# Chapter 2: Watershed Characterization

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# Watershed Characterization

## 2.1 Introduction

This chapter provides a brief background on the characteristics of the Severn Sound watershed, including the natural, human and physical features and their interactions. The chapter concludes by summarizing drinking water systems in the Severn Sound watershed, as a prelude to the more in-depth assessment presented in Chapters 6 to 13. Watershed characteristics related to hydrologic and hydrogeologic conditions are presented in the following chapter (Chapter 3; Conceptual Water Budget). Understanding the characteristics of the Severn Sound watershed is essential in understanding how quality and quantity of drinking water is affected by both human and natural interactions.

The large geography covered by the Severn Sound watershed is quite diverse in terms of population density, economy, and land use. Human characteristics across the watershed vary from the more densely populated urban centers of Orillia, Midland and Penetanguishene, to smaller communities in most other areas. Despite almost 75,000 people living in the watershed, natural heritage features are the largest single land use in the watershed.

The information presented in this chapter represents only a small fraction of information related to the Severn Sound watershed in numerous reports produced by the Severn Sound Environmental Association (e.g. SSRAP 1988, 1993, 2002), and as such readers are directed to these reports for a more detailed assessment. Furthermore, Part II of the Ministry of Environment[1] (MOE) Assessment Report Technical Rules (MOE, 2008a) clearly states what information is required in this chapter, where the information is available. This chapter includes all of the information required by the Technical Rules.

In general, watershed characterization, and the conceptual water budget provided in the following chapter, is described as a 'drinking water focused' watershed plan, comprised of five main components as outlined in the ~~schematic~~ listed below. It must be noted however, that the information provided in this watershed characterization is not used to determine Issues and Threats to specific municipal drinking water systems – see the municipal vulnerability and threats chapters (chapter 6-13) for details on individual drinking water systems.

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

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## Characterization

The five main components are:

1. **Watershed Boundaries**
   Delineates the area within the watershed, encompassing both the natural and human features
2. **Water Budget**
   Describes the movement of water through the hydrologic cycle and quantifies the amount of water flowing through the Source Protection Region
3. **Physical Geography**
   Describes the natural features in the watershed, how they have changed over time and the interactions that occur
4. **Drinking Water Systems**
   Details the location and population served by municipal and non-municipal wells, as well as the pumping rates
5. **Natural Geography and Ecology**
   Depicts the flora and fauna present within the watershed, highlighting important details, such as the current status of habitats

## 2.2 Watershed and Subwatershed Boundaries

The Severn Sound watershed is one of four watersheds with the South Georgian Bay Lake Simcoe Source Protection Region. The three other watersheds within the Source Protection Region include the Lake Simcoe, Nottawasaga Valley and the Black-Severn River watersheds (~~Figure 2-1~~Figure 2-1; figures are located at the end of the chapter). The land portion of the Severn Sound watershed (~~Figure 2-2~~Figure 2-2) is drained by seven major tributary rivers or streams, accounting for more than 76 percent of the total drainage area. Miscellaneous drainage directly to the Sound or along the coast of the Township of Tiny and Severn Sound is drained by smaller tributaries accounting for 24 percent of the total land drainage. There are four major inland lakes included in the land drainage: Farlain Lake, Little Lake (Midland), Orr Lake and Bass Lake. Major wetlands include: Tiny Marsh, Wye Marsh and Matchedash Bay. ~~Table 2-1~~ Table 2-1 provides the drainage areas of the subwatersheds and areas of major hydrologic features. The largest unit is the North River subwatershed at 319 km$^2$. It is located within the Townships of Severn and Oro-Medonte and the City of Orillia. Small miscellaneous subwatersheds when totaled amount to 297 km$^2$. Note that the Severn River represents the single largest riverine input into Severn Sound. The drainage area of the Severn River is very large (approx. 3800 km$^2$) due to its connection to Lake Simcoe and other waterways via the Trent Severn Waterway. The Severn Sound watershed was historically defined in the Severn Sound Remedial Action Plan (SSRAP) as including the direct watershed inputs into Severn Sound, excluding the Severn River (SSRAP 1993). Water quality is monitored where the Severn River enters Severn Sound at Port Severn, as well as in Lake Couchiching and MacLean Lake, in order to determine upstream impacts on the Sound.

**Table 0-12 1: Drainage area of subwatersheds in the Severn Sound watershed (Data Source: SGBLS).**

| Subwatershed | Drainage Area (km²) |
|---|---|
| North River | 318.74 |
| Coldwater River | 191.40 |
| Sturgeon River | 98.30 |
| Hogg Creek | 60.00 |
| Wye River | 208.15 |
| Port Severn and Matchedash Bay North | 19.71 |
| Waubaushene and Matchedash Bay South | 19.08 |
| Lafontaine Creek | 54.74 |
| Tiny Coastal North East | 46.46 |
| Copeland Creek | 23.56 |
| Penetang Bay West | 24.15 |
| Penetanguishene and Tay Point | 25.00 |
| Tiny Coastal Area West Central | 21.49 |
| Tiny Coastal Area South | 46.51 |
| Tiny Coastal Area North West | 37.85 |
| Midland Area | 24.16 |
| Tiffin Basin and Port McNicoll Area | 16.10 |
| Victoria Harbour Area | 16.52 |
| Honey Harbour to Port Severn | 68.40 |
| Severn Sound Islands | 59.53 |
| **Total:** | **1,379.87** |

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## 2.3 Physical and Natural Geography

### 2.3.1 Natural Vegetation – wetlands, woodlands and riparian areas.

During the period from 1988 to 2002, extensive rehabilitation of riparian habitat was implemented as part of the Severn Sound Remedial Action Plan (SSRAP). Ongoing SSEA stewardship programs since then have encouraged tree planting in old fields, riparian habitat naturalization and shoreline naturalization to continue to achieve a net gain of natural vegetation cover in the Severn Sound area.

The vegetation cover was systematically mapped in the Severn Sound area by MNR using the 2002 ortho images for Simcoe County. The natural vegetation cover was combined with revised drainage (based on 2002 ortho image interpretation) to allow an assessment of ~~current~~ conditions in the subwatersheds of Severn Sound.

The Habitat Framework Guidelines (Environment Canada, 2004) were used to evaluate natural vegetation cover and riparian habitat in the Severn Sound area. Based on the overall analysis shown in ~~Table 2-2~~Table 2-2, woodland cover meets the forest cover guideline of 30%. Riparian natural vegetation, however, did not meet the guideline of 75% of stream length in eight of ten sub-watersheds (see also ~~Figure 2-3~~Figure 2-3). Those that did not meet the guideline ranged between 44 and 63% cover. Natural vegetation cover will fluctuate depending on cutting and planting over time. The riparian habitat is expected to continue to rise as projects started more recently grow up and are recognized in forest cover analysis in future years (see also SSRAP 2002). This may however, be offset by land clearing in other areas.

**Table 0-22-2 Natural Vegetative Cover in the Severn Sound Watershed (Data Source: MNR/SSEA).**

| Area of Watershed | Subwatershed | Percentage of… | Wetland | Wooded Wetland | Woodland | Total Vegetated | Open Water (Lake or Pond)[1] | No Woodland or Wetland | Total Area $(km^2)$[4] |
|---|---|---|---|---|---|---|---|---|---|
| Southern[2] | **Miscellaneous coastal wetlands** | Subwatershed area | 2.0% | 2.9% | 54.7% | 54.7% | 1.3% | 39.1% | 297.0 |
| Southern[2] | **Miscellaneous coastal wetlands** | Stream length flowing through | 7.0% | 6.3% | 47.7% | 61.0% | 3.1% | 35.9% | 716.9 |
| Southern[2] | **North River** | Subwatershed area | 2.3% | 4.6% | 41.9% | 48.8% | 2.7% | 48.5% | 318.7 |
| Southern[2] | **North River** | Stream length flowing through | 7.9% | 4.7% | 31.1% | 43.7% | 7.5% | 48.8% | 581.1 |
| Southern[2] | **Coldwater River** | Subwatershed area | 1.5% | 2.9% | 48.0% | 52.4% | 30.0% | 47.3% | 191.4 |
| Southern[2] | **Coldwater River** | Stream length flowing through | 5.2% | 5.9% | 52.3% | 63.4% | 1.9% | 34.7% | 299.5 |
| Southern[2] | **Wye River** | Subwatershed area | 5.5% | 3.7% | 29.6% | 38.8% | 2.5% | 58.7% | 208.1 |
| Southern[2] | **Wye River** | Stream length flowing through | 13.6% | 4.6% | 31.8% | 50.0% | 6.6% | 43.6% | 370.2 |
| Southern[2] | **Hog Creek** | Subwatershed area | 1.5% | 3.6% | 35.5% | 40.6% | 30.0% | 59.1% | 60.0 |
| Southern[2] | **Hog Creek** | Stream length flowing through | 10.1% | 6.8% | 37.5% | 54.4% | 2.0% | 43.6% | 120.2 |
| Southern[2] | **Sturgeon River** | Subwatershed area | 3.8% | 11.0% | 44.8% | 59.6% | 50.0% | 39.9% | 98.3 |
| Southern[2] | **Sturgeon River** | Stream length flowing through | 18.0% | 16.3% | 40.0% | 74.3% | 4.3% | 21.4% | 243.0 |
| Southern[2] | **Lafontaine Creek** | Subwatershed area | 0.6% | 2.1% | 39.7% | 42.4% | 20.0% | 57.4% | 54.7 |
| Southern[2] | **Lafontaine Creek** | Stream length flowing through | 4.7% | 5.8% | 33.7% | 44.2% | 2.1% | 53.7% | 97.3 |
| Southern[2] | **Copeland Creek** | Subwatershed area | 2.5% | 2.0% | 57.0% | 61.5% | 90.0% | 37.6% | 23.6 |
| Southern[2] | **Copeland Creek** | Stream length flowing through | 10.9% | 3.1% | 62.8% | 76.8% | 1.9% | 21.3% | 68.3 |
| Southern[2] | **Severn Sound Area** | Subwatershed area | 2.6% | 4.1% | 43.9% | 50.7% | 1.6% | 47.8% | 1251.8 |
| Southern[2] | **Severn Sound Area** | Stream length flowing through | 9.2% | 6.5% | 40.6% | 56.3% | 4.6% | 39.1% | 2497.3 |
| Northern[3] | **Severn Sound North Shore (NRVIS)** | Subwatershed area | 5.0% | 0.0% | 63.5% | 68.5% | 5.5% | 26.0% | 68.4 |
| Northern[3] | **Severn Sound North Shore (NRVIS)** | Stream length flowing through | 23.4% | 0.0% | 30.0% | 53.4% | 34.2% | 12.4% | 53.2 |

[1]Excludes Severn Sound
[2]Based on 2002 SOLRIS Woodlands, NRVIS Evaluated Wetlands and Water Polygons (includes Unevaluated Wetland Areas)

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[3]Based on NRVIS Woodlands, NRVIS Evaluated Wetlands and Water Polygons (includes Unevaluated Wetland Areas)
[4]Excludes major islands off Severn Sound

### 2.3.2 Surface Water Quality

The chemical, physical and microbiological characteristics of natural water make up an integrated index we define as "water quality.". Water quality is a function of both natural processes and anthropogenic impacts. For example, natural processes such as weathering of minerals and various kinds of erosion are two actions that can affect the quality of surface water. There are also several types of anthropogenic influences, including point source and non-point sources of pollution. Point sources of pollution are specific, identifiable sources of contaminants to the surface water or groundwater system. Examples include municipal and industrial wastewater discharges, ruptured underground storage tanks, and landfills. Non-point sources are diffuse sources of pollution such as agricultural drainage, urban runoff, land clearing, construction activity or land application of waste that typically travel to waterways through surface runoff and infiltration. Contaminants delivered by point and non-point sources can travel in suspension and/or solution and many are monitored by routine sampling of surface waters in the Severn Sound watershed.

Throughout the Severn Sound watershed, there are 12 Provincial Water Quality Monitoring Network (PWQMN) Sstations, plus 2 supplementary stations that do not fall under the MOEMECP program but are sampled at the same time (Figure 2-4Figure 2-4). Each tributary system is unique in size, hydrology and subwatershed characteristics. The Severn River is a highly regulated large river with a large catchment that includes drainage from the Canadian Shield. The Wye River is somewhat regulated by a dam on Orr Lake, and one in Wye Marsh. Copeland, Lafontaine, and Hogg Creeks along with the Coldwater, Sturgeon and North Rivers are all essentially unregulated. Samples are collected 7 to 8 times a year, on a monthly basis during the ice-free period.

Samples are generally collected 7 to 8 times a year, with sampling occurring throughout the year, including winter months. Each sample, analyzed for up to 32 chemical parameters by the Laboratory Services Branch of the Ministry of the Environment, is assessed using the Provincial Water Quality Objectives and Guidelines (PWQO of the Ministry of Environment, 1994). The goal of the PWQO is to protect and preserve aquatic life and to protect the recreational potential of surface waters within the province of Ontario. As the PWQMN is a regional scale, ambient program the information provided does not relate to any specific drinking water system—quality of surface water being used as a source for drinking water is presented in the Issues Evaluation sections of the municipal Vulnerability and Threats chapters (chapters 6 to 13).

Meeting the PWQO is generally a minimum requirement, as one has to take into account the effects of multiple objective/guideline exceedences, overall ecosystem health, and the protection of site-specific uses such as use as a source of drinking water. In instances where a chemical parameter is not included in the PWQO/G, the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG) is applied (Environment Canada, 2003).

Long-term stream water quality data is available for two stations, Coldwater River at Coldwater (Station 206 approximate 1974 – 1993 from PWQMN, 1989 – 1999 from SSRAP data, 2002 –

2020 from PWQMN) and the Severn River at Lock 45, Port Severn (Station PS2, 1968 – 1993 from PWQMN, 1984 – 1995 from MOE[2] data, 2002 – 2020 from PWQMN). At Station 206 and PS2, there was a period when high frequency sampling was conducted to more closely monitor the impacts of watershed restoration efforts. Following major implementation efforts in the watershed between 1990 and 1994 through the SSRAP, sampling frequency at monitoring stations decreased. Monitoring data is available for other tributary stations generally from 1994-1999 and 2002-2020 from PWQMN. Two supplementary stations were added (SSEA data), one on the Wye River at Wyebridge (W23), beginning in 2001, and one on Lafontaine Creek near the mouth at the 13th Conc. of Tiny (LAC1), beginning in 2017.

Results from each sample, analyzed for up to 32 chemical parameters by the Laboratory Services Branch of the MOE, are assessed using the Provincial Water Quality Objectives (PWQO) (MOE, 1994). For all monitoring stations, annual medians of key water quality variables were calculated and compared with PWQO. The goal of the PWQO is to protect and preserve aquatic life and to protect the recreational potential of surface waters within the Province of Ontario. As the PWQMN is a regional scale, ambient program, the information provided does not relate to any specific drinking water system —quality of surface water being used as a source for drinking water is presented in the Issues Evaluation sections of the municipal Vulnerability and Threats chapters (chapters 6 to 13).

Meeting the PWQO is generally a minimum requirement, as one has to take into account the effects of multiple objective/guideline exceedances, overall ecosystem health, and the protection of site-specific uses such as use as a source of drinking water. In instances where a chemical parameter is not included in the PWQO, the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG) are applied (Environment Canada, 2003).

Results from individual sampling events from 2010-2020 were compared against the PWQO (Table 2-3). These results indicated that while objectives were met more the 50% of the time in most cases, for phosphorus, suspended solids, iron, aluminum and cadmium, there were instances of exceedances. Exceedances in phosphorus and suspended solids in particular indicate that water quality impacts are still occurring across the landscape. ~~Analysis of data collected between 2002 and 2009 shows t~~The 10-year median concentration of total phosphorus (2010-2020) is below the guideline with the exception of one station on the Wye River near Wyevale (~~(Table 2-3,~~ Station 203). This was also the case for the period between 2002-2009.

At ~~three~~ four of the ~~sites~~ stations, the 10-year median concentration of aluminum exceeds the objective (Stations 41, W23 and 203 on the Wye River and Station 207 on the North River~~, Table 2-3~~). This was also the case between 2002-2009.

All other parameters evaluated met the respective ~~objective or guideline~~PWQO based on 10-year medians.

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

~~Sampling also occurred from 1988 to 2004. Following major implementation efforts in the watershed between 1990 and 1994, through the Severn Sound Remedial Action Plan, sampling frequency at monitoring stations decreased. Results for this time period are shown in Table 2-4. During that time the median concentration for phosphorus was above guidelines at three stations (Station 43 at Hog~~ Hogg ~~Creek and Stations 203 and 208 at Wye River).~~Only a few parameters used to characterize current conditions were available in the historical data, namely total phosphorus, suspended sediment, nitrate and chloride. Results of trend analyses for ~~this time period~~entire data record are shown in ~~Table 2-4~~Table 2-4.

Based on these results, which are also illustrated as time series plots in ~~When the results from 1988 to 1994 are compared to those from 2002 to 2009~~Figures 2-5 to 2-8, a change in stream chemistry can be seen. Total phosphorus and suspended solids have decreased over the long term ~~or remained the same between the two periods~~at nearly all stations. In the last 10 years or so, declines have slowed and concentrations at most stations have leveled off. ~~, while c~~Chloride and nitrate concentrations have increased over the long term ~~between the two periods~~ at nearly all stations and~~.~~ concentrations have continued to increase over the last 10 years.

Since metals analysis began in 2002, there have been widespread increases in zinc, cadmium and copper. The cause of these increases is unclear. There has been no change in iron and aluminum.

**Table 0-3: Percentage of tributary samples meeting Provincial Water Quality Objectives from 2010 to 2020 for the Severn Sound watershed. Watershed position is indicated as upstream (US), midstream (MID) or downstream (DS) (Data Source: MECP, SSEA).**

| River System | Monitoring Station (watershed position) | Chloride | Phosphorus | Nitrate | Suspended Solids | Iron | Zinc | Aluminum | Cadmium | Copper |
|---|---|---|---|---|---|---|---|---|---|---|
| Copeland Creek | 201 (DS) | 100 | 86 | 100 | 91 | 86 | 97 | 72 | 57 | 97 |
| Coldwater River | 45 (US) | 100 | 80 | 100 | 88 | 84 | 97 | 73 | 62 | 100 |
| Coldwater River | 206 (DS) | 100 | 79 | 100 | 88 | 80 | 99 | 68 | 59 | 100 |
| Hogg Creek | 43 (US) | 100 | 79 | 100 | 91 | 80 | 99 | 62 | 59 | 100 |
| Hogg Creek | 204 (DS) | 100 | 75 | 100 | 85 | 74 | 99 | 53 | 61 | 100 |
| Lafontaine Creek | LAC1 (DS) | 100 | 76 | 100 | n.d. | 100 | 100 | 88 | 100 | 100 |
| North River | N3 (US) | 99 | 93 | 100 | 95 | 86 | 96 | 82 | 51 | 100 |
| North River | 207 (DS) | 100 | 79 | 100 | 100 | 77 | 100 | 42 | 57 | 100 |
| Severn River | PS2 (DS) | 100 | 99 | 100 | 100 | 100 | 100 | 100 | 67 | 100 |
| Sturgeon River | 205 (DS) | 100 | 81 | 100 | 90 | 85 | 100 | 77 | 53 | 100 |
| Wye River | 41 (US) | 100 | 83 | 100 | 95 | 84 | 97 | 43 | 55 | 99 |
| Wye River | 203 (MID) | 100 | 37 | 83 | 91 | 53 | 100 | 8 | 54 | 100 |
| Wye River | W23 (MID) | 100 | 66 | 92 | n.d. | 81 | 100 | 19 | 100 | 100 |
| Wye River | 208 (DS) | 100 | 85 | 99 | 100 | 86 | 100 | 79 | 52 | 100 |
| - | Objective | 210 mg/L | 0.03 mg/L | 2.9 mg/L | 30 mg/L | 300 µg/L | 20 µg/L | 100 µg/L | 0.5 µg/L | 5 µg/L |

Note that the median value for phosphorus from 2010-2020 was greater than the objective for station 203. Median values for aluminum from 2010-2020 were greater than the objective for stations 207, 41, 203 and W23.
n.d. indicates no data available.

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**Table 0-4: Results of trend analysis of water quality variables for the Severn Sound watershed, based on Mann Kendall tests.**

*Results were deemed significant at $p < 0.05$, except where otherwise noted. The earliest year when data is available is shown in brackets, with exceptions noted below; analyses included data up to 2020. Watershed position is indicated as upstream (US), midstream (MID) or downstream (DS). Trend directions are indicated as increasing, decreasing or unchanging (no change) (Data Source: MECP, SSEA).*

| River System | Monitoring Station | Chloride (1994) | Phosphorus (1994) | Nitrate (1994) | Particulates (1994) | Iron (2002) | Zinc (2002) | Aluminum (2002) | Cadmium (2002) | Copper (2002) |
|---|---|---|---|---|---|---|---|---|---|---|
| Copeland Creek | 201 (DS) | increasing | decreasing | increasing | no change | no change | increasing | no change | increasing | increasing |
| Coldwater River | 45 (US) | increasing | decreasing | increasing | decreasing | no change | increasing | no change | increasing | increasing |
| Coldwater River | 206 (DS) | increasing | decreasing | increasing | decreasing | no change | increasing | no change | increasing | increasing |
| Hogg Creek | 43 (US) | increasing | decreasing | increasing | decreasing | decreasing | increasing | no change | increasing | increasing |
| Hogg Creek | 204 (DS) | increasing | decreasing | increasing | decreasing | no change | increasing | no change | increasing | increasing |
| Lafontaine Creek | LAC1 (DS) | i.d. | i.d. | i.d. | n.d. | i.d. | i.d. | i.d. | i.d. | i.d. |
| North River | N3 (US) | increasing | decreasing | no change | decreasing | no change | increasing | no change | increasing | no change |
| North River | 207 (DS) | increasing | decreasing | increasing | decreasing | no change | increasing | no change | no change | increasing |
| Severn River | PS2 (DS) | increasing | decreasing | increasing | decreasing | increasing | increasing | no change | no change | increasing |
| Sturgeon River | 205 (DS) | increasing | decreasing | increasing | decreasing | no change | increasing | no change | increasing | increasing |
| Wye River | 41 (US) | increasing | decreasing | increasing | no change | no change | increasing | no change | increasing | increasing |
| Wye River | 203 (MID) | increasing | decreasing | increasing | decreasing | no change | increasing | no change | increasing | increasing |
| Wye River | W23 (MID) | no change | decreasing | no change | decreasing | i.d. | i.d. | i.d. | i.d. | i.d. |
| Wye River | 208 (DS) | increasing | decreasing | increasing | decreasing | no change | increasing | no change | no change | increasing |

*n.d. indicates no data available.

**i.d. indicates insufficient data to conduct trend analyses.
For cadmium, trend analysis indicated an increasing trend at $p < 0.1$ for stations 201, 206, 205 and 41. Although the trends were of slightly weaker strength than other results that were significant at $p < 0.05$, they are worth noting.
***In the following cases, the earliest year available differs from that shown in brackets:

- For chloride, phosphorus and nitrate at PS2 the earliest year available is 1968.
- For phosphorus, nitrate and particulates at W23 the earliest year available is 2001.
- For chloride, phosphorus, nitrate and particulates at N3 and for particulates at PS2 the earliest year available is 2002.
- For chloride at W23 the earliest year available is 2010.
- For all variables at LAC1 and for iron, zinc, aluminum, cadmium, and copper at W23, the earliest year available is 2017.

