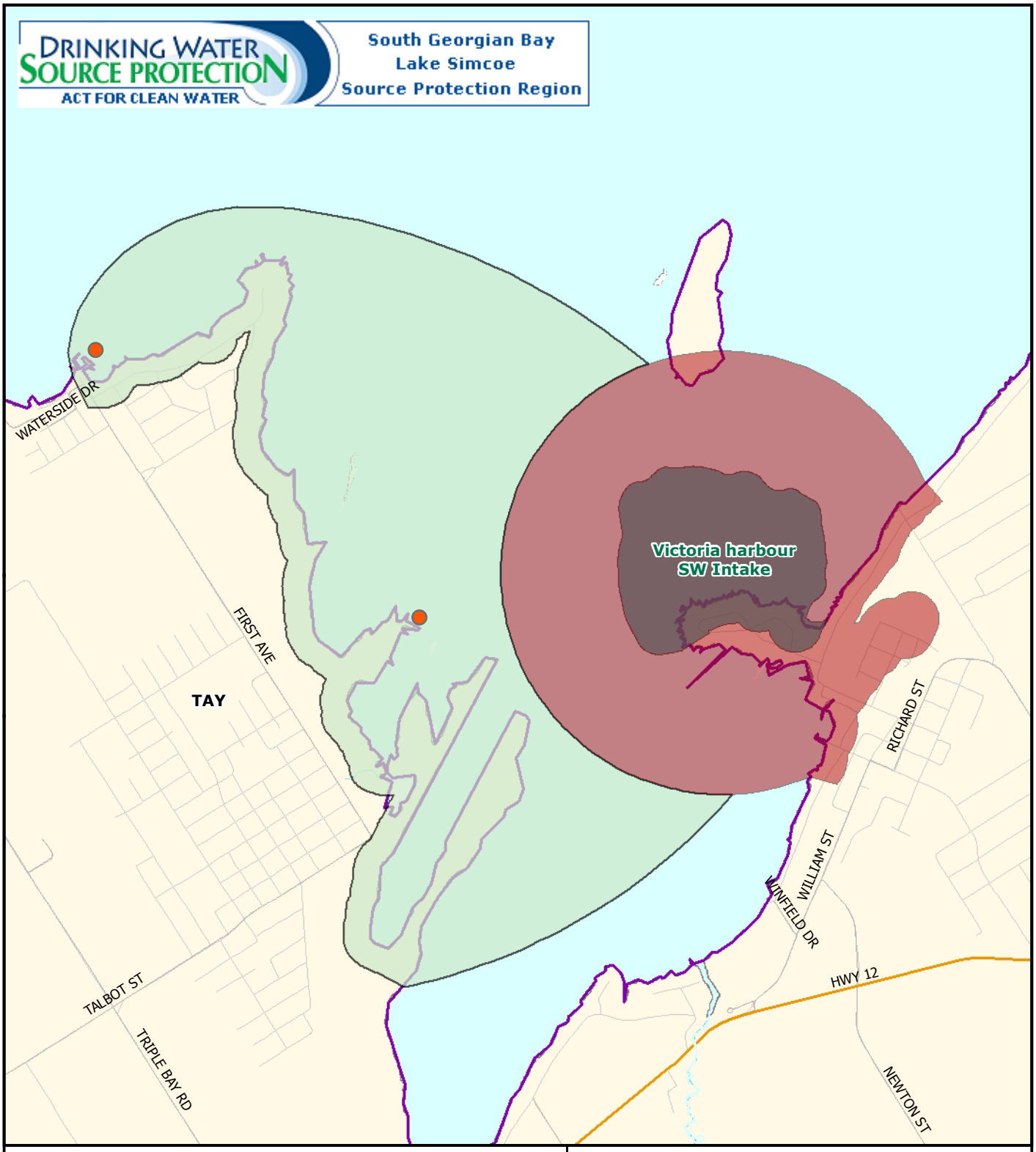
Severn Sound Environmental Association

Ontario

FIGURE
12b-6



Potential Significant Threat
Intake Protection Zone 1 (IPZ-1)
Intake Protection Zone 2 (IPZ-2, within IPZ-1)
Intake Protection Zone 3 (IPZ-3)

Potential Significant Threats to Victoria Harbour Surface Water Intake

Created by: LSRCA
Date: 2011-05-12

Scale: 1:25,000
0 0.2 0.4 0.6km
UTM Zone 17N, NAD83

Severn Sound Environmental Association

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 12b-7