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Longer-term stream water quality data is available for two stations, Coldwater River at Coldwater (Station 206 approximate 1974 – 1993 from PWQMN, 1989 – 1999 from SSRAP data, 2002 – 2009 from PWQMN) and the Severn River at Lock 45, Port Severn (Station SR2, 1968 – 1993 from PWQMN, 1984 – 1995 from MOE data, 2002 – 2009 from PWQMN). The Severn River is a highly regulated large river while the Coldwater River is a largely unregulated stream. Only a few parameters used to characterize current conditions were available in the historical sampling.The Severn River is a highly regulated large river while the Coldwater River is a largely unregulated stream.

For the Coldwater River, annual medians using summer only data (Jun-Sept) were calculated. Figure 2-5 illustrates trends (PWQMN and SSEA data used) from 1973 to 2009 for chloride, total phosphorus and total nitrate. A significant increase in chloride can be seen for this time period. Phosphorus appears to be decreasing, while nitrate concentrations increase, level out and continue to fluctuate over the years.

The same analysis was done for the Severn River at Port Severn. Annual medians using summer only data (Jun-Sept) were calculated (the trends were also found to be the same for year round results). Figure 2-6 shows a significant increase of chloride, as was seen in the Coldwater River (Figure 2-5), and a slight decrease in total phosphorus. Unlike the Coldwater River results described above, total nitrate concentrations significantly decreased from 1968 to 2009.

The Simcoe Muskoka District Health Unit monitors the E. coli levels in surfaces water at public beaches throughout the summer season. In the Severn Sound watershed this includes beaches in Severn and Tay. The Provincial Water Quality Objective for E. coli is less than 100 E. coli per 100 ml sample. Figures 2-1 to 2-5 show the number of exceedances over time for 8 beaches in the area, as well as the percentage of samples that exceeded the standard each year.

Washago Centennial Park Beach in Severn reported over 75% of samples exceedingexceeding the guidelines for both the 2020 (78%) and 2021 (82%) summer seasons. Both Mackenzie Park Beach and Patterson Park Beach, in Tay, reported very few *E. coli* exceedances between 20006 and 2011, but have been reporting more regular exceedances since 2011, with the only exceedance free year for both in that time period being 2013.

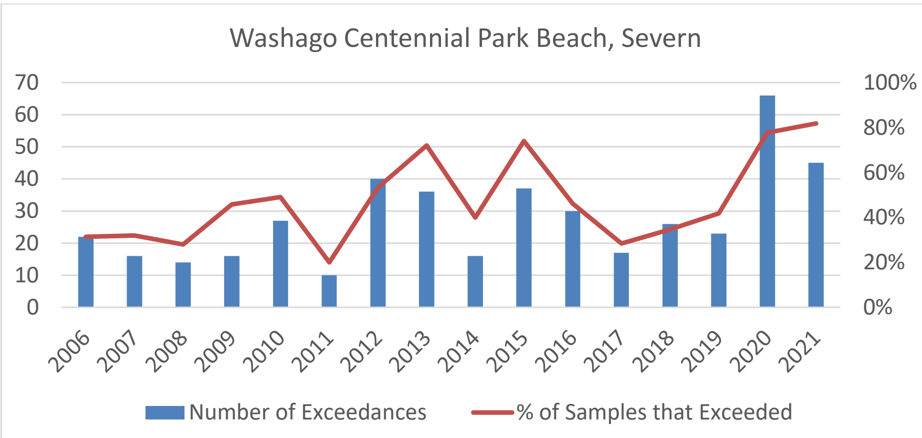


**Figure 0-1 Washago Centennial Park Beach, Severn: *E. Coli* Exceedances in Surface Water Samples (≥100 *E. coli* / 100 ml), 2006-2021.**

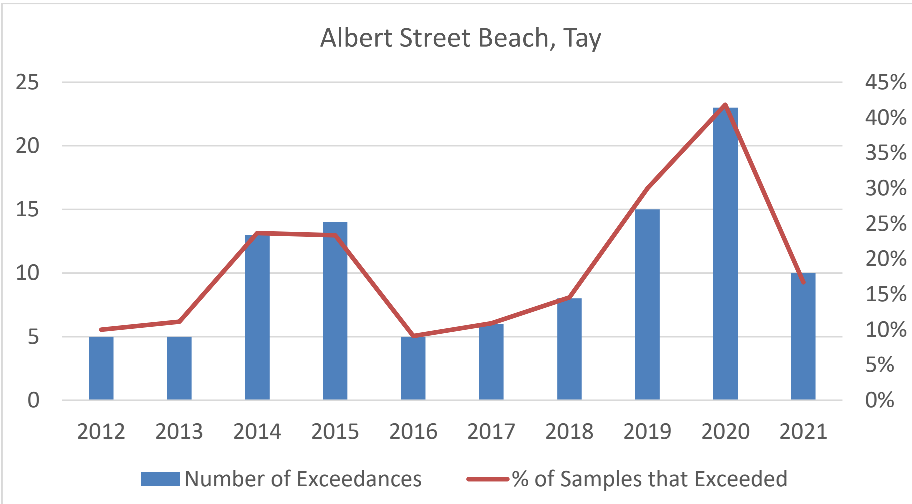


**Figure 0-2 Albert Street Beach, Tay: *E. Coli* Exceedances in Surface Water Samples (≥100 *E. coli* / 100 ml), 2012-2021.**

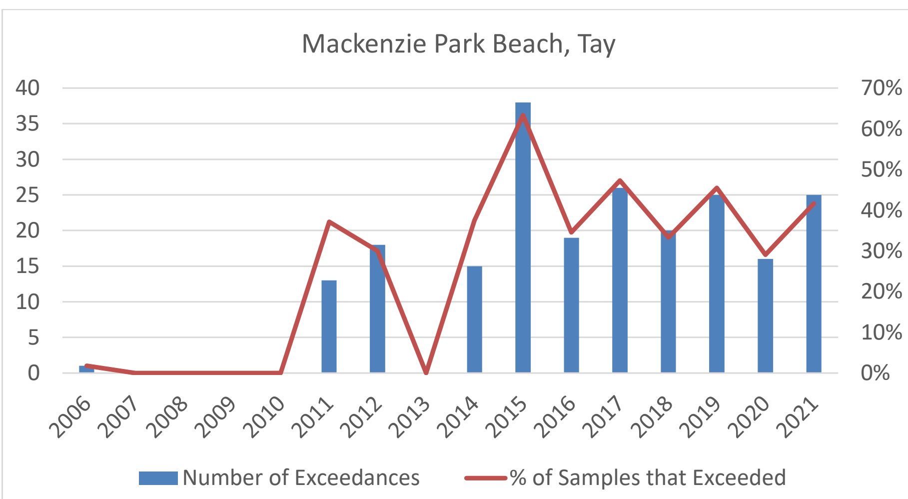


**Figure 0-3 Mackenzie Park Beach, Tay: *E. Coli* Exceedances in Surface Water Samples (≥100 *E. coli* / 100 ml), 2006-2021.**

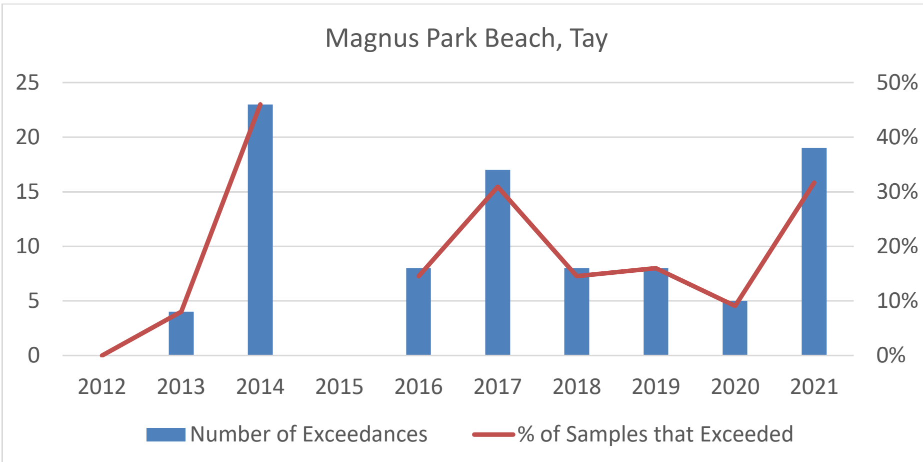


**Figure 0-4 Magnus Park Beach, Tay: *E. Coli* Exceedances in Surface Water Samples (≥100 *E. coli* / 100 ml), 2012-2021.**

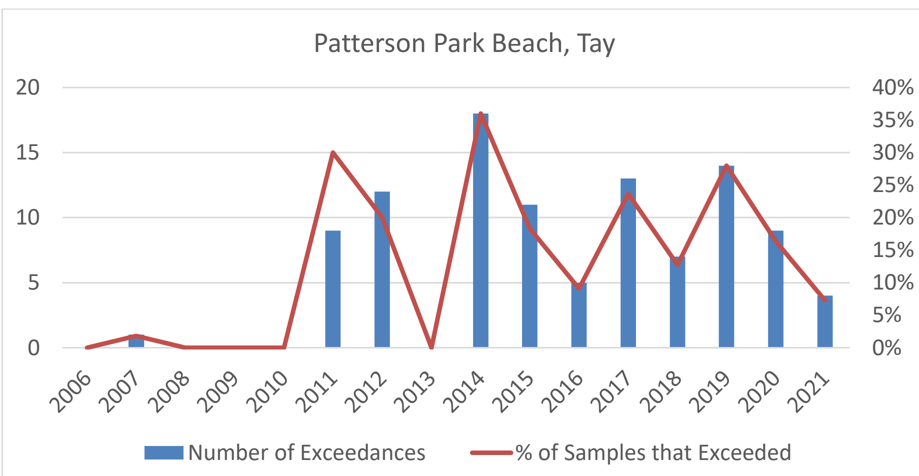


**Figure 0-5 Patterson Park Beach, Tay: *E. Coli* Exceedances in Surface Water Samples (≥100 *E. coli* / 100 ml), 2006-2021.**

### 2.3.3 Groundwater Quality

Groundwater quality was sampled in 1995 at 188 private water wells throughout the Severn Sound area by Severn Sound RAP staff as reported by Singer et al. (1999). The private drilled wells were selected to represent wells completed in Precambrian bedrock (29), Palaeozoic bedrock (23), overburden <20 m (39) and overburden >20 m (97). The wells were in use and were sampled during 1995 using the existing pumps with treatment systems bypassed. The condition of the wells was not considered in the selection of the testing. The basic chemistry as summarized in Table 2-5~~Table 2-5~~ indicates that the basic chemical groundwater quality is generally good with a relatively low proportion of wells exceeding the Ontario Drinking Water Standards, Objectives and Guidelines (ODWSOG). Bedrock wells had a higher proportion of elevated chloride concentrations, while a significant proportion of wells exceeded the aesthetic objective for iron. Only overburden wells had a proportion of samples exceeding the ODWS for nitrate concentration.

**Table 0-52-5: Major ion concentrations in private wells sampled throughout the Severn Sound area in 1995. TDS=Total Dissolved Solids.** Source: Singer et al. 1999. Groundwater resources of the Severn Sound RAP Area. MOE Severn Sound RAP Report.

| Parameter | Description of wells | Sodium | Sulphate | Chloride | Nitrate | Iron | TDS | Hardness |
|---|---|---|---|---|---|---|---|---|
| Number of samples | Precambrian bedrock | 29 | 29 | 29 | 29 | 29 | 27 | 29 |
| Minimum concentration | Precambrian bedrock | 4 | 9 | 1.6 | 0.03 | 0.01 | 261 | 31 |
| Mean concentration | Precambrian bedrock | 110 | 149 | 132 | 0.85 | 0.45 | 743 | 267 |
| Maximum concentration | Precambrian bedrock | 450 | 600 | 1500 | 7.55 | 6.9 | 4040 | 1220 |
| % exceeding ODWSOG | Precambrian bedrock | 17 | 7 | 10 | 0 | 28 | 41 | n.a. |
| Number of samples | Paleozoic Bedrock | 22 | 23 | 23 | 23 | 23 | 22 | 23 |
| Minimum concentration | Paleozoic Bedrock | 3.4 | 7.75 | 0.5 | 0.05 | 0.01 | 144 | 45 |
| Mean concentration | Paleozoic Bedrock | 42 | 175 | 53 | 0.23 | 0.43 | 557 | 327 |
| Maximum concentration | Paleozoic Bedrock | 187 | 1870 | 394 | 2.3 | 3.9 | 3890 | 2050 |
| % exceeding ODWSOG | Paleozoic Bedrock | 0 | 13 | 4 | 0 | 17 | 32 | n.a. |
| Number of samples | Overburden <20m | 38 | 39 | 39 | 38 | 39 | 36 | 39 |
| Minimum concentration | Overburden <20m | 1 | 7.41 | 0.3 | 0.05 | 0.01 | 110 | 76 |
| Mean concentration | Overburden <20m | 8.36 | 22 | 18 | 4.5 | 0.29 | 339 | 240 |
| Maximum concentration | Overburden <20m | 116 | 59 | 285 | 58 | 4.8 | 898 | 458 |
| % exceeding ODWSOG | Overburden <20m | 0 | 0 | 3 | 11 | 18 | 11 | n.a. |
| Number of samples | Overburden >20m | 90 | 96 | 97 | 96 | 97 | 92 | 97 |
| Minimum concentration | Overburden >20m | 1 | 0.5 | 0.4 | 0.05 | 0.01 | 137 | 22 |
| Mean concentration | Overburden >20m | 10.1 | 16 | 8.37 | 0.92 | 0.14 | 242 | 137 |
| Maximum concentration | Overburden >20m | 49 | 37 | 85 | 6.05 | 1 | 470 | 335 |
| % exceeding ODWSOG | Overburden >20m | 0 | 0 | 0 | 12 | 18 | 0 | n.a. |

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In addition to above study of private water well quality, groundwater quality is assessed through the Provincial Groundwater Monitoring Network (PGMN). The PGMN was established to monitor ambient groundwater levels and quality to help set baseline conditions and assess how groundwater is affected by land use and water use. Monitoring well chemistry helps identify trends and emerging issues, and provides a basis for making informed resource management decisions. It also helps measure the effectiveness of programs and policies that are designed to manage and protect the groundwater resources. As the PGMN is a regional scale, ambient program, the information provided does not relate to any specific drinking water system – quality of groundwater being used as a source for drinking water is presented in the Issues Evaluation sections of the municipal vulnerability and threats chapters (Chapter 6 to 13).

Groundwater quality sampling has been carried out by SSEA at 8~~9~~ Provincial Groundwater Monitoring Network (PGMN) wells located within the Severn Sound watershed (~~Figure 2-4~~Figure 2-4). The initial sampling following the establishment of each monitoring well included a comprehensive characterization of 209 quality parameters including basic chemistry, metals, volatile organic chemicals, chlorinated organic chemicals and pesticides. The subsequent chemistry sampling at each well included analysis of 51 basic chemistry and metal parameters. Analyses were carried out at Laboratory Services Branch of the Ministry of Environment, Conservation and Parks and the results were compared to the Ontario Drinking Water Standards, Objectives and Guidelines (ODWSOG).

The results shown in ~~Table 2-6~~ Table 2-6 are based on 4~~1~~ to 12~~3~~ samples taken over the period ~~2004~~2010 to ~~2009~~2021. ~~, depending on the date on which the well was established.~~ To give a general overview of the groundwater quality, a selected number of parameters were chosen including: sodium, chloride, iron, aluminum, manganese, nitrite, nitrate and alkalinity. Of the 8~~9~~ wells sampled, none of the wells exceeded the ODWSOG for these parameters with the exception of the aesthetic objectives for iron in two wells (W~~0~~313-1 and W~~0~~311-1) and sodium in one well (W439-1).

Apart from the basic chemistry, ~~however, Well~~ well W~~0~~441-1 exceeded the Ontario Provincial Drinking Water Standard for uranium in the first water quality sampling occasion and in a subsequent sampling occasion (16 Jun, 2005 and 23 Aug, 2005). Additional monitoring of ~~W~~well W~~0~~441-1 following the issuing of the report (4 Nov, 08 and 27 Oct, 09), showed similar slightly elevated concentrations for uranium. Following the receipt of the initial uranium sampling results, the Medical Officer of Health was immediately informed of the exceedance and a subsequent investigation of the well in relation to private wells in the area was carried out by SSEA and Simcoe-Muskoka Health Unit staff in cooperation with the Ministry of the Environment (Rogojin, 2005). The report concluded that there are no obvious anthropogenic sources of the uranium in the area and that the uranium source is potentially naturally occurring.~~,~~ The well ~~it~~ has not exceeded the standard since 2011, and continues to decrease throughout the sampling period (0.0382 mg/L in 2005 to 0.0137 mg/L in 2021);~~,~~ ~~but~~ further sampling will ~~work would~~ be required to ensure the trend continues.~~confirm such a conclusion. Additional monitoring of Well W0441 following the issuing of the report (4 Nov, 08 and 27 Oct, 09), showed similar slightly elevated concentrations for uranium.~~

**Table 0-62-6: PGMN Water Quality (201004-20200109) (Data Source: SSEA and PGMNMOEMECP).**

| Stations | | Sodium | Chloride | Iron | Aluminum | Manganese | Nitrite | Nitrate+Nitrite | Alkalinity total fixed |
|---|---|---|---|---|---|---|---|---|---|
| ODWSOG | | 20-200 mg/L | 250 mg/L | 0.3 mg/L | 0.1 mg/L | 0.05 mg/L | 1 mg/L | 10 mg/L | 30-500 mg/l |
| W453-1 ** | Min | 3.28 | 2.40 | 0.000 | 0.0016 | 0.0008 | 0.001 | 0.121 | 99 |
| W453-1 **- | Max | 4.82 | 5.60 | <0.030 | <0.0050 | 0.0029 | 0.050 | 0.500 | 127 |
| W453-1 **- | Median | 3.93 | 3.75 | <0.030 | <0.0050 | 0.0017 | 0.001 | 0.150 | 111 |
| W444-1 ** | Min | 4.20 | 0.60 | 0.120 | 0.0007 | 0.0216 | 0.001 | 0.020 | 165 |
| W444-1 **- | Max | 4.90 | 36.00 | 0.160 | <0.0050 | 0.0244 | 0.050 | 0.800 | 186 |
| W444-1 **- | Median | 4.49 | 1.45 | 0.135 | <0.0050 | 0.0236 | 0.002 | 0.040 | 179 |
| W443-1 * | Min | 3.15 | 0.30 | 0.000 | 0.0010 | 0.0002 | 0.001 | 2.550 | 160 |
| W443-1 *- | Max | 3.48 | 2.80 | 0.000 | 0.0081 | 0.0004 | 0.050 | 3.600 | 167 |
| W443-1 *- | Median | 3.21 | 2.10 | 0.000 | 0.0011 | 0.0003 | 0.008 | 2.820 | 163 |
| W442-1 ** | Min | 3.71 | 0.80 | 0.080 | 0.0011 | 0.0145 | <0.001 | 0.020 | 161 |
| W442-1 **- | Max | 15.90 | 39.30 | 0.170 | <0.0050 | 0.0189 | 0.050 | 0.700 | 184 |
| W442-1 **- | Median | 4.09 | 2.50 | 0.110 | <0.0050 | 0.0156 | 0.001 | 0.047 | 179 |
| W441 ** | Min | 3.98 | 6.20 | 0.000 | 0.0004 | 0.0080 | 0.015 | 4.000 | 210 |
| W441 **- | Max | 5.39 | 10.50 | 0.286 | <0.0050 | 0.0221 | 0.050 | 5.660 | 239 |
| W441 **- | Median | 4.44 | 8.85 | 0.022 | <0.0050 | 0.0119 | 0.023 | 4.855 | 231 |
| W439-1 ** | Min | 18.70 | 0.20 | 0.090 | 0.0011 | 0.0097 | 0.001 | 0.020 | 128 |
| W439-1 **- | Max | 21.10 | 2.50 | 0.110 | <0.0050 | 0.0127 | 0.050 | 0.500 | 142 |
| W439-1 **- | Median | 20.00 | 1.00 | 0.094 | <0.0050 | 0.0105 | 0.002 | 0.034 | 138 |
| W313-1 ** | Min | 4.72 | 0.70 | 1.000 | 0.0002 | 0.0002 | 0.001 | 0.020 | 142 |
| W313-1 **- | Max | 5.65 | 1.96 | 1.340 | <0.0050 | 0.0011 | 0.050 | 0.500 | 161 |
| W313-1 **- | Median | 5.00 | 1.50 | 1.225 | <0.0050 | 0.0003 | 0.003 | 0.045 | 158 |
| W311-1 * | Min | 2.60 | 0.80 | 0.500 | 0.0007 | 0.0316 | 0.001 | 0.020 | 163 |
| W311-1 * - | Max | 3.22 | 4.40 | 0.640 | 0.0012 | 0.0349 | 0.050 | 0.500 | 181 |
| W311-1 * - | Median | 3.03 | 1.10 | 0.580 | 0.0008 | 0.0340 | 0.004 | 0.035 | 177 |

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Note: results are in micrograms/L while the objectives are in mg/L. There are 1000 micrograms in 1 milligram.

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While not mentioned in the water quality sections above, there has been increased interest and concern of the levels of pharmaceuticals and personal care products accumulating in the environment through the movement of water (surface and ground) and what the possible impacts are on ecosystems and humans. Pharmaceuticals and Personal Care Products (PPCPs) are a group of chemicals commonly referred to as 'emerging contaminants' and 'contaminants of emerging concern'. The ~~MOE~~MECP defines these terms as the presence of chemicals that were previously, or are currently, unknown, unrecognized and/or unregulated in the environment.

PPCP compounds are typically found where people use personal care products (such as their homes) or where people and animals are being treated medicinally (i.e. hospitals, veterinary clinics, etc.). PPCP enter the environment through a number of channels including:

- residual pharmaceutical compounds which pass through the body into sewers;
- topical medications and personal care products that get washed off; and
- any products that are unused or expired and are improperly disposed of.

The result is these compounds are frequently found in water that is influenced by sewage (streams, rivers, ground water) and are appearing in some sources of drinking water.

T~~Recently t~~he ~~Ministry of the Environment~~Ministry of the Environment (Now, the Ministry of Environment, Conservation and Parks) carried out a study that involved the collection and analysis of ~~over 250~~hundreds of water samples (both surface and ground) from 17 drinking water systems throughout the Province (full results can be found in *Survey of the Occurrence of Pharmaceuticals and Other Emerging Contaminants in Untreated Source and Finished Drinking Water in Ontario* (MOE, 2010b)). Samples were tested for 46 different pharmaceuticals, antibiotics, and hormones. Results showed that the concentration of these compounds was in the nanogram per litre (ng/L) or parts per trillium range (MOE, 2010b).

Currently there is no Canadian Drinking Water Quality Guidelines (CDWQG), Ontario Drinking Water Quality Standards (ODWQS) or Provincial Water Quality Objectives (PWQO) for pharmaceuticals, nor are there any standards in North America or Europe to go by. Since there is very little information and research on how PPCPs interact in the environment, the possible short- and long-term impacts they have on both ecosystems and humans are unknown. The ~~Ministry of the Environment~~Ministry of the Environment, Conservation and Parks~~-~~ has conducted studies in the past that show that current drinking water treatments being used can reduce the amount of some pharmaceuticals and other contaminants of emerging concern in raw water (MOE, 2010b).

In terms of Source Water Protection, many activities that are potential sources of these compounds (e.g. sewage treatment plants, landfills) have been identified as prescribed Drinking Water Threats in the Source Protection Region and may therefore be indirectly managed under the *Clean Water Act, 2006.* That being said, the current circumstances for identifying Significant Threats do not identify PCPPs as ~~a~~ potentially hazardous chemicals and this is a shortcoming that may need to be addressed in the future as more information becomes available.

### 2.3.4 Aquatic Habitats – fisheries and macroinvertebrate communities

Habitat can be described as a place where an animal or plant normally lives, often characterized by a dominant plant form or physical characteristic. All living things have a number of basic requirements in their habitats including space, shelter, food, and reproduction. In an aquatic system, good water quality is an additional requirement. In a river system, water affects all of these habitat factors. Its movement and quantity affects the usability of the space in the channels, it can provide shelter and refuge by creating an area of calm in a deep pool, it carries small organisms, organic debris and sediments downstream which can provide food for many organisms, and its currents incorporate air into the water column which provides oxygen for both living creatures and chemical processes in the water and sediments. Habitat features also frequently affect and are affected by other features and functions in a system. For instance, the materials comprising a channel bed can affect the amount of erosion that will take place over time; this in turn affects the channel shape and the flow dynamics of the water. The coarseness of the channel's bed load can also affect the suitability for fish habitat – some species require coarse, gravelly deposits for spawning substrates, while finer sediments in the shallow fringes of slow moving watercourses often support wetland plants that are required by other species. These ideal habitats are not always available to organisms, and the aquatic communities throughout the Severn Sound watershed are slowly degrading due to the increased pressures of an expanding human population.

The communities impacted by anthropogenic factors tend to see a gradual and permanent change in the surrounding aquatic habitat. Normally, fish tend to be able to avoid getting diseases but, when faced with situations such as rising temperatures, murky waters and loss of habitat, they become stressed, making them susceptible to pathogens and diseases. Similarly, benthic invertebrates have a ranging tolerance to different conditions, but when these are exceeded they are unable to move to different habitats quickly, making them very vulnerable.

Degradation and loss of aquatic habitat can be attributed to numerous factors both within the watercourse and the surrounding subwatershed. Stressors to aquatic habitat include change in land use, discharge of pollutants (e.g. Wwastewater treatment plants) and recreational activities. Impacts from recreational activities in these areas, for example, can include increased bank erosion and instability, loss of riparian area resulting in an increase in input of total suspended solids (TSS) and pollution, and introduction of invasive species. Silt in the water can get trapped in the gills of fish and cause permanent damage. The sediment that settles on the bottom can cover the eggs of organisms, reducing the future population of a species, and can smother the benthic invertebrates living on the streambed.

Removal of riparian vegetation can also impact the communities living within watercourses. Not only does the vegetation act as a filter for debris and runoff, but shrubs and their roots provide shelter and shade to the organisms living in the water. When removed, species become vulnerable to predation and the watercourse can experience an increase in temperature. Increased water temperatures further stress the aquatic communities as this causes the levels of dissolved oxygen to decrease and forces species with specific temperature tolerance levels to leave the area, if capable of doing so. Warmer waters also provide new growth habitat for algae, further decreasing oxygen levels.

While having sites that are heavily degraded, municipalities, ~~environmental associations~~conservation agencies and nature groups in the Severn ~~s~~Sound watershed are continuously working towards improving and restoring streams and rivers to their historical conditions.

Through implementation of the Severn Sound Remedial Action Plan, rehabilitation of significant reaches of stream habitat has been achieved through the restricting of livestock access and the restoration of natural riparian vegetation in tributaries of Severn Sound (SSRAP ~~Stage 3 Report~~ 2002).

### *2.3.4.1 Fish Communities*

Fish have very specific requirements for temperature regime, suspended sediment levels (turbidity), and nutrient levels. The subwatersheds of the Severn Sound ~~W~~watershed and the nearby waters of Georgian Bay contain a variety of cold-water and warmwater species (Table 2-7), with approximately 65 fish species.

The fish community of Severn Sound is reviewed in detail in the ~~Severn Sound~~SS-RAP Stage 3 Report (SSRAP ~~Stage 3 Report~~ 2002).

Cold-water

Coldwater species are generally intolerant of increased temperatures, preferring a range between 10 and 18 degrees Celsius. Cold temperatures are often maintained by groundwater discharge (i.e. baseflow, which is the portion of stream flow supplied by groundwater discharge). If baseflow levels decline, the temperature of the watercourse will increase, ~~encouraging~~ which may encourage warmwater species to replace coldwater species. Coldwater species also require high levels of dissolved oxygen (which is in higher concentration in cold water) and cannot tolerate high turbidity levels, as the suspended sediment clogs the gills and impairs the ability of the fish to breathe. Presence or absence of cold-water fish species is shown in ~~Figure 2-8~~ Figure 2-10 for tributaries across Severn Sound area. It should be noted that cold-water fish species are absent at most sites sampled in the North River with the exception of some upstream tributaries, especially Silver Creek. Examples of coldwater species found within the Severn Sound ~~W~~watershed are Brook Trout (*Salvelinus fontinalis)* and Chinook Salmon (*Onchorhynchus tshawytscha*).

## Warm-water

Warmwater fish species are more tolerant of higher temperatures, with most being able to tolerate temperatures up to 30 degrees Celsius. As they are accustomed to higher temperatures, they do not require the high concentrations of dissolved oxygen that coldwater species do. Warmwater species can also survive in habitats with increased levels of suspended sediment and nutrient levels. Examples of warm-water species found within the Severn Sound wWatershed are Largemouth Bass (*Micropterus salmoides)* and Smallmouth Bass (*Micropterus dolomiuei).*

**Table 0-72-7: Fish species found in the Severn Sound watershed (Data Source: SSRAP, 1993).**

| Fish | Species | Thermal Status |
|---|---|---|
| Carp* | *Cyprinus carpio* | Warmwater |
| Golden shiner | *Notemigonus chrysoleucas* | Warmwater |
| Emerald shiner | *Notropis atherinoides* | Coolwater |
| Common shiner | *N. cornutus* | Warmwater |
| Spottail shiner | *N.hudsonius* | Coolwater |
| Spotfin shiner | *N.spilopterus* | Warmwater |
| Sand shiner | *N.stramineus* | Warmwater |
| Blackchin shiner | *N.heterodon* | Warmwater |
| Blacknose shiner | *N.heterolepsis* | Warmwater |
| Mimic shiner | *N.volucellus* | Warmwater |
| Northern Redbelly Dace | *Chrosomus eos* | Warmwater |
| Creek chub | *Semotilus atromaculatus* | Warmwater |
| Brassy minnow | *Hybognathus hankinsoni* | |
| Bluntnose Minnow | *Pimephales notatus* | Warmwater |
| Fathead minnow | *P.promelus* | Warmwater |
| Alewife* | *Alosa pseudoharengus* | |
| Gizzard shad | *Dorosoma cepedianum* | |
| Mottled Sculpin | *Cottus bairdi* | Coldwater |
| Slimy sculpin | *Cottus cognatus* | Coldwater |
| Burbot | *Lota lota* | Coldwater |
| Yellow perch | *Perca flavescens* | Coolwater |
| Walleye | *Stizostedion vitreum* | Coolwater |
| Logperch | *Percina caprodes* | Warmwater |
| Iowa darter | *Etheostoma exile* | Warmwater |
| Johnny darter | *E.nigrum* | Warmwater |
| White Bass | *Morone chrysops* | |
| White perch* | *M. americana* | Warmwater |
| Largemouth bass | *Micropterus salmoides* | Warmwater |
| Smallmouth bass | *M. dolomieui* | Coolwater |
| Black crappie | *Pomoxis nigromaculatues* | Warmwater |

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| Fish | Species | Thermal Status |
|---|---|---|
| Pumpkinseed | *Lepomis gibbosus* | Warmwater |
| Bluegill | *L.macrochirus* | Warmwater |
| Longear sunfish | *L. megalotis* | |
| Rock bass | *Ambloplites rupestris* | Warmwater |
| Threespine stickleback | *Gasterosteus aculeatus* | |
| Brook stickleback | *Culaea inconstans* | Warmwater |
| Brook silversides | *Labidesthes sicculus* | Coolwater |
| Sea lamprey* | *Petromyzon marinus* | |
| Silver lamprey | *Ichthyomyzon unicuspis* | |
| Lake sturgeon | *Acipenser fulvescens* | Coldwater |
| Bowfin | *Amia calva* | Warmwater |
| Tadpole madtom | *Noturus gyrinus* | |
| Brown bullhead | *Ictalurus nebulosus* | Warmwater |
| Channel catfish | *Ictalurus punctatus* | Warmwater |
| American eel* | *Anguilla rostrata* | Warmwater |
| Trout-perch | *Percopsis omiscomaycus* | Warmwater |
| Rainbow smelt* | *Osmerus mordax* | Coldwater |
| Lake trout backcross* | *Salvelinus namaycush X S.fontinalis* | - |
| Brook trout | *S.fontinalis* | Coldwater |
| Brown trout* | *Salmo trutta* | Coldwater |
| Rainbow trout* | *Oncorhynchus mykiss* | Coldwater |
| Pink salmon* | *Oncorhynchus gorbuscha* | Coldwater |
| Chinook salmon* | *Oncorhynchus tshawytscha* | Coldwater |
| Lake Whitefish | *Coregonus clupeaformis* | Coldwater |
| Lake Herring | *Coregonus artedi* | Coldwater |
| Longnose Gar | *Lepisosteus osseus* | Warmwater |
| Banded killifish | *Fundulus diaphanus* | Warmwater |
| Northern pike | *Esox lucius* | Coolwater |
| Muskellunge | *Esox masquinongy* | Warmwater |
| Central mudminnow | *Umbra limi* | Warmwater |
| Northern hog sucker | *Hypentelium nigricans* | Coolwater |
| White sucker | *Catostomus commersoni* | Coolwater |
| Longnose sucker | *Catostomus catostomus* | Coolwater |
| Redhorse | *Moxostoma sp.* | Coolwater |
| Quillback | *Carpiodes cyprinus* | Coolwater |
| Round Goby* | *Neogobius melanostomus* | Warmwater |

** Non-native species*

Based on tributary fish biomass surveys from 1982 to 2000 (MNR) data summarized in SSRAP 2002), the abundance of young-of-the-year rainbow trout is improving in area streams with some fluctuation at some stream locations.

Fish were surveyed at 34 agricultural drains and tributary sites across Severn Sound in 2000 (work of Port and Associates summarized in SSRAP 2002). A total of 31 species were captured at one or more sites in the Severn Sound area. None of the species captured during this survey were considered rare, threatened or endangered in Ontario, based on the Species at Risk list at the time. Four species of salmonids were captured. The most widely distributed salmonid was brook trout (10 sites) followed by rainbow trout (9 sites), brown trout (3 sites) and chinook salmon (2 sites) (~~Figure 2-8~~Figure 2-10). One or more salmonid species was present at 50% of the sites. Other game species present included largemouth bass, smallmouth bass and black crappie, which were present at one site each. Yellow perch were present at two sites.

Temperature measurements of ~~31~~ 213 sites in Severn Sound area tributaries have been recorded using temperature-loggers over the period ~~2006~~ 2010 to ~~2009~~2020, with historical data available for many sites as far back as 2006. Thermal habitat was determined using the DFO/MNR protocol (Stoneman and Jones 1996) which calls for stream temperatures measurements made between 4:00 pm and 4:30 pm on days when air temperature exceeds 25 °C. Stream temperature regime is classified into warm, cool and cold~~-~~water based on ranges provided in the protocol (~~Figure 2-7~~Figure 2-9). Based on the thermal regime, streams throughout most of the Severn Sound watershed are considered to be cool to cold~~-~~water. An exception is the warm~~-~~water North River system which borders the Precambrian Shield and has little overburden or groundwater input. Tributaries to the main North River such as Silver Creek, near Orillia and a tributary flowing into Bass Lake are notable exceptions, having cool water thermal regimes.

#### *2.3.4.2 Macroinvertebrate Communities*

Aquatic insects, or benthic macroinvertebrates, are an integral part of the food web of rivers and shallow lakes. Their benthic ('on the bottom') feeding habits bring these organisms into intimate contact with the sediments that accumulate persistent chemicals produced by human activity. This makes them an ideal indicator of water quality as different species have different tolerances to factors such as nutrient enrichment, dissolved solids, dissolved oxygen and temperature. The approach taken in the Severn Sound watershed has been to use qualitative collection methods to determine presence/absence of benthic macroinvertebrates (generally identified to ~~as low a taxonomic~~family level~~ as practical~~) at a number of sites across the watershed, and to collect quantitative samples using a T-sampler at key locations across the watershed~~selected sites~~ that ~~would~~ can provide an indication of the year-to-year changes due to human or ~~to~~ natural impacts ~~fluctuations~~ and to remedial efforts.

The 17~~8~~ long-term quantitative stream benthos stations within~~from~~ the Severn Sound watershed~~area~~ were used to assess changes in the benthic community from 1998~~6~~ to 2021~~005~~. Stations ~~Not all sites~~ were sampled yearly up to 2014, then biennially due to limitations on sample ~~each year and data for more recent years is currently under~~ preparation and identification ~~limits~~capacity. Site selection was based on representation of the stream at upper mid and near mouth reaches, as well as at reaches known to be ~~part~~ influenced by~~of~~ restoration projects, modified conditions or potential contaminant sources. For the purposes of this characterization, %EPT Richness (Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly)) was calculated ~~(EPT) Richness were estimated~~ at the family taxonomic level for each stream station ~~sampled~~ (~~Figure 2-9~~Figure 2-11). These three insect orders have young life-cycle stages that live in streams for long periods before emerging as adults, and in general, the majority of taxa in these groups are pollution sensitive, providing a good preliminary indication of stream water quality. ~~They generally have moderate to low tolerance of pollution sources and the EPT Richness at the family level provides a good preliminary indication of stream quality.~~

All long-term sites sampled had at least one family represented, indicating a relatively healthy benthic community structure. ~~with o~~One ~~a few~~ exception~~s~~ was a site on the headwaters of ~~that related to local construction (Copeland Creek) or beaver dam removal (Hogg~~ Hogg Creek ~~)~~in 2002, which was possibly due to beaver dam removal. ~~during some of years.~~ The %EPT Richness median ranged between 17.6%~~1~~ ~~and~~ to 70.3%~~15 families~~ across the watershed. The highest %EPT R~~r~~ichness was consistently found at sites in the Coldwater ~~River~~, ~~Silver Creek,~~ Sturgeon ~~River~~ and North Rivers, and Silver Creek, with widely fluctuating year-to-year values in the Wye River, ~~Hog~~ Hogg ~~Creek~~, Lafontaine ~~Creek~~ and Copeland Creeks. These latter streams are still affected by erosion and/or pollution sources (Table 2-8).

Preliminary trend analysis has been completed, indicating that the benthic community structure across the watershed has remained similar over the sampling period (1998-2021), except for station H1. This station is located on the headwaters of Hogg Creek and demonstrates a positive increasing trend. Additional analysis will need to be completed to clarify trends throughout the watershed.

**Table 0-8: Benthic Invertebrate Trends from 1998 to 2021**

| Benthic Stations (biennial sampling) | C1 | C2 | C3 | C4 | CC1 | H1 | H2 | H3 | LAC1 | N1 | SC5 | S0 | S1 | S2 | W1 | W2 | W3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| First year analyzed | 1998 | 1998 | 1998 | 1998 | 2000 | 1998 | 1998 | 1998 | 2009 | 1999 | 2007 | 1998 | 1998 | 1998 | 1998 | 1998 | 1998 |
| Last year analyzed | 2018 | 2020 | 2020 | 2018 | 2019 | 2019 | 2019 | 2019 | 2019 | 2011 | 2020 | 2020 | 2020 | 2020 | 2021 | 2021 | 2021 |
| # years in range | 18 | 17 | 19 | 18 | 17 | 18 | 19 | 19 | 8 | 13 | 18 | 19 | 19 | 19 | 20 | 20 | 19 |
| % EPT | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Min | 47.4 | 38.9 | 4.0 | 20.1 | 17.6 | 0.0 | 6.3 | 16.4 | 9.0 | 47.4 | 41.0 | 9.9 | 37.3 | 11.8 | 10.8 | 11.4 | 19.5 |
| Max | 74.0 | 86.4 | 52.1 | 78.6 | 66.3 | 80.2 | 78.3 | 70.2 | 35.6 | 78.6 | 78.1 | 85.6 | 86.7 | 70.3 | 58.7 | 72.4 | 73.6 |
| Median | 60.1 | 58.1 | 23.9 | 57.3 | 43.3 | 29.8 | 46.4 | 49.4 | 17.6 | 70.3 | 66.9 | 58.1 | 57.3 | 46.3 | 41.9 | 36.8 | 59.0 |

Notes:

Sampling of N1 began in 1999, CC1 2000, SC5 2007 and LAC1 2009.

H1 and W3 for year 2000 and C2 for year 2007, 2008 "No Data".

Yearly sampling 1998 to 2013, 2014 to present biennial sampling.

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## 2.4 Human Geography – population and land use

### 2.4.1 Population and Municipal Boundaries

Within the Severn Sound watershed, there are 11 municipal governments: the City of Orillia, the County of Simcoe, the District Municipality of Muskoka, and eight local municipalities. The total permanent municipal population estimated for the Severn Sound watershed is almost 75,000 (based on 2006 census, Table 2-8Table 2-9, Figure 2-10Figure 2-12). This population is affected by the seasonal residential population that resides in the Severn Sound area each recreational season (especially during summer). Total population during this season could rise by 2 or 3 times the permanent population. Percentage change in the permanent population between the 2001 and 2006 census were highest in the Township of Tiny and the Township of Georgian Bay (District Municipality of Muskoka), due largely to infilling and conversion of seasonal residences to permanent residences. The highest densities are in the urban municipalities of Orillia, Midland and Penetanguishene. The Beausoleil First Nations on the Christian Island First Nation Reserve is located just off shore of Penetanguishene. This reserve had a population of 621 during the 2006 census, at a density of 12 people per $km^2$.

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**Table 0-92-8: Municipal population and population density in the Severn Sound watershed.**
**(Data Sources: Statistics Canada - Census Data on populations, County of Simcoe/District of Muskoka - municipal areas, SSEA - watershed areas).**

| Upper Tier Municipality | Lower Tier Municipality | 2021 Population | 2006 Population | % Change in Population 20016 to 202106 |
|---|---|---|---|---|
| **City of Orillia** | n.a. | 33,411 | 30,259 | 9.4~~3.9~~ |
| **Simcoe County** | Twp of Springwater | 21,701 | 17,456 | 19.6~~8.4~~ |
| **Simcoe County** | Twp of Oro-Medonte | 23,017 | 20,031 | 13.0~~9.4~~ |
| **Simcoe County** | Twp of Severn | 14,576 | 12,030 | 17.5~~8.0~~ |
| **Simcoe County** | Twp of Tay | 11,091 | 9,748 | 12.1~~6.4~~ |
| **Simcoe County** | Twp of Tiny | 12,966 | 10,784 | 16.8~~19.4~~ |
| **Simcoe County** | Town of Penetanguishene | 10,077 | 9,354 | 7.2~~12.5~~ |
| **Simcoe County** | Town of Midland | 17,817 | 16,300 | 8.5~~0.5~~ |
| **District of Muskoka** | Georgian Bay | 3,441 | 2,340 | 32.0~~17.5~~ |
| | **Total** | **148,097** | **128,302** | **13.4** |

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### 2.4.2 Land use

It is important to consider land use when implementing Source Water Protection measures because land cover, and changes to it, will affect several aspects of the water budget including surface water runoff, evaporation and infiltration. Often land being developed will have higher proportion of impervious surfaces, such as roadways, parking lots and building roofs. This, in turn increases runoff rates, resulting in erosion and reduced infiltration to recharge groundwater reserves. The potential for the introduction of contaminants to both groundwater and surface water must be a consideration when a new land use is proposed.

Land use within the Severn Sound watershed has been summarized from detailed land use into seven classes (~~Table 2-9~~Table 2-~~9~~10, ~~Figure 2-11~~Figure 2-13). These include:

- Extraction;
- Natural Heritage Features (woodland, wetlands, natural riparian areas);
- Rural cropland (hay, pasture and idle);
- Rural row crops (market garden, orchard, row crop, sod farm, tree farm);
- Urban/high intensity (dense urban development, golf course);
- Urban/infrastructure (roads, parking area); and,
- ~~o~~Open water (inland lakes, ponds)

Land use is based on information from the Ministry of Natural Resources, Simcoe County and SSEA (see also Section 2.3.1). The largest land use within the Severn Sound watershed is Natural Heritage Features, comprising of 52% of the area. The second largest land use in the watershed is agriculture at 32%, composed of 9% more intensive use (rural- cropland) and 23% non-intensive use (rural - hay, pasture and idle). Urban land use represents 13% of the total area in the watershed.

**Table 0-10~~2-9~~: Land use in the Severn Sound watershed (Data Sources: MNR, County of Simcoe and SSEA).**

| Land Use | Area (km2) | % of Total |
|---|---|---|
| Extraction | 12 | 1 |
| Natural Heritage Feature | 657 | 52 |
| Rural - Cropland | 115 | 9 |
| Rural - Hay/Pasture or Idle | 290 | 23 |
| Urban/ High Intensity | 61 | 5 |
| Urban/ Infrastructure | 97 | 8 |
| Open Water | 20 | 2 |
| **Total** | **1252** | **100** |

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### 2.4.2.1 Areas of Settlement

Settlement Areas, as defined in municipal official plans (required by the Places to Grow Act, 2005), for the Source Water Protection area include: the City of Orillia, the Towns of Midland and Penetanguishene, and the smaller communities of Victoria Harbour, Port McNicoll, Elmvale, Coldwater, Hillsdale, Perkinsfield, Wyevale, Horseshoe Valley, Warminster, Orr Lake, Honey Harbour, Port Severn. Other built up areas include the coastal areas of the Townships of Tiny, Tay, Severn and Georgian Bay. Areas of Settlement are presented in ~~Figure 2-12~~ Figure 2-14, as well as the location of First Nation reserves and Federal Lands.

### 2.4.2.2 Impervious Surfaces

The hardening of the land's surface through paving and the construction of buildings significantly alters the hydrologic properties or drainage characteristics of an area. The result is reduced groundwater recharge and increased surface runoff. For the purpose of characterizing the Severn Sound watershed, we provide a map of impervious surfaces using the typical definition where all hardened surfaces are shown, including roads, parking lots and buildings. ~~Figure 2-13~~ Figure 2-15 shows that the areas with the most impervious surface cover are the major urban areas such as Orillia, Midland and Penetanguishene. Rural areas typically have very little impervious surface cover.

In the context of identifying risks to municipal drinking water systems, a slightly different definition of impervious surface area is applied to that described above. Source Water Protection defines total impervious surface area as "the surface area of all highways and other impervious land surfaces used for vehicular traffic and parking, and all pedestrian paths" (MOE, 2008a). This definition of total impervious surface is essentially used as a proxy for the application of road salt, a potential threat to municipal drinking water, as excess sodium is linked to a number of negative health issues (such as high blood pressure) and is of particular concern to those on low-sodium diets. The Technical Rules (MOE, 2008a) requires that the percentage of total impervious surface be calculated for each vulnerable area, including the Highly Vulnerable Aquifers (HVA), Significant Groundwater Recharge Areas (SGRA), Wellhead Protection Areas (WHPA) and Intake Protection Zones (IPZ).

Total impervious surface calculations for WHPA and IPZs were conducted as a component of the technical studies undertaken to investigate potential Threats to individual municipal drinking water supplies. The methods and results of the WHPA and IPZ impervious surface calculations can be found in each of the municipal vulnerability and threats chapters (Chapters 6 to 13). Similarly, methods and results for total impervious surface cover for the two broad scale vulnerable areas—HVAs and SGRAs—can be found in Chapter 4.

### 2.4.2.3 *Agriculture and the Raising of Livestock*

Based on the Ontario 2006 census data, the Severn Sound watershed supports a conventional farm economy with 719 farms involved in cash crop, livestock and mixed operations. The number of farms from the 2001 census was 716.

From Table 2-9Table 2-10, approximately 115 km$^2$ of land is cultivated with continuous row crop (corn), mixed grains, grain rotation, specialty crops (berries, vegetables) and sod being the dominant crop systems in the area. Approximately 290 km$^2$ of land is used for hay/pasture or idle land. Generally, there has been little change in the relative distribution of the land in production over the last two decades. However, there were fewer farmsteads between 1991 and 2000.

A direct comparison of the number of livestock operations surveyed in 1991 and 2000 by the Severn Sound RAP (SSRAP 1993, 2002) found a decrease in livestock operations of 17% and a decrease in Livestock Units of 20.6%. Table 2-10 Table 2-11 shows the highest density of cattle and calves are in Springwater and Tay Townships, with Springwater having the highest density of pigs and chickens. Overall, Springwater and Oro-Medonte have the highest livestock density, as illustrated in Figure 2-14Figure 2-16.

**Table 0-112-10: Livestock Density (number/km²) within the Severn Sound watershed (Data Source: Statistics Canada, 2006 Census).**

| Census Consolidated Subdivision (CCS) | % Municipal area within watershed | Cattle and Calves | Pigs | Sheep and Lambs | Horses and Ponies | Chicken and Hens |
|---|---|---|---|---|---|---|
| Springwater | 20 | 20.5 | 17.7 | 3.1 | 0.8 | 236.0 |
| Oro-Medonte | 52 | 15.4 | 6.7 | 8.4 | 1.5 | 2.0 |
| Severn | 51 | 5.6 | 0.1 | 2.6 | 0.5 | 12.8 |
| Tay | 100 | 18.9 | 0.0 | 1.6 | 1.7 | 5.2 |
| Tiny | 100 | 7.3 | 4.4 | 2.6 | 0.6 | 3.7 |
| Georgian Bay/Muskoka Lakes | 4 | 0.5 | 0.0 | 0.0 | 0.1 | 0.2 |

Note: Density calculations were completed using number of animals within each CCS for 2006, divided by the rural municipal area within each CCS portion of the watershed.

For example, Tay CCS consists of Township of Tay, and the Towns of Midland and Penetanguishene. Only the Tay Township area was used to calculate the Tay Twp livestock density.

Estimating the number of livestock being raised in vulnerable areas is an important task in determining risks to municipal drinking water supply. Livestock and associated activities, such as the storage or application of agricultural source material (i.e. manure spreading), have the potential to be a risk to drinking water due to both the pathogens (e.g. *Escherichia coli [E. coli]*) and chemicals (e.g. nitrogen) the material contains. The Technical Rules (MOE, 2008a) require that livestock density be calculated for each vulnerable area —Wellhead Protection Area

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(WHPA), Intake Protection Zone (IPZ), Significant Groundwater Recharge Area (SGRA) and Highly Vulnerable Aquifer (HVA). The methods used for these vulnerable areas is based on a Technical Bulletin provided by the Province (MOE, 2009b), and require interpretation of aerial photography to estimate capacity of a farm to house livestock. Methods and results of the WHPA and IPZ livestock density calculation, and whether these result in potential significant risks, can be found in each of the municipal vulnerability and threats chapters (Chapters 6 to 13). Similarly, livestock density for the broad scale vulnerable areas—HVAs and SGRAs— can be found in Chapter 4. To enable comparison of risk for different livestock types (e.g. hens versus cattle), livestock density estimates within these sections are presented as nutrient units per acre.

#### *2.4.2.4 Managed Lands*

Managed Land means land to which agricultural source material, commercial fertilizer, or non-agricultural source material (i.e. sewage or meat plant effluent) is applied (MOE 2008a). Managed lands include pasture, golf courses, residential areas, and areas where biosolids are applied. Managed Lands do not include areas such as forests, wetlands and commercial properties. The Technical Rules require that the percentage of managed lands within each vulnerable area (WHPA, IPZ, SGRA and HVA) be determined so that it can be established whether activities such as application of source material and fertilizer is a potential Significant, Moderate or Low Drinking Water Threat to the municipal water supply.

Methods and results of the WHPA and IPZ managed land calculation, and whether these result in potential Significant Threats, can be found in Chapters 6 to 13. Similarly, managed land information for the broad scale vulnerable areas—HVAs and SGRAs— can be found in Chapter 4.

For the purposes of characterizing the Severn Sound watershed, ~~Figure 2-15~~Figure 2-17~~,~~ provides a broad scale overview of managed lands in the area. This figure is based on the methods prescribed by the Province in a Technical Bulletin (MOE, 2009b) and shows the Municipal Property Assessment Corporation (MPAC) land use and property codes identified as having activities that have the potential to apply nutrients. ~~Figure 2-15~~ Figure 2-17 illustrates that areas of the watershed are classified as being managed lands. These include both urban (e.g. residential lawns) and rural (farms) areas.

## 2.5 Drinking Water Systems

Drinking water systems in Ontario are classified under O.Reg 170/03 (Drinking Water Systems) made under the *Safe Drinking Water Act, 2002*. The drinking water system classifications are:

(i) large municipal residential system;

(ii) small municipal residential system;

(iii) large municipal non-residential system;

(iv) small municipal non-residential system;

(v) non-municipal year-round residential system;

(vi) non-municipal seasonal residential system;

(vii) large non-municipal non-residential system; and

(viii) small non-municipal non-residential system;

The *Safe Drinking Water Act (SDWA), 2002*, came out of the recommendations from the Walkerton Inquiry to address the issues pertaining to the treatment and distribution of drinking water. The Act helps to protect drinking water through regulating the operation of drinking water systems and the testing of drinking water. The systems that are covered under O.Reg. 170/03 of the SDWA are listed below in ~~Table 2-11~~ Table 2-12 and include year-round municipal and private water systems that provide drinking water to residential developments and designated facilities that supply water to ‘“vulnerable populations’” (elderly, children). These facilities consist of schools (both public and private), universities, colleges or institutions that grant degrees, health and social care facilities, children’s camps, and child and youth care facilities.

The *Clean Water Act (CWA), 2006*, differs from the SDWA, in that it focuses more on protecting drinking water at the source rather than relying on the treatment system. In addition, the CWA focuses only on large and small municipal residential drinking water systems, where the SDWA focuses on municipal non-residential and non-municipal year-round residential systems as well. Other drinking water systems (as previously mentioned) are regulated under the *Safe Drinking Water Act* and the *Health Protection and Promotion Act (HPPA), 1990*. For more information on the CWA and the assessment report process, please refer to Chapter 1 of this report.

**Table 0-122~~-11~~: Drinking Water Systems and the legislation they are protected under.**

| Drinking Water System | Definition | Legislative Protection |
|---|---|---|
| Large Municipal Residential System | • Municipal<br>• Serves major residential development & more than 100 private residences | SDWA, CWA |
| Small Municipal Residential System | • Municipal<br>• Serves a major residential development & fewer than 101 private residences | SDWA, CWA |
| Large Municipal Non-Residential System | • Municipal<br>• Non-residential<br>• Capable of supplying drinking water at a rate of more than 2.9 L/s | SDWA, HPPA |

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| Drinking Water System | Definition | Legislative Protection |
|---|---|---|
| Small Municipal Non-Residential System | • Municipal<br>• Non-residential<br>• Not capable of supplying drinking water at a rate of more than 2.9 L/s | SDWA, HPPA |
| Non-Municipal Year-Round Residential System | • Non-municipal<br>• Year-round<br>• Serves a major residential development or trailer park or campground & has more than 5 service connections | SDWA |
| Non-Municipal Seasonal Residential System | • Non-municipal<br>• Seasonal<br>• Serves a major residential development or trailer park or campground & has more than 5 service connections | HPPA |
| Large Non-Municipal Non-Residential System | • Non-municipal<br>• Does not serves major residential development/trailer park or campground that has more than 5 service connections<br>• Capable of supplying drinking water at a rate of more than 2.9 L/s | HPPA |
| Small Non-Municipal Non-Residential System | • Non-municipal<br>• Serves a designated facility or public facility<br>• Does not serves major residential development/trailer park or campground that has more than 5 service connections<br>• Not capable of supplying drinking water at a rate of more than 2.9 L/s | HPPA |

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The Terms of Reference (ToR) for the SGBLS Assessment Reports identifies all the drinking water systems and associated wells and surface intakes required in this Assessment Report. In accordance with the ToR, only drinking water systems classified as large municipal residential, and small municipal residential have been included (Type i and ii) in this report. Within the entire SGBLS Source Protection Region there are 108 drinking water systems, serviced by 277 wells and 16 surface water intakes. Within the Severn Sound area there are 35 drinking water systems, serviced by 87 municipal wells and 2 surface water intakes (~~Table 2-12~~Table 2-1~~2~~3, ~~Figure 2-16~~Figure 2-18). Locations of non-municipal and non-residential drinking water systems that are not included in this report are shown in ~~Figure 2-17~~Figure 2-19. Locations of these drinking water systems were provided by the MOE and represent those systems that are registered with the MOE under the former O.Reg 252 (now Reg. 318 of the *Health Promotion and Protection Act*).

Information pertaining to each municipal drinking water system, such as the location, population served and pumping rates are presented in ~~Table 2-12~~Table 2-13.

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The maximum annual and average monthly average pumping rates are available in Appendix WB-3B. A few of the drinking water systems in the South Georgian Bay-Lake Simcoe Source Protection Region are spread across more than one watershed. In the Severn watershed, the Orillia Well Supply System is in both the Severn Sound and the Black-Severn River watershed.

One of the wells (Well 3) is in the Severn Sound watershed, while the other two wells are located in the Black-Severn River watershed. Pumping rates for the other wells and the surface water intake can be found in Lakes Simcoe and Couchiching-Black River Assessment Report, Part 2. Where current average pumping rates were not available, maximum permitted rates were used (denoted by *).

Information presented in these tables has been sourced either directly from the municipality or through well head protection reports from across the Source Protection Region. Specific details about each drinking water system are provided in Chapters 6-13.

**Table 0-13~~2-12~~: Municipal Drinking Water Systems in the Severn Sound Watershed (2008/2009 data obtained from SSEA).**

| Municipality | Subwatershed | Drinking Water System (DWS) Name | DWS Classification | Population served by DWS | Well Name | Easting | Northing | Current Average Pumping (m3/a) | Pumping Data Current as of… |
|---|---|---|---|---|---|---|---|---|---|
| The Town of Midland | Midland Area | Midland Well Supply | 1 | 20,000 combined for all of Midland | Well #11 | 586375 | 4956110 | 179,392 | 2009 |
| ~~The Town of Midland~~ | ~~Midland Area~~ | ~~Midland Well Supply~~ | ~~1~~ | ~~20,000 combined for all of Midland~~ | ~~Well #12~~ | ~~586460~~ | ~~4956076~~ | ~~0~~ | ~~2009~~ |
| The Town of Midland | Midland Area | Midland Well Supply | 1 | 20,000 combined for all of Midland | Well #14 | 586584 | 4956038 | 98,688 | 2009 |
| The Town of Midland | Midland Area | Midland Well Supply | 1 | 20,000 combined for all of Midland | Well #15 | 589276 | 4954994 | 269,879 | 2009 |
| The Town of Midland | Midland Area | Midland Well Supply | 1 | 20,000 combined for all of Midland | Well #16 | 586747 | 4956238 | 122,416 | 2009 |
| The Town of Midland | Midland Area | Midland Well Supply | 1 | 20,000 combined for all of Midland | Well #17 | 586853 | 4956277 | 138,409 | 2009 |
| ~~The Town of Midland~~ | ~~Penetanguishene and Tay Point~~ | ~~Midland Well Supply~~ | ~~1~~ | ~~20,000 combined for all of Midland~~ | ~~Well #20~~ | ~~586800~~ | ~~4956812~~ | ~~-~~ | ~~2009~~ |
| ~~The Town of Midland~~ | ~~Penetanguishene and Tay Point~~ | ~~Midland Well Supply~~ | ~~1~~ | ~~20,000 combined for all of Midland~~ | ~~Well #24~~ | ~~586768~~ | ~~4956788~~ | ~~-~~ | ~~2009~~ |
| ~~The Town of Midland~~ | ~~Penetanguishene and Tay Point~~ | ~~Midland Well Supply~~ | ~~1~~ | ~~20,000 combined for all of Midland~~ | ~~Well #25~~ | ~~586786~~ | ~~4956791~~ | ~~-~~ | ~~2009~~ |
| ~~The Town of Midland~~ | ~~Penetanguishene and Tay Point~~ | ~~Midland Well Supply~~ | ~~1~~ | ~~20,000 combined for all of Midland~~ | ~~Well #26~~ | ~~586800~~ | ~~4956812~~ | ~~-~~ | ~~2009~~ |
| The Town of Midland | Midland Area | Midland Well Supply | 1 | 20,000 combined for all of Midland | Well #6 | 586676 | 4956097 | 151,588 | 2009 |
| The Town of Midland | Wye River | Midland Well Supply | 1 | 20,000 combined for all of Midland | Well #7a | 588714 | 4953130 | 359,530 | 2009 |

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| Municipality | Subwatershed | Drinking Water System (DWS) Name | DWS Classification | Population served by DWS | Well Name | Easting | Northing | Current Average Pumping (m3/a) | Pumping Data Current as of… |
|---|---|---|---|---|---|---|---|---|---|
| The Town of Midland | Wye River | Midland Well Supply | 1 | 20,000 combined for all of Midland | Well #7b | 588715 | 4953150 | 405,643 | 2009 |
| The Town of Midland | Midland Area | Midland Well Supply | 1 | 20,000 combined for all of Midland | Well #9 | 586363 | 4954742 | 241,720 | 2009 |
| The Town of Midland | Midland Area | Midland Well Supply | 1 | 20,000 combined for all of Midland | Well # 1A | 587448 | 4956216 | - | 2009 |
| The City of Orillia | North River | Orillia Water Supply System | 1 | 33411 (All Orillia wells [3]) | Well #3 (West) | 622904 | 4940267 | 660,983 | 2009 |
| The Township of Oro-Medonte | Coldwater River | Braestone Well Supply | 1 | Data Gap802 combined | Well #1 | 612452 | 4937408 | Data Gap | 2022 |
| The Township of Oro-Medonte | Coldwater River | Braestone Well Supply | 1 | Data Gap802 combined | Well #2 | 612460 | 4937400 | Data Gap | 2022 |
| The Township of Oro-Medonte | Coldwater River | Horseshoe Highlands subdivision Well Supply | 1 | 2,700 | Well 1 / Well 2 | 605847 / 605976 | 4934293 / 4934361 | 154,386 | 2009 |
| The Township of Oro-Medonte | Coldwater River | Medonte Hills Well Supply | 1 | 550 | Well #1 / Well 2 | 605943 / 605933 | 4943393 / 4943381 | 28,200 | 2009 |
| The Township of Oro-Medonte | Coldwater River | Robincrest Well Supply | 1 | 790 | Well #1 / Well #2 | 606119 / 606097 | 4945214 / 4945201 | 52,248 | 2009 |
| The Township of Oro-Medonte | Coldwater River | Sugar Bush Well Supply | 1 | 1,565 combined (Sugar Bush wells [3]) | Well #1 | 609038 | 4935464 | 116,934 combined (Sugar Bush wells [3]) | 2009 |
| The Township of Oro-Medonte | Coldwater River | Sugar Bush Well Supply | 1 | 1,565 combined (Sugar Bush wells [3]) | Well #2 | 609405 | 4934971 | 116,934 combined (Sugar Bush wells [3]) | 2009 |

| Municipality | Subwatershed | Drinking Water System (DWS) Name | DWS Classification | Population served by DWS | Well Name | Easting | Northing | Current Average Pumping (m3/a) | Pumping Data Current as of… |
|---|---|---|---|---|---|---|---|---|---|
| The Township of Oro-Medonte | Coldwater River | Sugar Bush Well Supply | 1 | 1,565 combined (Sugar Bush wells [3]) | Well #3 | 610037 | 4934822 | 116,934 combined (Sugar Bush wells [3]) | 2009 |
| The Township of Oro-Medonte | North River | Warminster Well Supply | 1 | 1200 | Well #1 / Well #3 | 616622 / 616622 | 4944518 / 4944518 | 84,347 | 2009 |
| The Town of Penetanguishene | Penetang Bay West | Lepage Subdivision (Penetanguishene) Well Supply | 2 | 62 | Well #1 / Well #2 | 582493 / 582489 | 4958380 / 4958380 | 7,044 | 2009 |
| The Town of Penetanguishene | Penetanguishene and Tay Point | Payette (Penetanguishene) Well Supply | 1 | 6,700 combined (Payette wells [3]) | Well #1 | 584973 | 4959416 | 1,050,871 combined (Payette wells [3]) | 2009 |
| The Town of Penetanguishene | Penetanguishene and Tay Point | Payette (Penetanguishene) Well Supply | 1 | 6,700 combined (Payette wells [3]) | Well #2 | 584982 | 4959438 | 1,050,871 combined (Payette wells [3]) | 2009 |
| The Town of Penetanguishene | Penetanguishene and Tay Point | Payette (Penetanguishene) Well Supply | 1 | 6,700 combined (Payette wells [3]) | Well #3 | 585063 | 4959422 | 1,050,871 combined (Payette wells [3]) | 2009 |
| The Town of Penetanguishene | Copeland Creek | Robert Street West Supply Well | 0 | 0 | Well #2 / Well #3 | 583030 / 582951 | 4956991 / 4956941 | 0 | 2009 |
| The Township of Severn | North River | Bass Lake Woodlands Well Supply | 1 | 450 combined (Bass Lake Woodlands wells [3]) | Well #1 | ~~619710~~619722 | ~~4941726~~4941696 | ~~42,928 combined (Bass Lake Woodlands wells [3])~~102492 | ~~2009~~2025 |
| The Township of Severn | North River | Bass Lake Woodlands Well Supply | 1 | 450 combined (Bass Lake Woodlands wells [3]) | Well #2R | ~~619724~~619728 | ~~4941700~~4941706 | ~~42,928 combined (Bass Lake Woodlands wells [3])~~239148 | ~~2009~~2025 |

**Commented [MC4]:** Max permitted rate

**Commented [MC5]:** Max permitted rate

| Municipality | Subwatershed | Drinking Water System (DWS) Name | DWS Classification | Population served by DWS | Well Name | Easting | Northing | Current Average Pumping (m3/a) | Pumping Data Current as of... |
|---|---|---|---|---|---|---|---|---|---|
| The Township of Severn | North River | Bass Lake Woodlands Well Supply | 1 | 450 combined (Bass Lake Woodlands wells [3]) | Well #3R | ~~619722~~619728 | ~~4941708~~4941704 | ~~42,928 combined (Bass Lake Woodlands wells [3])~~270684 | ~~2009~~2025 |
| The Township of Severn | Coldwater River | Coldwater Well Supply | 1 | 1,400 combined (Coldwater wells [3]) | Well 1 | 607198 | 4951172 | 151,218 combined (Coldwater wells [3]) | 2009 |
| The Township of Severn | Coldwater River | Coldwater Well Supply | 1 | 1,400 combined (Coldwater wells [3]) | Well 2 | 607157 | 4951235 | 151,218 combined (Coldwater wells [3]) | 2009 |
| The Township of Severn | Coldwater River | Coldwater Well Supply | 1 | 1,400 combined (Coldwater wells [3]) | Well 3 | 607203 | 4951222 | 151,218 combined (Coldwater wells [3]) | 2009 |
| The Township of Springwater | Wye River | Elmvale Well Supply | 1 | 2,894 | Well #1 / Well #2 | 590127 / 590134 | 4937486 / 4937498 | 219,990 | 2009 |
| The Township of Springwater | Sturgeon River | Hillsdale Well Supply | 1 | 1,104 combined (Hillsdale wells [3]) | Well #1 | 599315 | 4938406 | 89,252 combined (Hillsdale wells [3]) | 2009 |
| The Township of Springwater | Sturgeon River | Hillsdale Well Supply | 1 | 1,104 combined (Hillsdale wells [3]) | Well #2 | 599309 | 4938397 | 89,252 combined (Hillsdale wells [3]) | 2009 |
| The Township of Springwater | Sturgeon River | Hillsdale Well Supply | 1 | 1,104 combined (Hillsdale wells [3]) | Well #3 | 599309 | 4938395 | 89,252 combined (Hillsdale wells [3]) | 2009 |
| *The Township of Tay* | - | *Rope Subdivision Water Treatment Plant* | *2* | *70* | *SW* | - | - | *12,371* | *2009* |

**Commented [MC6]:** Max permitted rate

| Municipality | Subwatershed | Drinking Water System (DWS) Name | DWS Classification | Population served by DWS | Well Name | Easting | Northing | Current Average Pumping (m3/a) | Pumping Data Current as of... |
|---|---|---|---|---|---|---|---|---|---|
| *The Township of Tay* | - | *Victoria Harbour Water Treatment Plant* | *1* | *8,000* | *SW* | - | - | *1,000,952* | *2009* |
| The Township of Tiny | Tiny Coastal Area South | Bluewater Well Supply | 1 | 756 combined (Bluewater wells [3]) | Well #18-1 | 579721 | 4940964 | 75,710 combined (Bluewater wells [3]) | 2009 |
| The Township of Tiny | Tiny Coastal Area South | Bluewater Well Supply | 1 | 756 combined (Bluewater wells [3]) | Well #18-2 | 579711 | 4940957 | 75,710 combined (Bluewater wells [3]) | 2009 |
| The Township of Tiny | Tiny Coastal Area South | Bluewater Well Supply | 1 | 756 combined (Bluewater wells [3]) | Well #8-1 | 579691 | 4940077 | 75,710 combined (Bluewater wells [3]) | 2009 |
| The Township of Tiny | Tiny Coastal North East | Cooks Lake Well Supply | 2 | 218 | Well #12-1 / Well #12-2 | 581197 / 581195 | 4962382 / 4962389 | 32,324 | 2009 |
| The Township of Tiny | Tiny Coastal North East | Georgian Bay Estates Well Supply | 1 | 600 combined (Georgian Bay Estates wells[3]) | Well #19-1 | 583059 | 4968176 | 64,836 combined (Georgian Bay Estates wells[3]) | 2009 |
| The Township of Tiny | Tiny Coastal North East | Georgian Bay Estates Well Supply | 1 | 600 combined (Georgian Bay Estates wells[3]) | Well #19-4 | 583157 | 4968207 | 64,836 combined (Georgian Bay Estates wells[3]) | 2009 |
| The Township of Tiny | Tiny Coastal North East | Georgian Bay Estates Well Supply | 1 | 600 combined (Georgian Bay Estates wells[3]) | Well #19-5 | 583193 | 4968230 | 64,836 combined (Georgian Bay Estates wells[3]) | 2009 |
| The Township of Tiny | Tiny Coastal Area North West | Castle Cove (Georgian Highlands) Well Supply | 2 | 391 combined (Castle Cove Wells [5]) | Well #1-4 | 568836 | 4957561 | 18,209 | 2009 |

| Municipality | Subwatershed | Drinking Water System (DWS) Name | DWS Classification | Population served by DWS | Well Name | Easting | Northing | Current Average Pumping (m3/a) | Pumping Data Current as of... |
|---|---|---|---|---|---|---|---|---|---|
| The Township of Tiny | Tiny Coastal Area North West | Castle Cove (Sand Castle) Well Supply | 2 | 39~~2~~1 combined (Castle Cove Wells [5]) | Well #13-1 / Well #13-2 | 569654 / 569646 | 4956063 / 4956076 | 15,741 | 2009 |
| The Township of Tiny | Tiny Coastal Area North West | Castle Cove (Tiny Cove Estates) | 0 | 391~~3~~ combined (Castle Cove Wells [5]) | Well 30-1 / Well 30-2 | 569129 / 569127 | 4956880 / 4956880 | 12,955 | 2009 |
| The Township of Tiny | Tiny Coastal Area North West | Georgian Sands Well Supply | 1 | 2,083 combined (Georgian Sands [4], and Lafontaine [2] wells) | Well #1-1 | 572817 | 4954184 | 323,173 combined (Georgian Sands wells [4]) | 2009 |
| The Township of Tiny | Tiny Coastal Area North West | Georgian Sands Well Supply | 1 | 2,083 combined (Georgian Sands [4], and Lafontaine [2] wells) | Well #14-1 | 573130 | 4954109 | 323,173 combined (Georgian Sands wells [4]) | 2009 |
| The Township of Tiny | Tiny Coastal Area North West | Georgian Sands Well Supply | 1 | 2,083 combined (Georgian Sands [4], and Lafontaine [2] wells) | Well #2-1 | 572556 | 4954465 | 323,173 combined (Georgian Sands wells [4]) | 2009 |
| The Township of Tiny | Tiny Coastal Area North West | Georgian Sands Well Supply | 1 | 2,083 combined (Georgian Sands [4], and Lafontaine [2] wells) | Well #2-2 | 572566 | 4954450 | 323,173 combined (Georgian Sands wells [4]) | 2009 |
| The Township of Tiny | Lafontaine Creek | Lafontaine Well Supply | 2 | 2,083 combined (Georgian Sands [4], and Lafontaine [2] wells) | Well #23-1 / Well #23-4 | 574773 / 574784 | 4956375 / 4956380 | 9,522 | 2009 |
| The Township of Tiny | Tiny Coastal Area West Central | Lefaive Well Supply | 2 | 166 | Well #3-2, Well #3-3 | 578130 / 578115 | 4951498 / 4951492 | 12,049 | 2009 |
| The Township of Tiny | Tiny Coastal Area North West | Pennorth Well Supply | 2 | 77 | Well #7-1, Well #7-2 | 575959 / 575959 | 4952927 / 4952927 | 6,155 | 2009 |
| The Township of Tiny | Tiny Coastal Area West Central | Perkinsfield Well Supply | 1 | 502 combined (Perkinsfield wells [4]) | Well #11-2 | 581599 | 4951007 | 70,247 combined (Perkinsfield wells [4]) | 2009 |

| Municipality | Subwatershed | Drinking Water System (DWS) Name | DWS Classification | Population served by DWS | Well Name | Easting | Northing | Current Average Pumping (m3/a) | Pumping Data Current as of… |
|---|---|---|---|---|---|---|---|---|---|
| The Township of Tiny | Tiny Coastal Area West Central | Perkinsfield Well Supply | 1 | 502 combined (Perkinsfield wells [4]) | Well #22-3 | 581235 | 4950651 | 70,247 combined (Perkinsfield wells [4]) | 2009 |
| The Township of Tiny | Wye River | Perkinsfield Well Supply | 1 | 502 combined (Perkinsfield wells [4]) | Well #26-4 | 584498 | 4949761 | 70,247 combined (Perkinsfield wells [4]) | 2009 |
| The Township of Tiny | Wye River | Perkinsfield Well Supply | 1 | 502 combined (Perkinsfield wells [4]) | Well #26-5 | 584789 | 4949816 | 70,247 combined (Perkinsfield wells [4]) | 2009 |
| The Township of Tiny | Tiny Coastal Area South | Rayko Water System Well Supply | 2 | 96 | Well #6-2 / Well #6-3 | 580881 / 580877 | 4944033 / 4944033 | 10,825 | 2009 |
| The Township of Tiny | Tiny Coastal North East | Sawlog Bay Well Supply | 2 | 120 | Well #16-1 / Well #16-2 | 583232 / 583220 | 4967417 / 4967408 | 9,866 | 2009 |
| The Township of Tiny | Penetang Bay West | Tee Pee Point Well Supply | 2 | 226 | Well #9-1 / Well #9-2 | 584637 / 584627 | 4963183 / 4963187 | 18,431 | 2009 |
| The Township of Tiny | Tiny Coastal Area North West | Thunder Bay Well Supply | 2 | 58 | Well #20-1 / Well #20-2 | 574245 / 574245 | 4960453 / 4960442 | 6,123 | 2009 |
| The Township of Tiny | Tiny Coastal Area North West | Vanier Woods Well Supply | 2 | 173 | Well #15-1 / Well #14-2 | 570797 / 570817 | 4955410 / 4955427 | 14,308 | 2009 |
| The Township of Tiny | Copeland Creek | Whip-Poor-Will Well Supply | 2 | 170 | Well #21-1 / Well #21-2 | 582621 / 582619 | 4954542 / 4954533 | 34,339 | 2009 |
| The Township of Tiny | Tiny Coastal Area South | Woodland Beach Well Supply | 2 | 82 | Well #25-1 / Well #25-2 | 579254 / 579242 | 4938686 / 4938678 | 10,767 | 2009 |
| The Township of Tiny | Tiny Coastal Area South | Wyevale Well Supply | 1 | 691 combined (Wyevale wells [5]) | Well #17-1 | 585346 | 4945486 | 108,415 combined (Wyevale wells [5]) | 2009 |

| Municipality | Subwatershed | Drinking Water System (DWS) Name | DWS Classification | Population served by DWS | Well Name | Easting | Northing | Current Average Pumping (m3/a) | Pumping Data Current as of... |
|---|---|---|---|---|---|---|---|---|---|
| The Township of Tiny | Tiny Coastal Area South | Wyevale Well Supply | 1 | 691~~2~~ combined (Wyevale wells [5]) | Well #17-2 | 585332 | 4945508 | 108,415 combined (Wyevale wells [5]) | 2009 |
| The Township of Tiny | Tiny Coastal Area South | Wyevale Well Supply | 1 | 691~~3~~ combined (Wyevale wells [5]) | Well #17-3 | 585351 | 4945484 | 108,415 combined (Wyevale wells [5]) | 2009 |
| The Township of Tiny | Wye River | Wyevale Well Supply | 1 | 691~~4~~ combined (Wyevale wells [5]) | Well #29-1 | 586297 | 4944949 | 108,415 combined (Wyevale wells [5]) | 2009 |
| The Township of Tiny | Wye River | Wyevale Well Supply | 1 | 691~~5~~ combined (Wyevale wells [5]) | Well #29-2 | 586309 | 4944926 | 108,415 combined (Wyevale wells [5]) | 2009 |

*1 – Large Municipal System*

*2 – Small Municipal System*

*0 – Unknown*

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## 2.6 Interaction between Physical and Human Geography

Humans are dependent on the environment in a number of ways and the manner in which they work the land is determined by the physical geography of the surrounding environment. As technology advances more of the landscape can be modified to accommodate the needs of a community. On one hand, newer technology and methods allow for more sophisticated measures to be used to extract resources (such as drinking water) while minimizing impacts on the local environment. On the other hand, it also provides ways to supply resources to more people, encouraging population growth. By increasing the demands and stress put on an ecological system, the natural balance is altered with resulting consequences that will need to be studied and addressed.

Interactions between human and physical geography within the Severn Sound watershed are numerous. As previously mentioned, the population in the watershed continues to expand. The Townships of ~~Tiny~~ Georgian Bay and ~~the Town of Penetanguishene~~ Springwater have seen the most dramatic increase between the 200~~1~~6 and 200~~6~~21 census years with a ~~19.4~~32% and ~~12.5~~19.6% increase, respectively. For municipalities entirely within the Severn Sound watershed area, the Township of Tiny saw the largest increase at 16.8%. As areas like these become more urbanized there is an associated loss of natural vegetative cover. By removing the natural vegetation, the water quality and quantity of available drinking water can be altered.

*Natural Features*

Natural features in the environment generally serve to maintain water quality conditions. Naturally vegetated areas including grasslands, meadows, and woodland areas tend to improve the quality of water as it flows over land. The stems and roots of the vegetation slow the flow of water, enabling soil particles and other contaminants to be deposited and increase the amount of runoff that infiltrates into the soil. Water is filtered as it flows through the soil to the groundwater. Wetlands slow the flow of water, provide storage and can absorb some contaminants, including nutrients such as phosphorus, and thus have a natural filtering ability.

With the removal of natural features there is increased access for people and contaminants to waterways. As the quality of water decreases, it is not only human populations that are impacted. The fishery of Severn Sound has been under stress since the 1970s. Through the efforts of the SSRAP, the fisheries are beginning to restore themselves as prior habitats are restored and new habitats are created. As mentioned above, tributary fish biomass surveys from 1982 to 2000 (indicate that the abundance of young-of-the-year rainbow trout) is improving in area streams with some fluctuation at some stream locations.

Macroinvertebrate communities were sampled between 1996 to ~~2005~~ 2021 at 18 sites. Using % Ephemeroptera, Plecoptera and Trichoptera (EPT) Richness as a preliminary assessment of stream quality, results showed that the highest %EPT ~~r~~Richness was consistently found at sites in the Coldwater, Sturgeon and North Rivers and Silver Creek. The more widely fluctuating year-to-year values were found to be in the Wye River, and Lafontaine, ~~Hog~~ Hogg ~~Creek~~ and Copeland Creeks. These latter streams are still affected by erosion and/or pollution sources

*Agriculture*

There are a number of water quality issues that are associated with agriculture. Runoff from pasture and cropland can contain high levels of nutrients, sediment, and bacteria. Wind can erode topsoil with its associated contaminants. All of these substances can end up in local watercourses if the appropriate Best Management Practices (BMPs) are not implemented. These BMPs can include conservation tillage, cover cropping, maintaining vegetated riparian buffers, cattle fencing, and the appropriate use of fertilizers and pesticides.

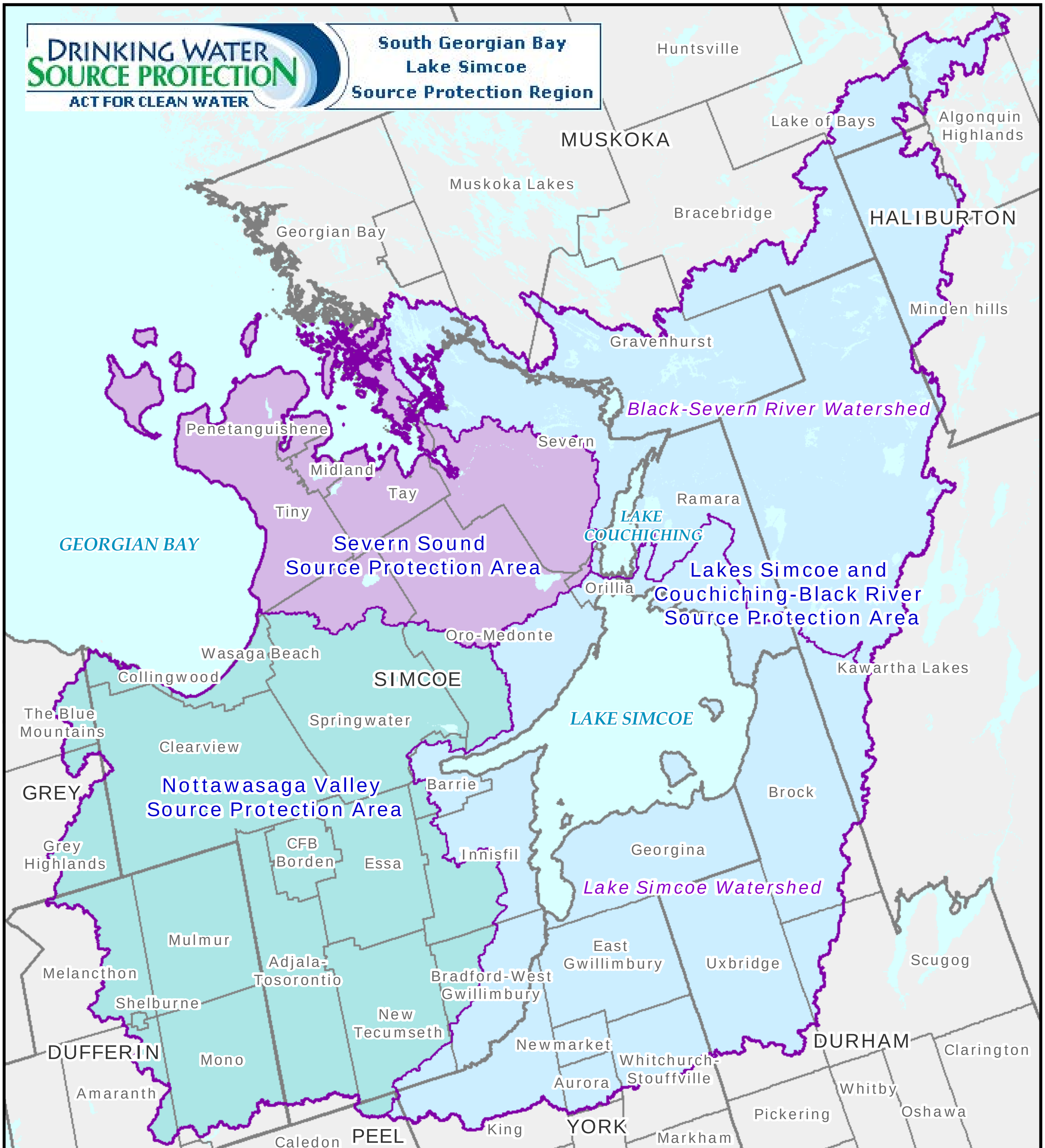
*Urbanization*

An increase in urbanization also leads to an increase in impervious surface areas, such as roads and rooftops. These have a significant effect on both water quality and quantity. Hardened or impervious surfaces reduce the amount of surface water infiltrating into the ground and causing an increase the volume and velocity of surface runoff, which leads to stream bank erosion, contributing more sediment to watercourses, and can even contribute to flooding. Runoff from imperious surfaces, particularly those built prior to the requirement for storm water management, can carry a host of pollutants to local watercourses. These pollutants build up on roads, driveways and parking lots and even lawns, and are washed to watercourses when it rains. Current water quality results indicate that the majority of waterways in the Severn Sound watershed are being impacted in some ways, especially due to elevated phosphorus. Groundwater results showed some ~~exceedences~~ exceedances that could be ~~contributable~~ attributable to changing land uses in nearby areas. There are many pollutants that can be carried by urban storm water runoff. Some examples include nutrients and pesticides from lawns, parks and golf courses; ~~road~~ deicing salts; tire residue; oil and gas; sediment; and nutrients and bacteria from pet and wild animal feces. The requirement for storm water management facilities and the recommendation for increased use of Low Impact Development measures in all new developments will help to mitigate these issues in urban areas, however, the ongoing maintenance of these facilities is crucial to ensuring that they continue to reduce sediment and nutrient loads as designed, otherwise these new developments would be contributing additional phosphorus to the system.

~~By c~~Characterizing the watershed, and the different elements within it, ~~it~~ gives a general overview of the health of the area. It puts into context the location of different features of the watershed and gives an understanding of the current pressures on drinking water supplies. By providing a broad analysis of the watershed it sets the stage for further in-depth analysis of water quantity stressors (Chapter 3) and the details for specific municipal systems (Chapters 6-13).

## 2.7 Data and Knowledge Gaps

This chapter contains all of the information required by the Technical Rules.




Source Water Protection Region

Source Protection Area (SPA)

- Lakes Simcoe and Couchiching-Black River SPA
- Nottawasaga Valley SPA
- Severn Sound SPA
- Watershed Boundaries
- Upper Tier Municipality
- Lower Tiers Municipality
- Water Body

## Source Water Protection Region Areas and Municipalities

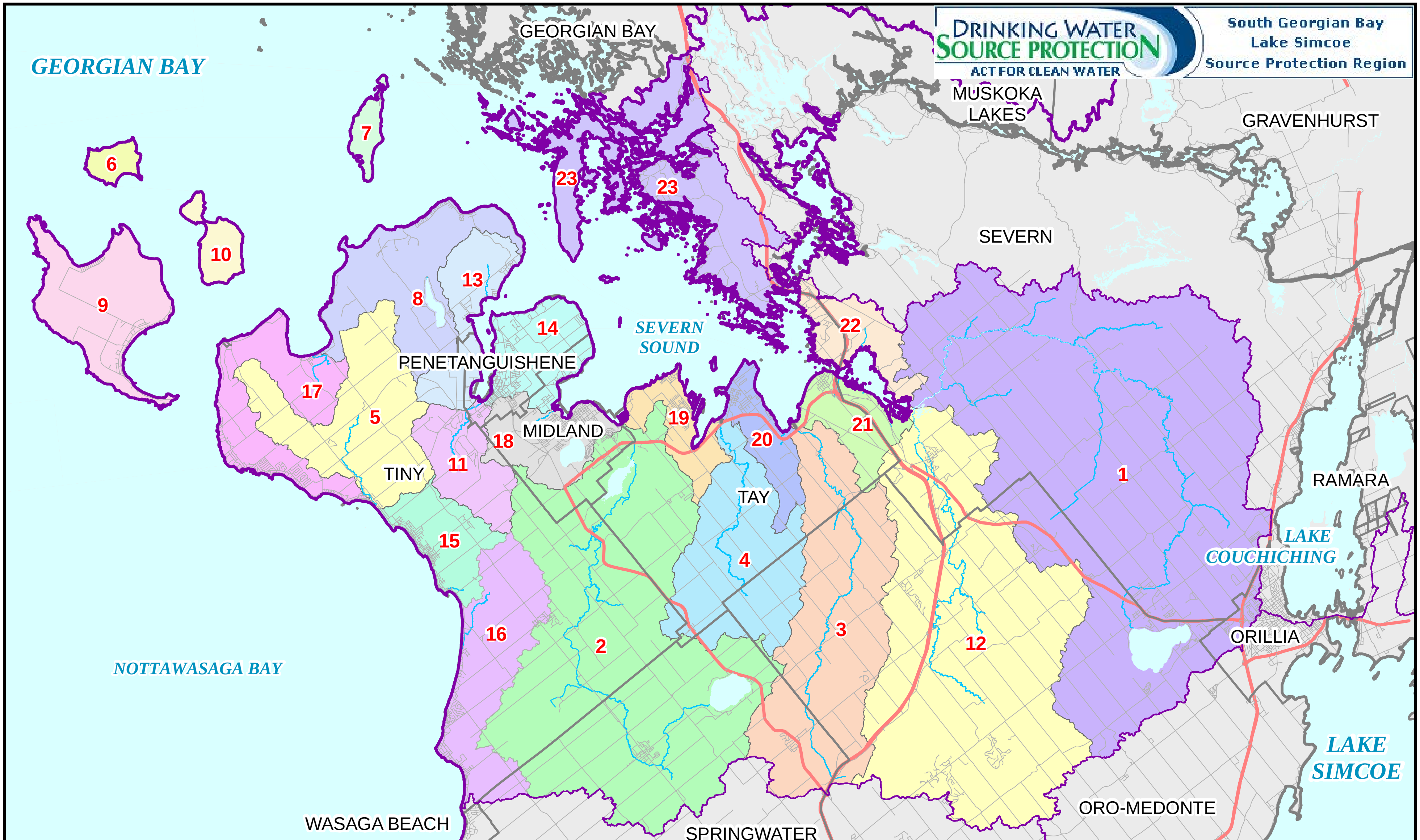
Created by: LSRCA
Date: 2010-01-21

Scale: 1:750,000
0 5 10 15 20km
UTM Zone 17N, NAD83

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

Ontario

Figure 2-**6**




**Subwatershed**

1. North R.
2. Wye R.
3. Sturgeon R.
4. Hogg Cr.
5. Lafontaine Cr.
6. Hope I.
7 Giant's Tomb I.
8.Tiny Coast NE
9. Christian I.
10. Beckwith I.
11. Copeland Cr.
12. Coldwater R.
13. Penetang Bay W
14. Penetanguishene and Tay Pt.
15. Tiny Coast Area W Central
16. Tiny Coast Area S
17. Tiny Coast Area NW
18. Midland Area
19. Tiffin Basin and Port McNicoll Area
20. Victoria Harbour Area
21. Waubaushene and Matchedash Bay S
22. Port Severn and Matchedash Bay N
23. Honey Harbour to Port Severn

- SWP Watershed Area
- Upper Tier Municipality
- Lower Tier Municipality
- Water Body
- Expressway / Highway
- Local Road
- Main Water Courses

**Severn Sound Watershed and Subwatershed Boundaries and Municipality Boundaries**

**Figure 2-7**

Created by: SSEA
Date: 2010-08-10

N

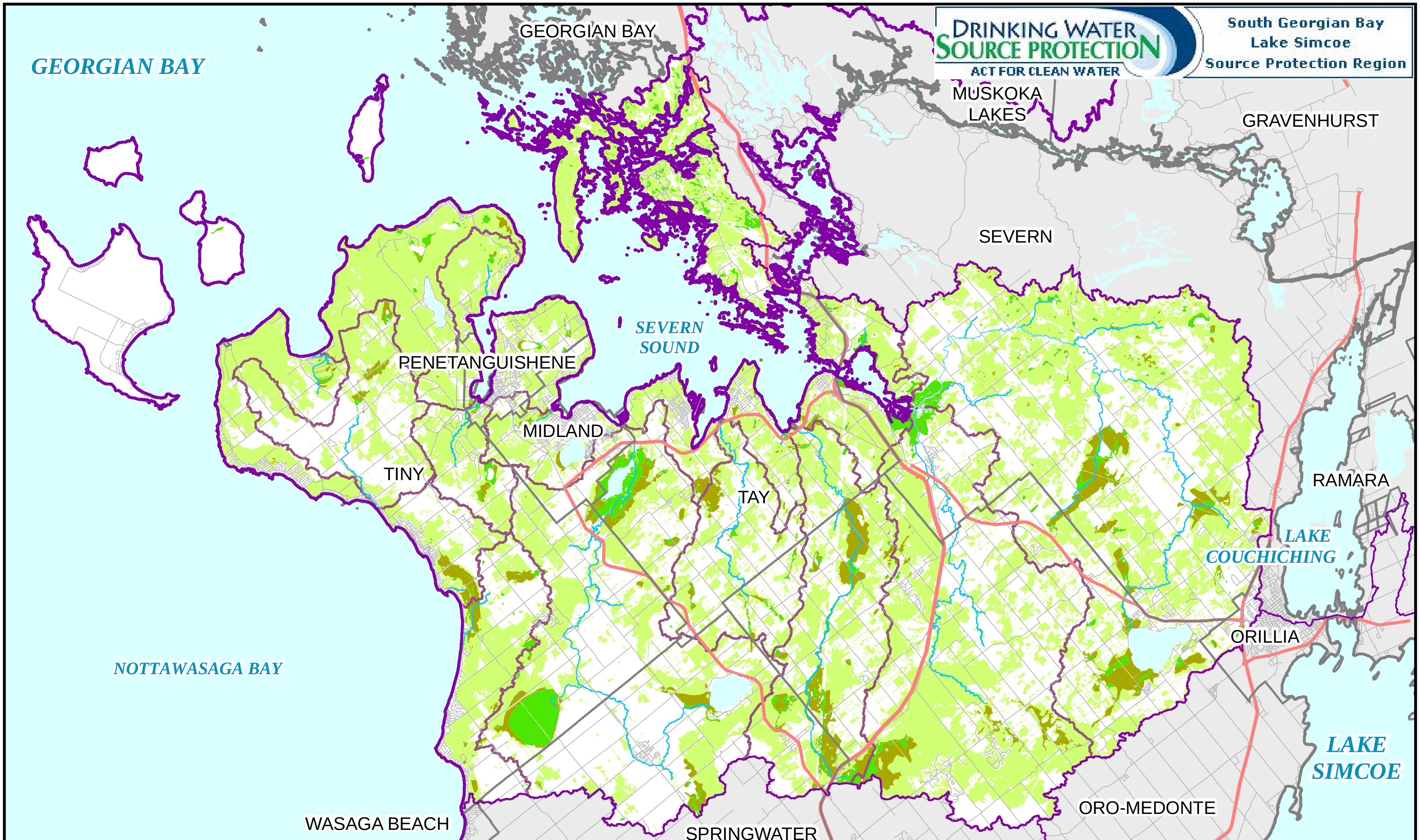
Scale: 1:300,000

0 2 4 6km

UTM Zone 17N, NAD83

This map was produced by the Severn Sound Environmental Association, member of the South Georgian Bay Lake Simcoe 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.




**LEGEND**

- Wetland
- Wooded Wetland
- Woodland
- Water Body
- Main Water Courses
- SWP Watershed Area
- Upper Tier Municipality
- Lower Tier Municipality
- Expressway / Highway
- Local Road

**Woodland, Wetland and Open Water Habitat in the Severn Sound Source Protection Authority Area**

**Figure 2-8**

Created by: SSEA
Date: 2010-08-10

N

Scale: 1:300,000

0 2 4 6km

UTM Zone 17N, NAD83

Severn Sound Environmental Association

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Base data have been compiled from various sources, under data sharing agreements.
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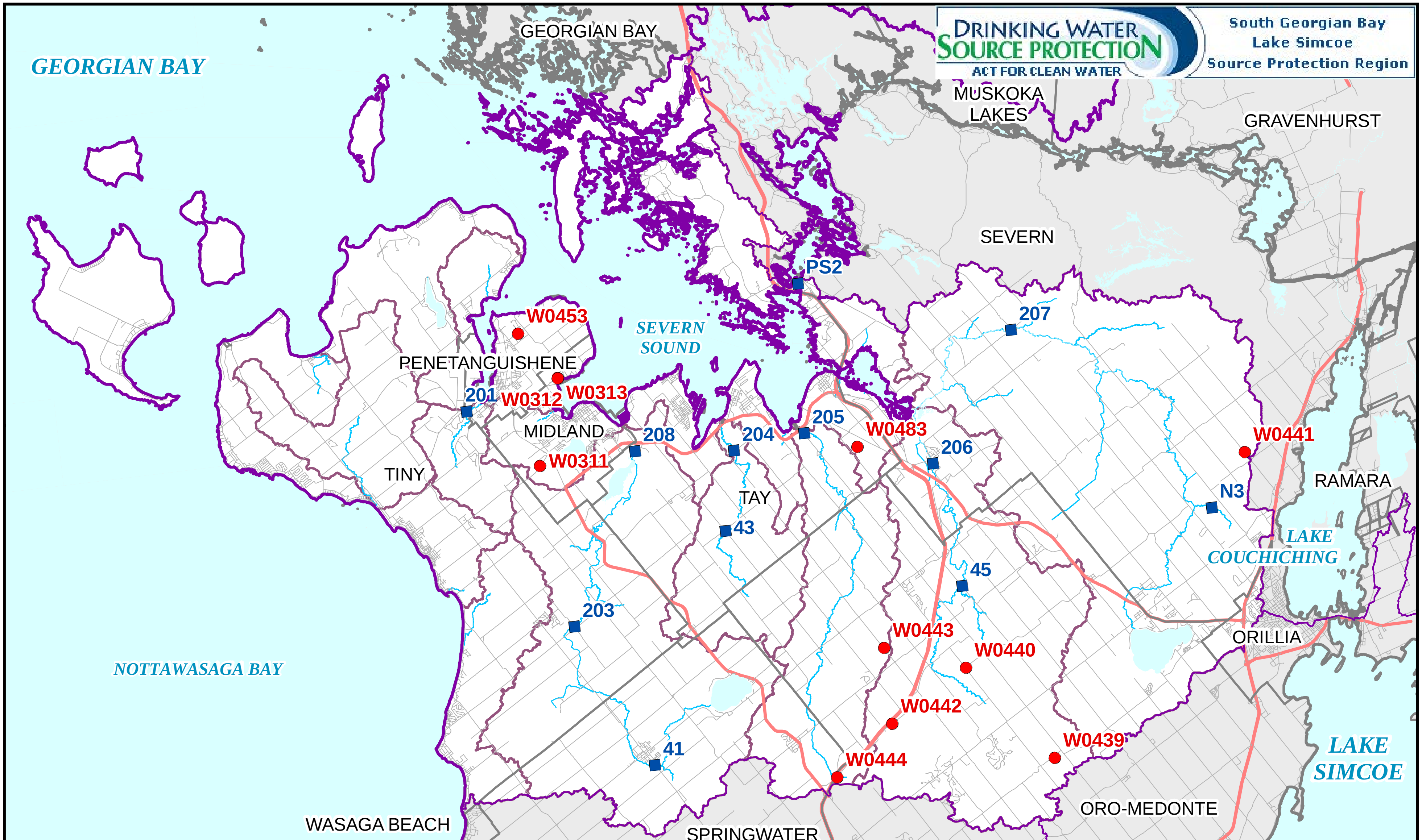
Ontario




**LEGEND**

- Provincial Water Quality Monitoring Network Station
- Provincial Groundwater Monitoring Network Station
- Water Body
- Main Water Courses
- SWP Watershed Area
- Upper Tier Municipality
- Lower Tier Municipality
- Expressway / Highway
- Local Road

**Severn Sound Area Groundwater and Surface Water Monitoring Stations**

**Figure 2-9**

Created by: SSEA
Date: 2010-08-10

N

Scale: 1:300,000
0 2 4 6km
UTM Zone 17N, NAD83

Severn Sound Environmental Association

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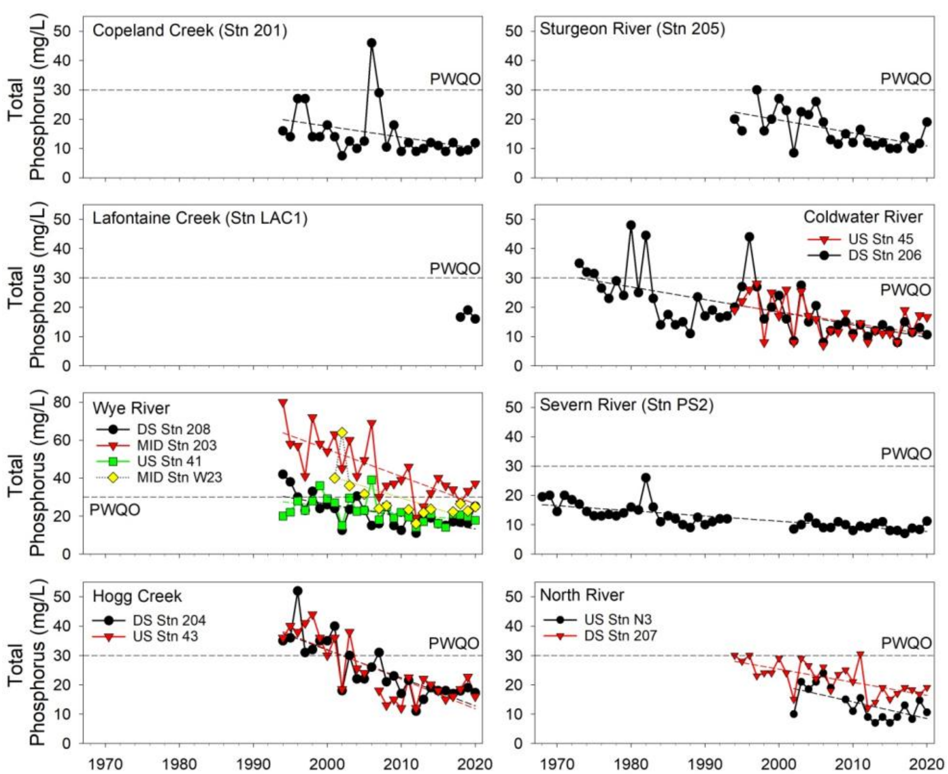
Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

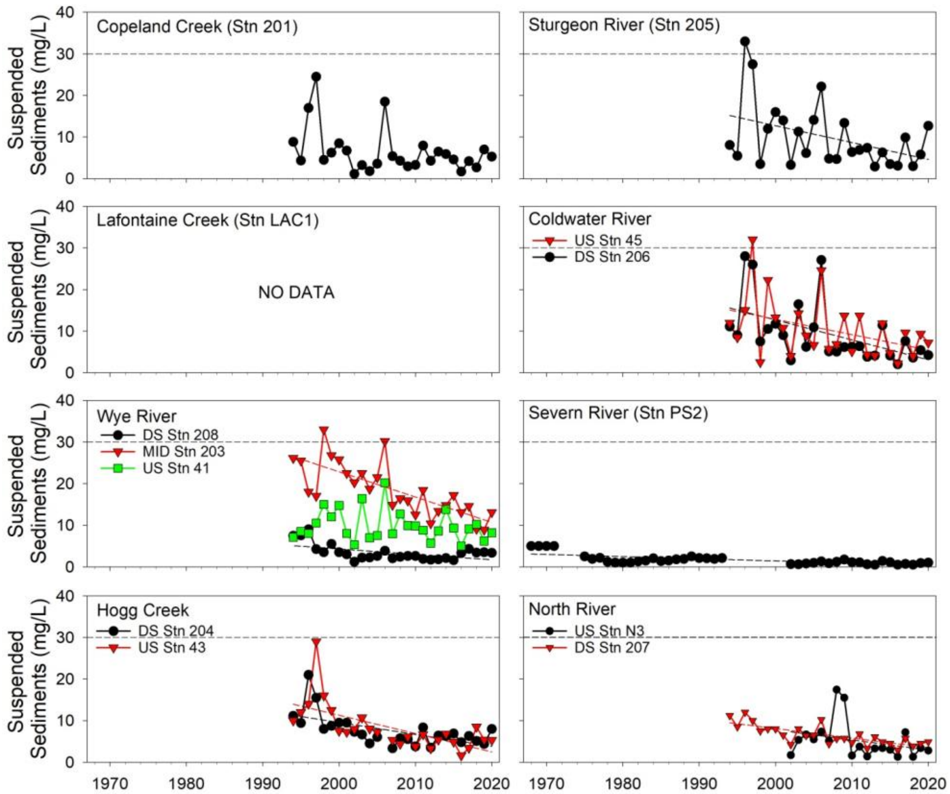
Ontario

**Figure 0-102-52-5**: Time series plots showing annual median total phosphorus concentrations versus year for Severn Sound tributary sites. The Provincial Water Quality Objective (PWQO) of 30 µg/L is also shown, along with the trend line where Mann Kendall trend tests indicate significant results. Note the change in phosphorus concentration scale for the Wye River graph (Data Source: MOEMECP, SSEA). Trends in summer median chloride (a), total phosphorus (b), and nitrate (c) in Coldwater River at Coldwater, 1973 to 2009




**Commented [AC7]:** Figure 2-5 Alternate text: Time series plots showing annual median total phosphorus concentrations versus year for Severn Sound tributary sites. The Provincial Water Quality Objective (PWQO) of 30 µg/L is also shown, along with the trend line where Mann Kendall trend tests indicate significant results. Graphs are plotted to show all sites on each individual river system. Copeland Creek (Station 201) shows a decreasing trend, with one value above the PWQO in mid-2000s. The Sturgeon River (Station 205) shows a decreasing trend, with no values above the PWQO. Lafontaine Creek (Station LAC1) did not have enough data for a trend, and no values above the PWQO. The Coldwater River (Stations 206 and 45) shows decreasing trends at both sites, with several values above the PWQO prior to the early 1980s. The Wye River (Stations 41, 203, W23 and 208) shows a decreasing trend at all sites, with most years exceeding the PWQO at Station 203 and several exceedances at the other stations prior to 2009. The Severn River (Station PS2) shows a decreasing trend, with no values above the PWQO. Hogg Creek (Stations 43 and 204) shows a decreasing trend at both stations, with several values above the PWQO prior to 2008. The North River (Stations N3 and 207) shows a decreasing trend at both stations, with no values above the PWQO.

**Figure 0-112 62 6: Time series plots showing annual median suspended sediment concentrations versus year for Severn Sound tributary sites. The Provincial Water Quality Objective (PWQO) of 30 mg/L is also shown, along with the trend line where Mann Kendall trend tests indicate significant results (Data Source: ~~MOE~~MECP, SSEA). ~~Trends in summer median chloride (a), total phosphorus (b), and nitrate (c) in the Severn River at Port Severn, 1968 to 2009.~~**




**Commented [AC8]:** Figure 2-6 Alternate text: Time series plots showing annual median suspended sediment concentrations versus year for Severn Sound tributary sites. The Provincial Water Quality Objective (PWQO) of 30 mg/L is also shown, along with the trend line where Mann Kendall trend tests indicate significant results. Graphs are plotted to show all sites on each individual river system. Copeland Creek (Station 201) did not show a trend, and there were no values above the PWQO. The Sturgeon River (Station 205) shows a decreasing trend, with one value above the PWQO in 1996. There was no data for Lafontaine Creek (Station LAC1). The Coldwater River (Stations 206 and 45) shows decreasing trends at both sites, with one value above the PWQO at Station 45 in 1997. The Wye River (Stations 41, 203 and 208) shows a decreasing trend at Stations 203 and 208, with PWQO exceedances at 203 in 1998 and 2006. The Severn River (Station PS2) shows a decreasing trend, with no values above the PWQO. Hogg Creek (Stations 43 and 204) shows a decreasing trend at both stations, with no values above the PWQO. The North River (Stations N3 and 207) shows a decreasing trend at both stations, with no values above the PWQO.

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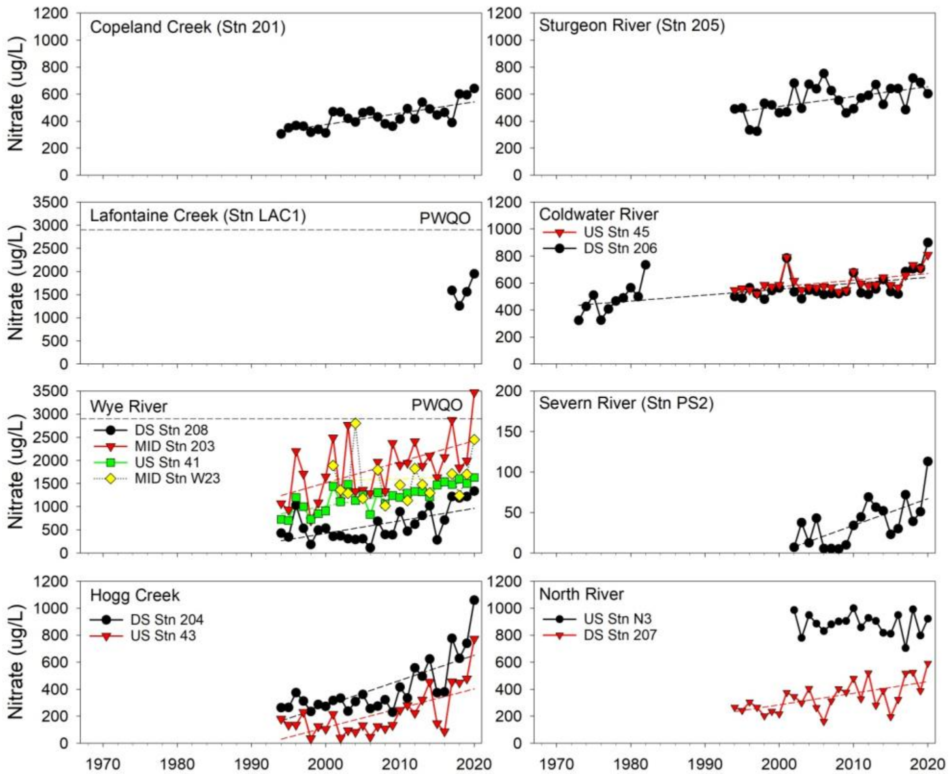
**Figure 0-12~~2-7~~: Time series plots showing annual median total nitrate concentrations versus year for Severn Sound tributary sites. The Provincial Water Quality Objective (PWQO) of 2900 µg/L is also shown, along with the trend line where Mann Kendall trend tests indicate significant results. Note the change in nitrate concentration scale for the Lafontaine Creek, Wye River and Severn River graphs (Data Source: ~~MOE~~MECP, SSEA).**




**Commented [AC9]:** Figure 2-7 Alternate text: Time series plots showing annual median total nitrate concentrations versus year for Severn Sound tributary sites. The Provincial Water Quality Objective (PWQO) of 2900 µg/L is also shown, along with the trend line where Mann Kendall trend tests indicate significant results. Graphs are plotted to show all sites on each individual river system. Copeland Creek (Station 201) shows an increasing trend, with no values above the PWQO. The Sturgeon River (Station 205) shows an increasing trend, with no values above the PWQO. Lafontaine Creek (Station LAC1) did not have enough data for a trend, and no values above the PWQO. The Coldwater River (Stations 206 and 45) shows increasing trends at both sites, with no values above the PWQO. The Wye River (Stations 41, 203, W23 and 208) shows an increasing trend at all stations except W23, with one value above the PWQO at Station 203 in 2020. The Severn River (Station PS2) shows an increasing trend, with no values above the PWQO. Hogg Creek (Stations 43 and 204) shows an increasing trend at both stations, with no values above the PWQO. The North River (Stations N3 and 207) shows an increasing trend at Station 207, with no values above the PWQO.

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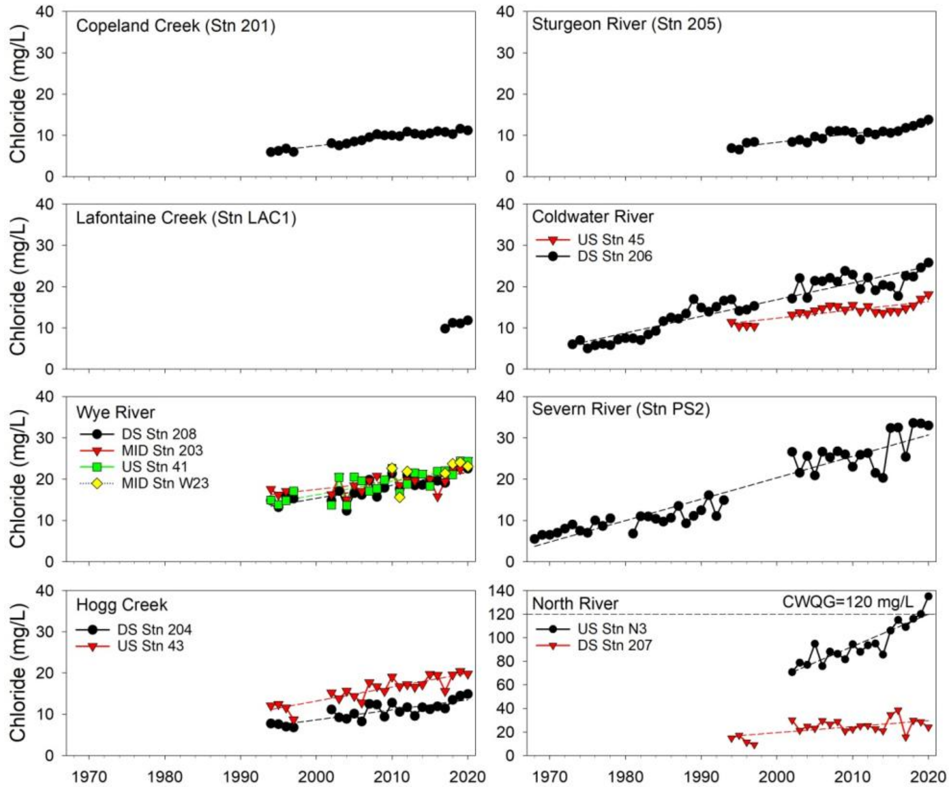
**Figure 0-132-8: Time series plots showing annual median total chloride concentrations versus year for Severn Sound tributary sites. The Canadian Water Quality Guideline (CWQG) of 120 mg/L is also shown, along with the trend line where Mann Kendall trend tests indicate significant results. Note the change in chloride concentration scale for the North River graph (Data Source: MOEMECP, SSEA).**




**Commented [AC10]:** Figure 2-8 Alternate text: Time series plots showing annual median total chloride concentrations versus year for Severn Sound tributary sites. The Canadian Water Quality Guideline (CWQG) of 120 mg/L is also shown, along with the trend line where Mann Kendall trend tests indicate significant results. Graphs are plotted to show all sites on each individual river system. Copeland Creek (Station 201) shows an increasing trend, with no values above the CWQG. The Sturgeon River (Station 205) shows an increasing trend, with no values above the CWQG. Lafontaine Creek (Station LAC1) did not have enough data for a trend, and no values above the CWQG. The Coldwater River (Stations 206 and 45) shows increasing trends at both sites, with no values above the CWQG. The Wye River (Stations 41, 203, W23 and 208) shows an increasing trend at all stations except W23, with no values above the CWQG. The Severn River (Station PS2) shows an increasing trend, with no values above the CWQG. Hogg Creek (Stations 43 and 204) shows an increasing trend at both stations, with no values above the CWQG. The North River (Stations N3 and 207) shows an increasing trend at both stations, with two exceedances of the CWQG at Station N3 in 2019 and 2020.

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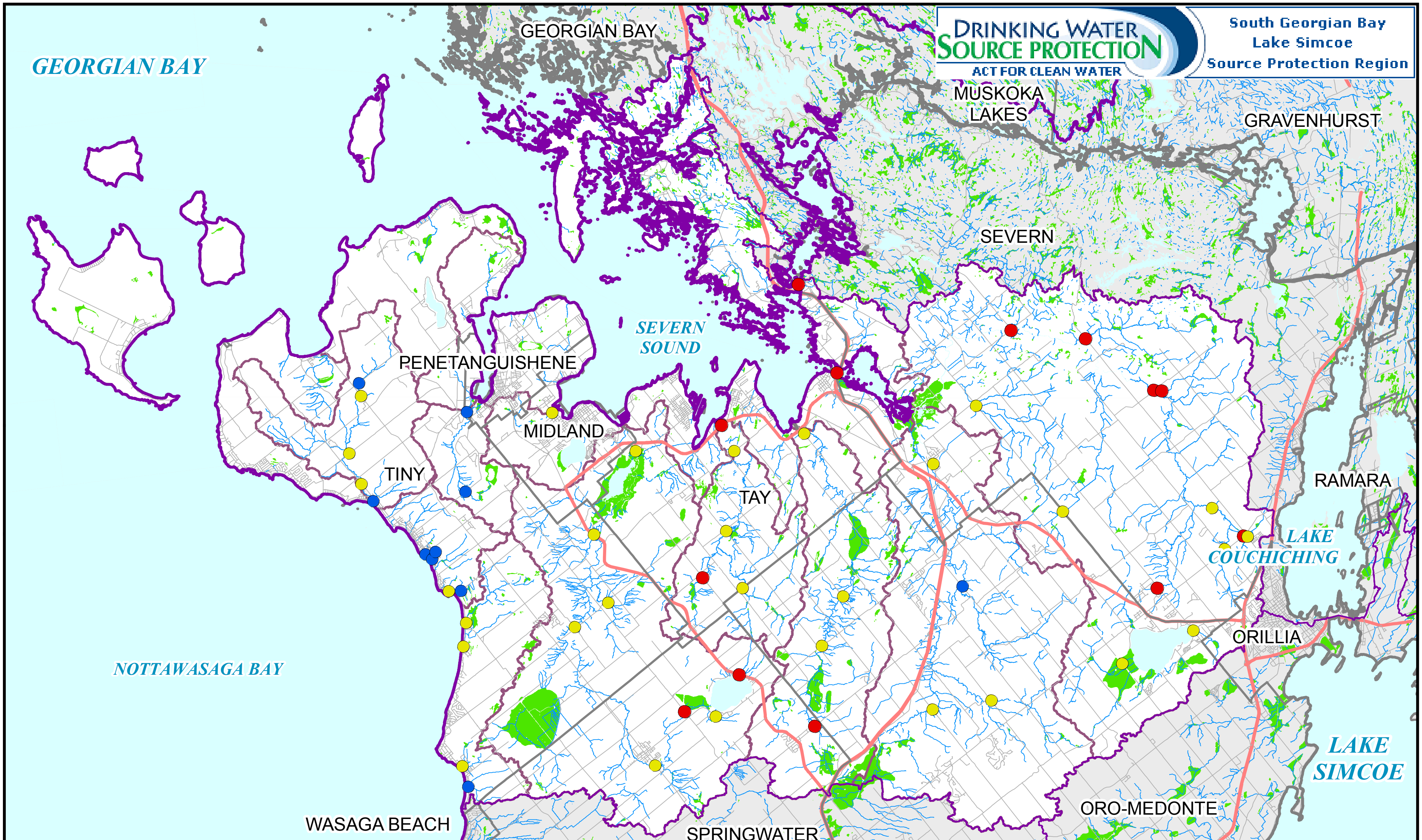


**LEGEND**

**Stream Habitat Summary**

- Cold Water
- Cool Water
- Warm Water
- Water Courses
- Water Body
- Wetland
- SWP Watershed Area
- Upper Tier Municipality
- Lower Tier Municipality
- Expressway / Highway
- Local Road

**Severn Sound Area**
**Stream Habitat Based On**
**Temperature (2006 to 2009)**

**Figure 2-14**

Created by: SSEA
Date: 2010-08-10

N

Scale: 1:300,000

0 2 4 6km

UTM Zone 17N, NAD83

Severn Sound Environmental Association

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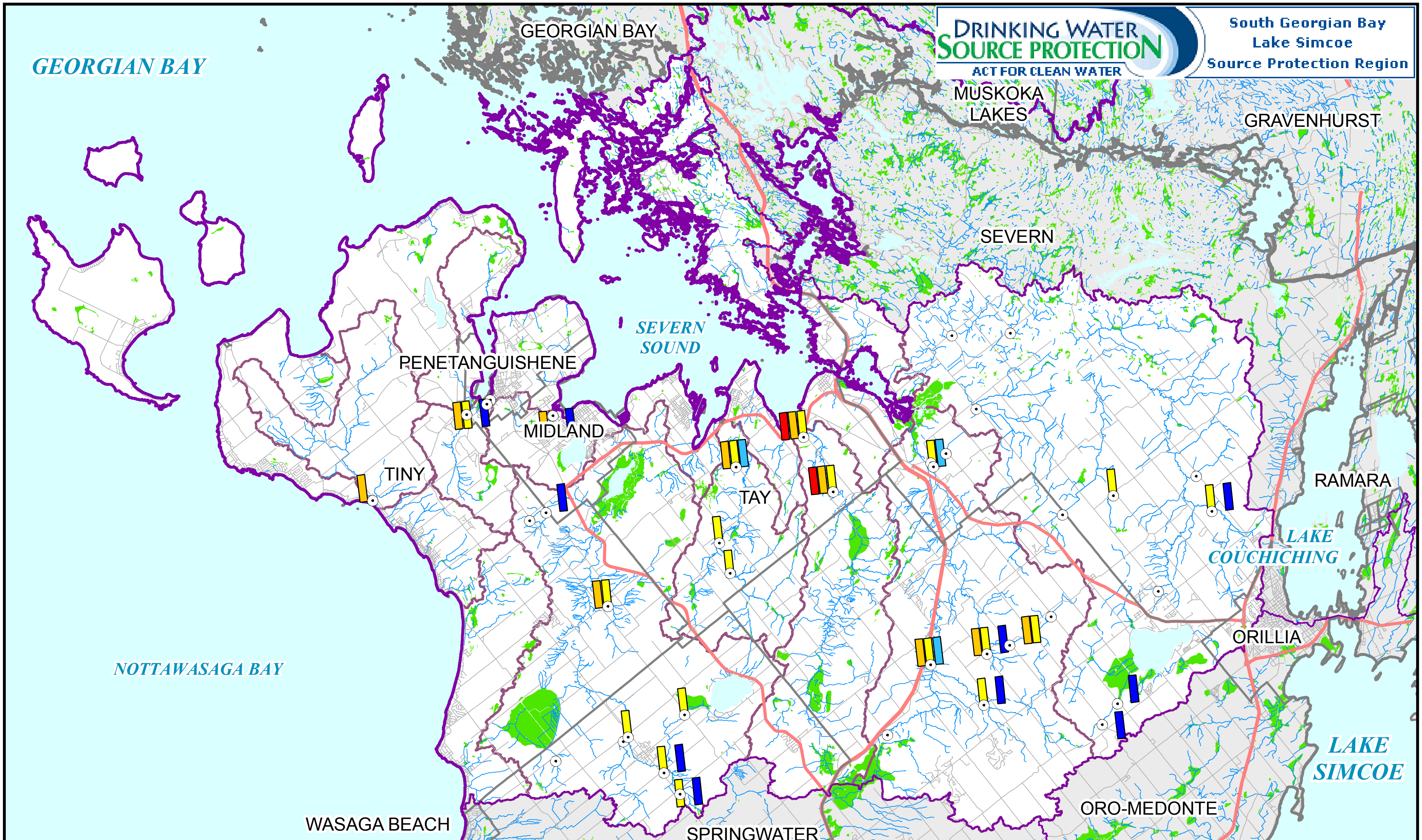
Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

Ontario




**LEGEND**

**Presence of Coldwater Fish Species**

- CHINOOK SALMON
- RAINBOW TROUT
- MOTTLED SCULPIN
- BROWN TROUT
- BROOK TROUT
- Fish Sampling Station

- Water Courses
- Water Body
- Wetland
- SWP Watershed Area
- Upper Tier Municipality
- Lower Tier Municipality
- Expressway / Highway
- Local Road

**Coldwater fish species presence in Severn Sound tributaries (Data Source: MNR/SSEA)**

**Figure 2-15**

Created by: SSEA
Date: 2010-08-10

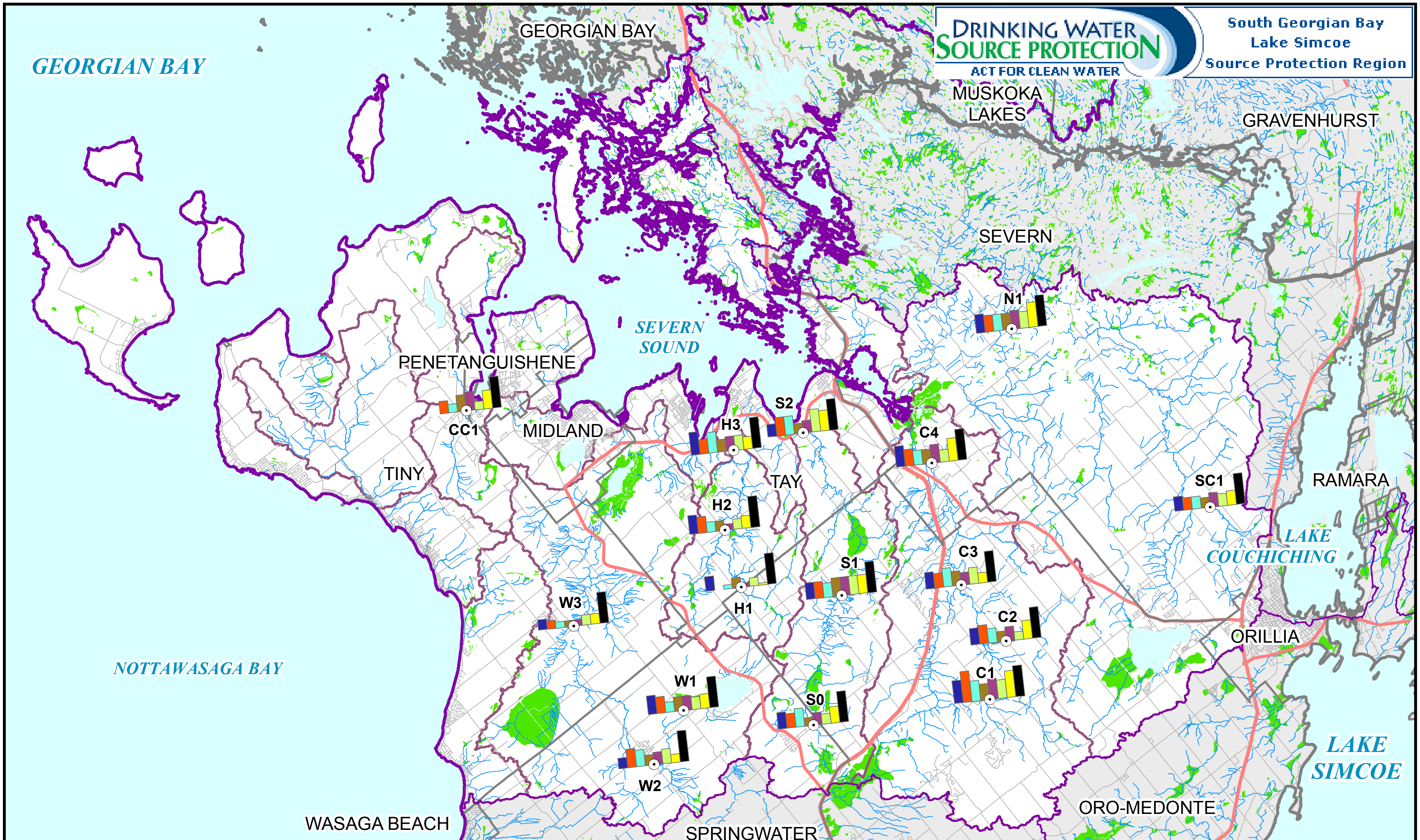
N

Scale: 1:300,000
0 2 4 6km
UTM Zone 17N, NAD83

Severn Sound Environmental Association

This map was produced by the Severn Sound Environmental Association, member of the South Georgian Bay Lake Simcoe 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




DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay Lake Simcoe Source Protection Region

**LEGEND**

- ⊙ Aquatic Invertebrate Station
- 1999
- 2000*
- 2001
- 2002
- 2003
- 2004
- 2005
- Maximum EPT Richness Throughout All Stations Reference Scale = 15
- Water Courses
- Water Body
- Wetland
- SWP Watershed Area
- Upper Tier Municipality
- Lower Tier Municipality
- Expressway / Highway
- Local Road

**Aquatic Invertebrate Station Locations and Relative Ephemeroptera, Plecoptera and Trichoptera (EPT) Richness in the Severn Sound Area**

**Figure 2-16**

Created by: SSEA
Date: 2010-08-10

N

Scale: 1:300,000
0 2 4 6km
UTM Zone 17N, NAD83

Severn Sound Environmental Association

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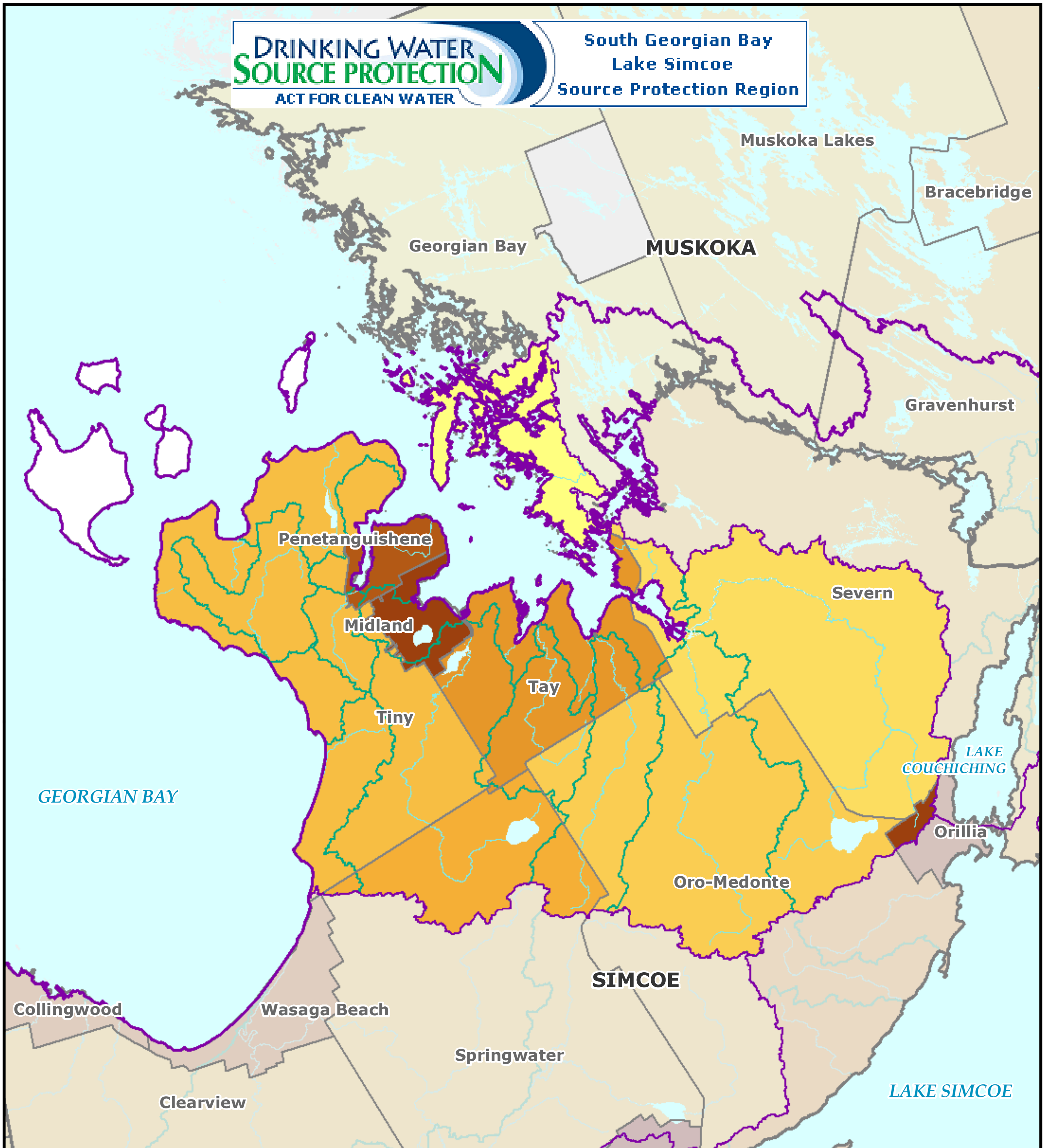
Ontario

Note: * H1 and W3 are "No Data" for year 2000. Sampling of CC1 began in 2000.




Population Density (person/km2)
(Based on 2006 Census)

- < 5.0
- 5.1 - 10.0
- 10.1 - 20.0
- 20.1 - 30.0
- 30.1 - 40.0
- 40.1 - 50.0
- 50.1 - 100.0
- 100.1 - 200.0
- 200.1 - 500.0
- 500.1 - 1000.0
- 1000.1 - 1500.0
- > 1500.1
- No Data

# Municipal Population Density in the Severn Sound Watershed

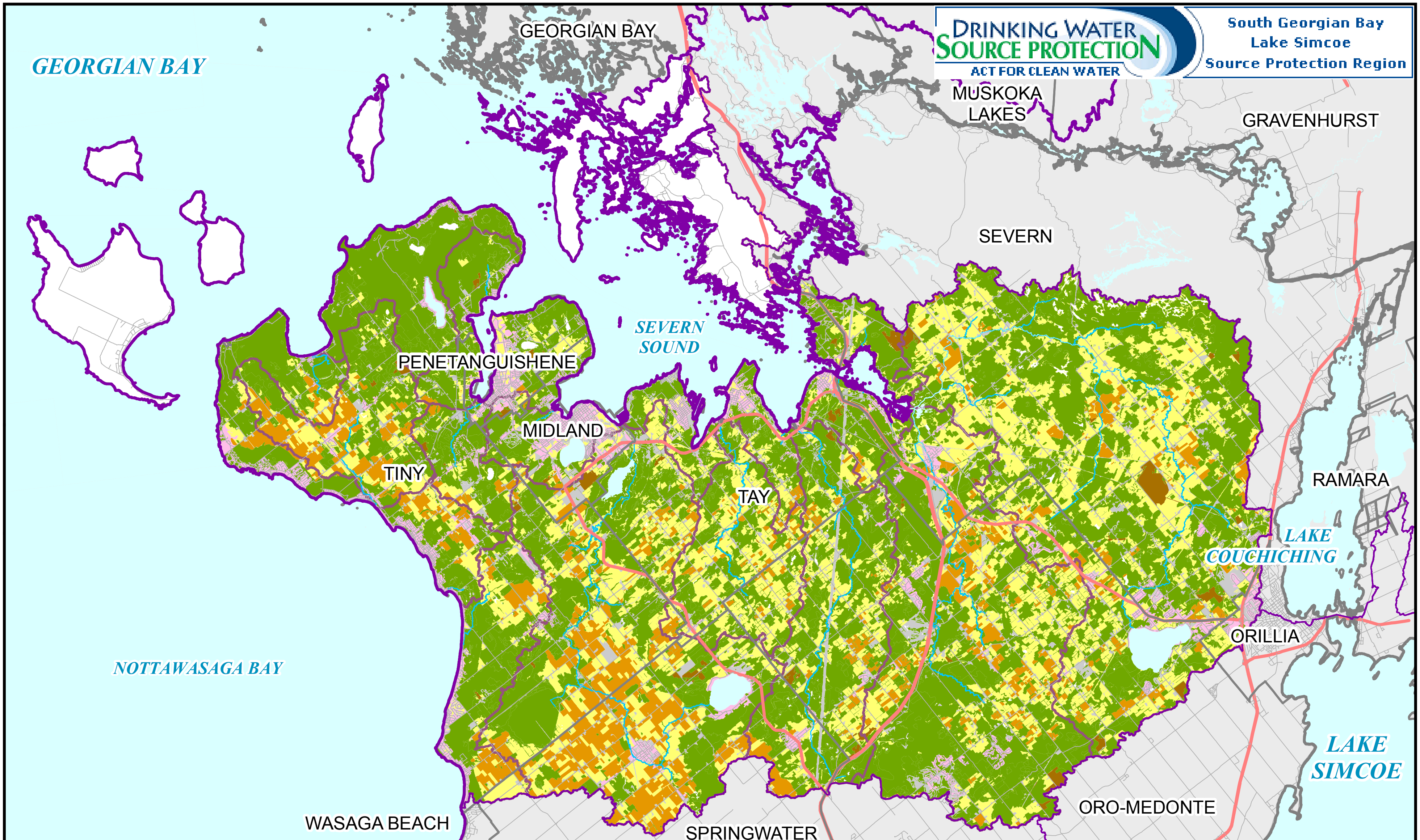
Created by: LSRCA
Date: 2010-01-26

Scale: 1:400,000
0 2 4 6 8 10km
UTM Zone 17N, NAD83

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

Ontario

**Figure 2-17**




**Land Use**

- Extraction
- Rural - Cropland
- Rural - Hay/Pasture/Idle
- Urban/ High Intensity
- Urban/ Infrastructure
- Natural Heritage Feature
- Main Water Courses
- Water Body
- SWP Watershed Area
- Upper Tier Municipality
- Lower Tier Municipality
- Expressway / Highway
- Local Road

Note: Complete land use was not available for the North Shore of Severn Sound

**Severn Sound Area Land Use**

**Figure 2-18**

Created by: SSEA
Date: 2010-08-10

N

Scale: 1:300,000
0 2 4 6km
UTM Zone 17N, NAD83

Severn Sound Environmental Association

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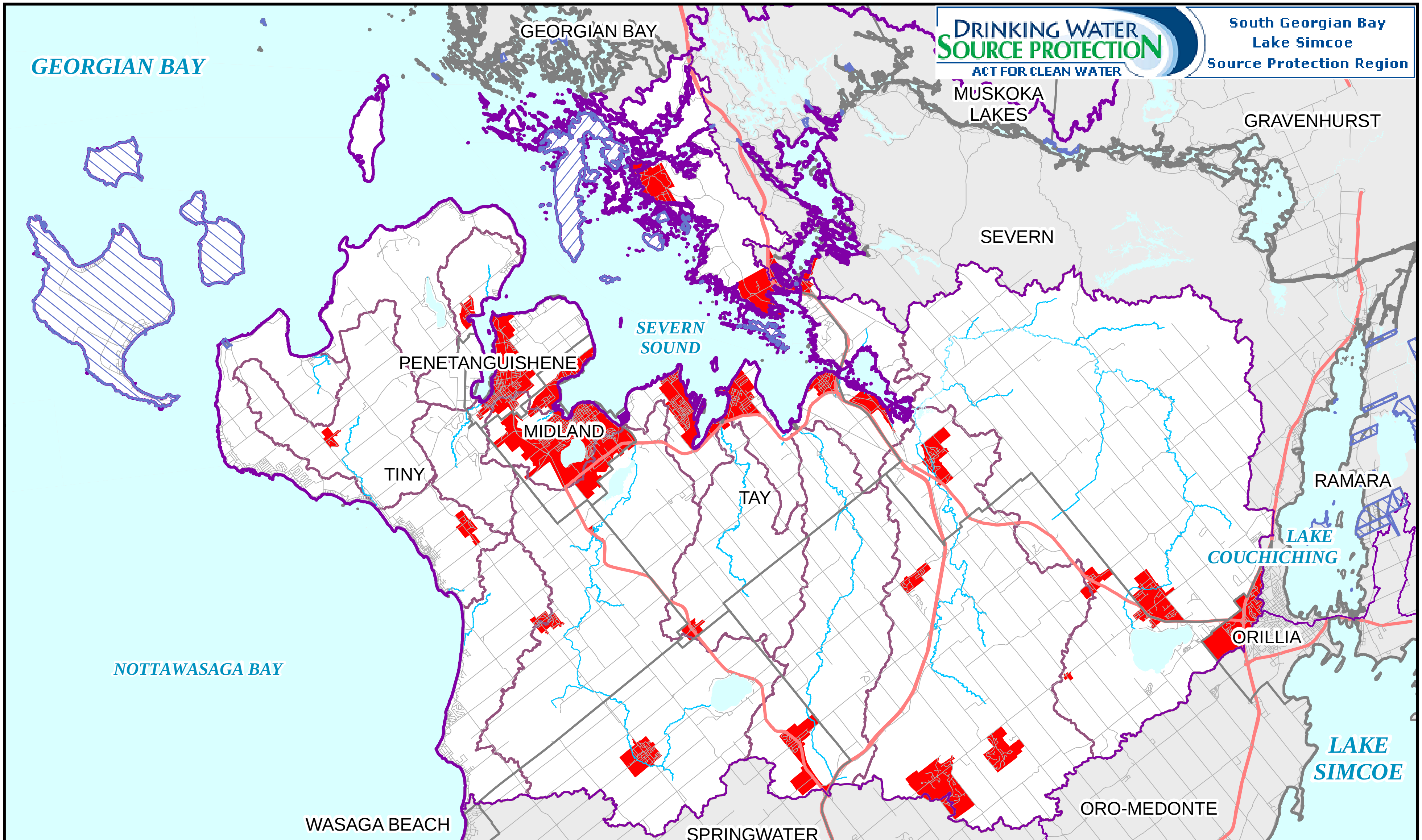
Ontario




**LEGEND**

- Federal Lands
- First Nations Lands
- Areas of Settlement
- Main Water Courses
- Water Body
- SWP Watershed Area
- Upper Tier Municipality
- Lower Tier Municipality
- Expressway / Highway
- Local Road

**Severn Sound Area**
**Areas of Settlement and Land Owners**
**As Defined in the Places to Grow Act, 2005**

**Figure 2-19**

Created by: SSEA
Date: 2010-08-10

N

Scale: 1:300,000
0 2 4 6km
UTM Zone 17N, NAD83

Severn Sound Environmental Association

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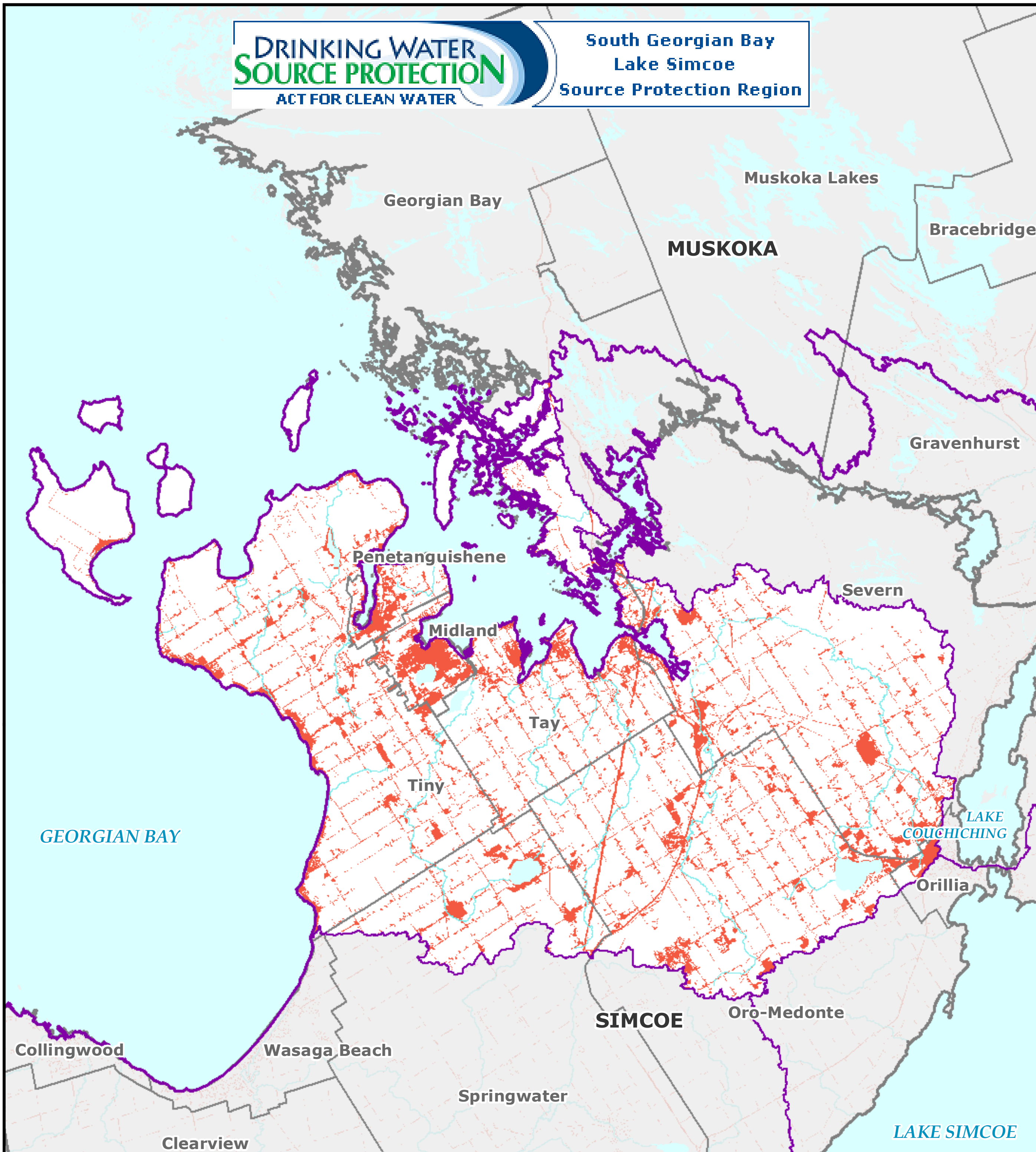
Ontario




Impervious Areas
(Hardened Surface such as roads and buildings)
SWP Watershed Area
SWP Watershed Region
Upper Tier Municipality
Lower Tiers Municipality
Water Body
Main Water Courses

## Impervious Areas in Severn Sound Watershed

Created by: LSRCA
Date: 2010-02-03

Scale: 1:400,000
0 2 4 6 8 10km
UTM Zone 17N, NAD83

Severn Sound Environmental Association

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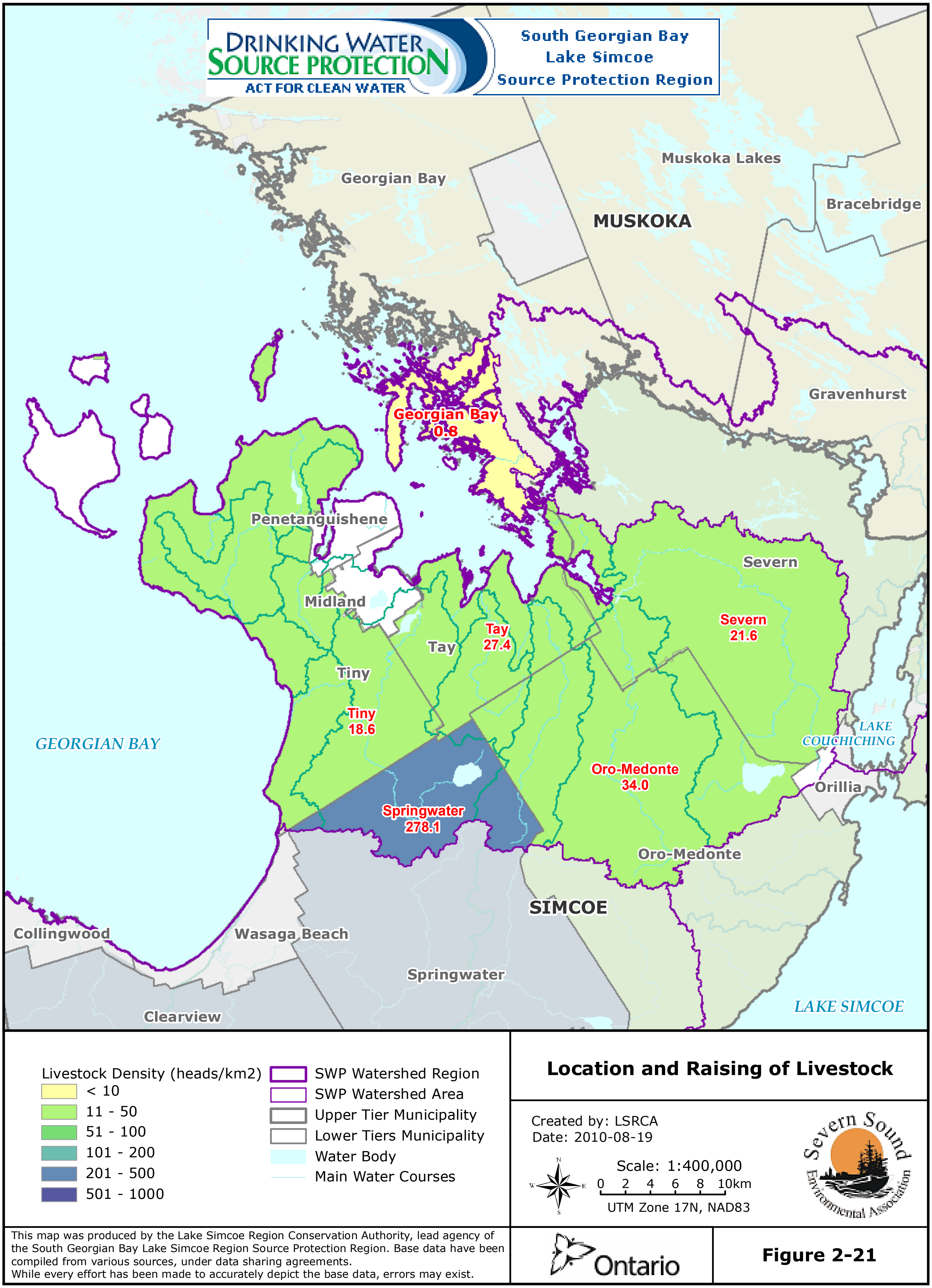
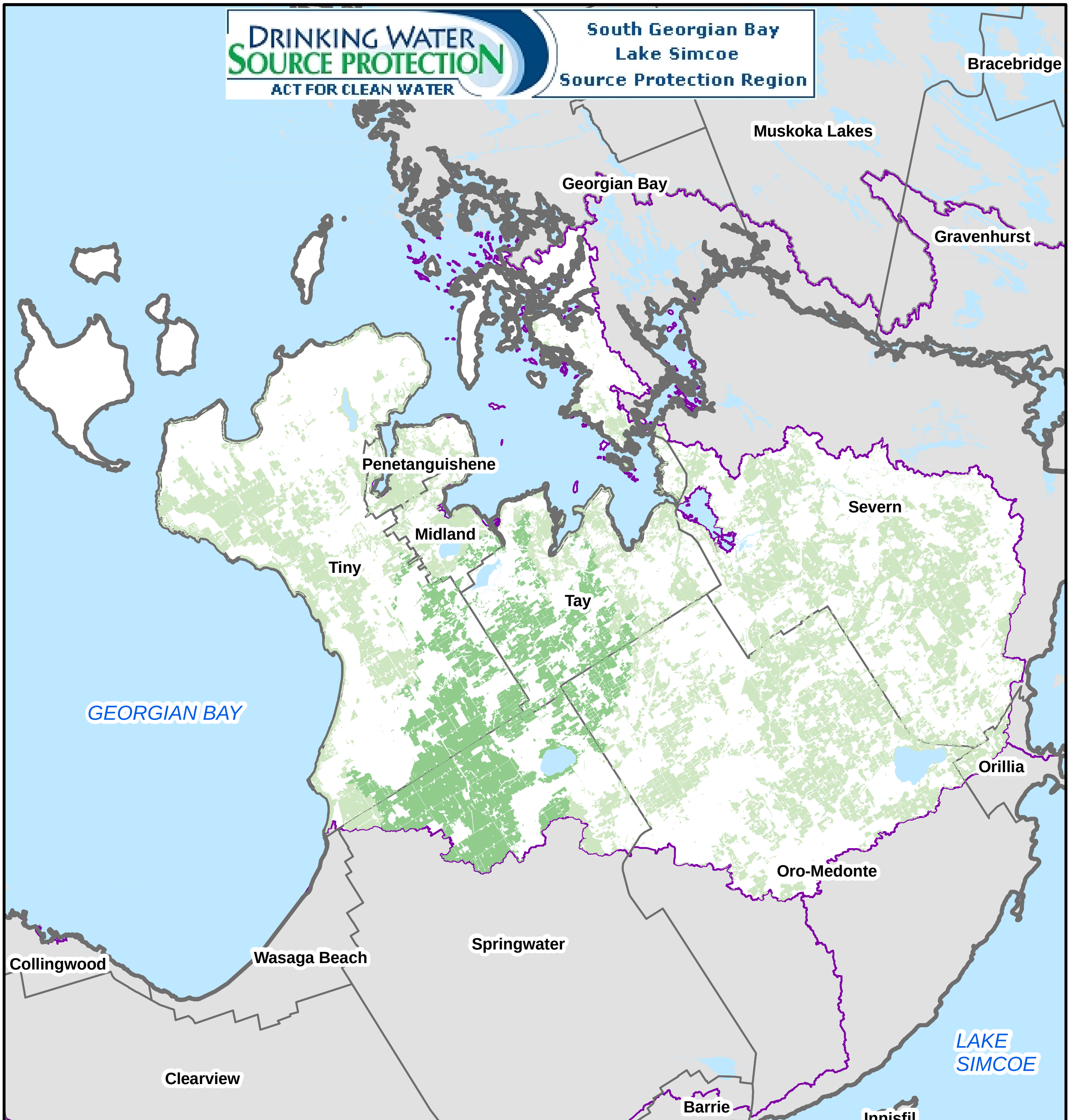
Ontario

**Figure 2-20**




**Location and Raising of Livestock**

**Figure 2-21**




## Legend

- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)
- UPPER TIER MUNICIPALITY
- LOWER TIER MUNICIPALITY
- SOURCE PROTECTION WATERSHED REGION

N W E S

3,500 1,750 0 3,500 Metres

# Managed Lands in the Severn Sound Watershed

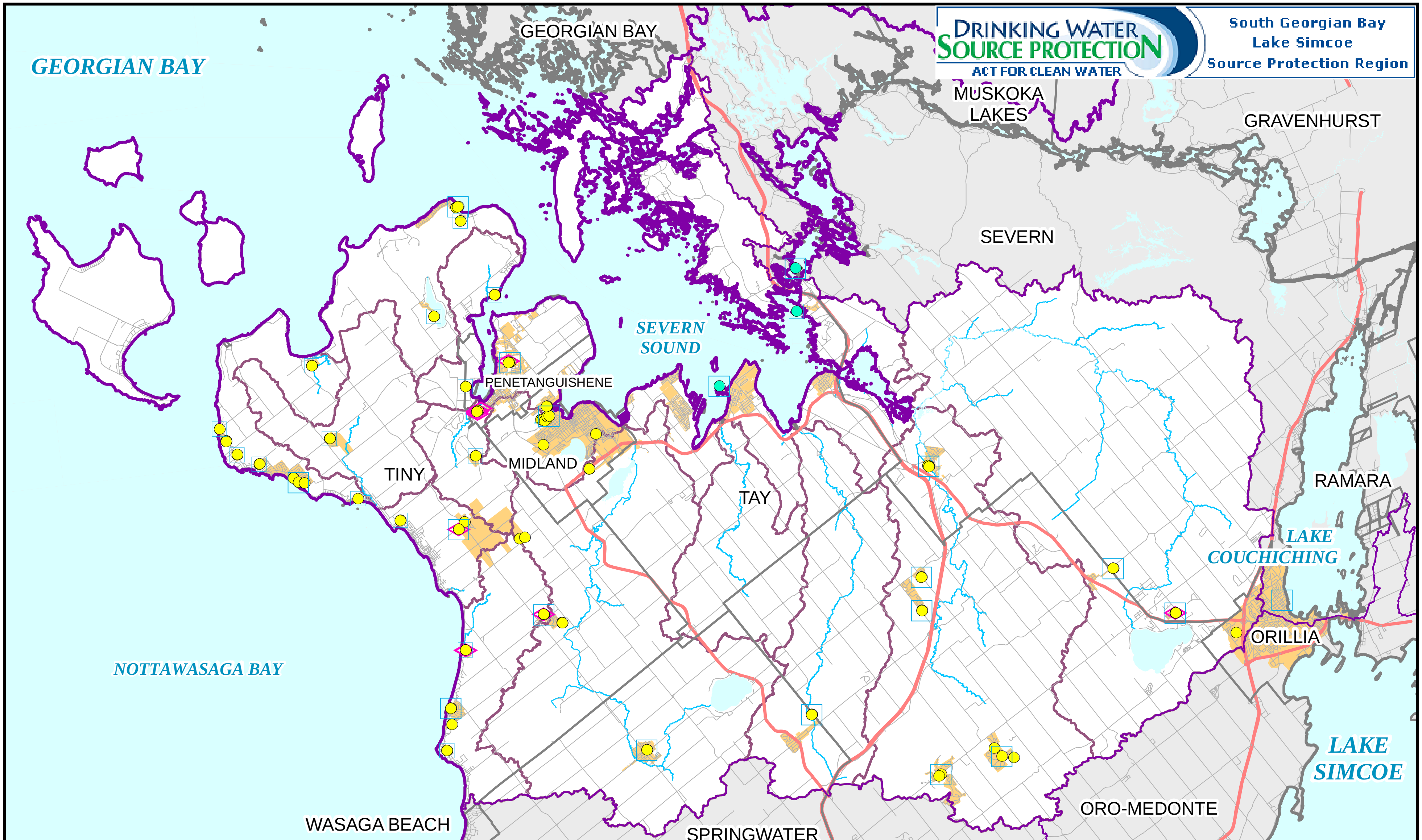
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

| | |
|---|---|
| DATE: JUNE 2010 | SCALE: 1:375000 |
| PROJECT: 0-071948.00 | FILE. NO.:0-07194800F2-10 |

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

GENIVAR Ontario

FIGURE
**2-22**




**LEGEND**

- Large Municipal Residential
- Small Municipal Residential
- Municipal SW Intakes
- Municipal Supply Wells
- Monitoring Wells
- Municipal Service Areas
- Main Water Courses
- Water Body
- SWP Watershed Area
- Upper Tier Municipality
- Lower Tier Municipality
- Expressway / Highway
- Local Road

**Severn Sound Area**
**Drinking Water System**
**Intakes and Supply Wells**

# Figure 2-23

Created by: SSEA
Date: 2010-08-10

N

Scale: 1:300,000

0 2 4 6km

UTM Zone 17N, NAD83

Severn Sound Environmental Association

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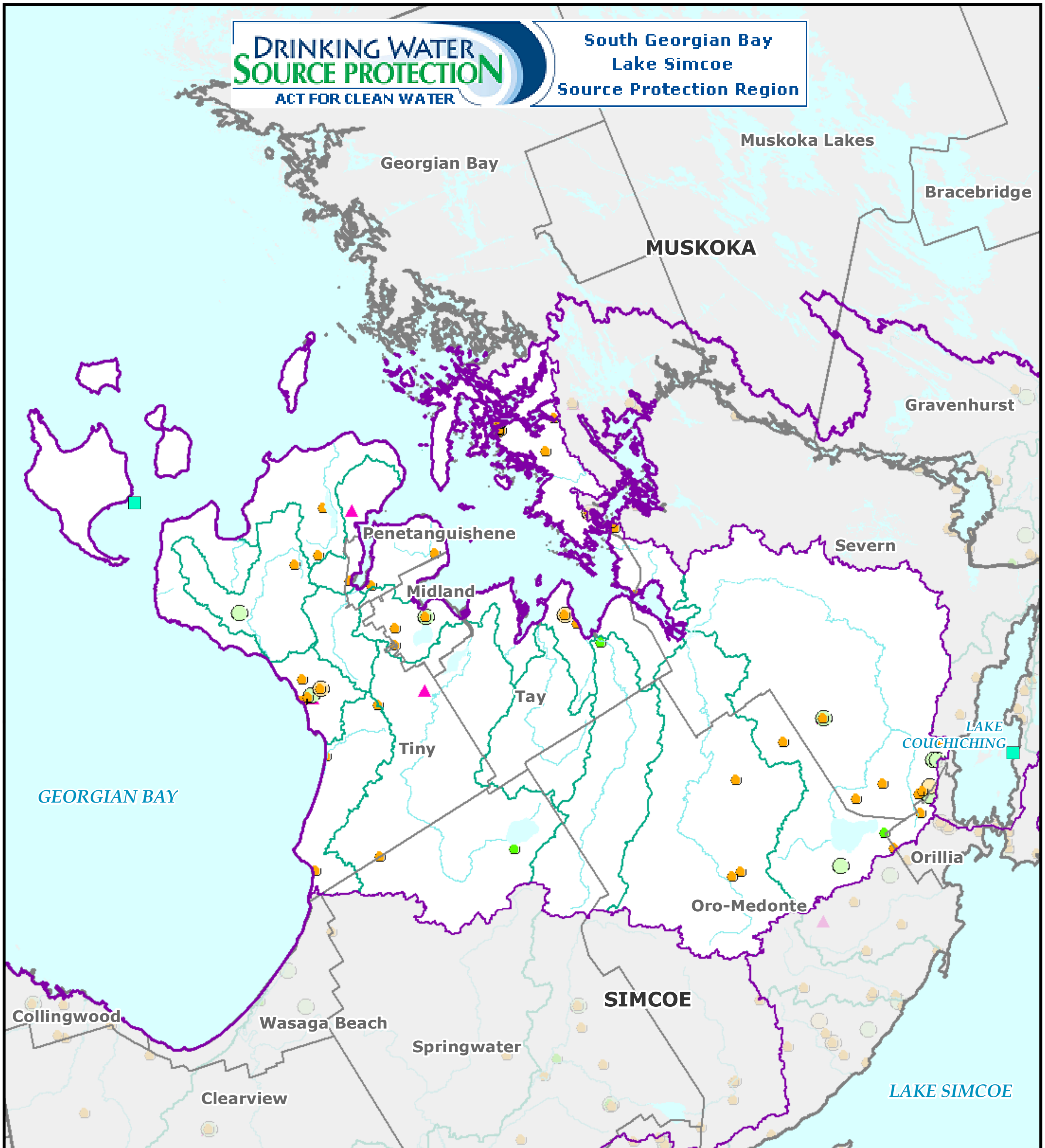
Ontario




Surface Water Intakes -- First Nation
Large Municipal Non-Residential
Small Municipal Non-Residential
Large Non-Municipal Non-Residential
Small Non-Municipal Non-Residential
Non-Municipal Year-Round Residential
Non-Municipal Seasonal Residential

**Drinking Water System (Non-Residential and Non-Municipal)**

Created by: LSRCA
Date: 2010-01-13

Scale: 1:400,000
0 2 4 6 8 10km
UTM Zone 17N, NAD83

Severn Sound Environmental Association

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Ontario

**Figure 2-24**