CHAPTER 2: WATERSHED CHARACTERIZATION

TABLE OF CONTENTS

List of Tables

List of Figures

2 WATERSHED CHARACTERIZATION

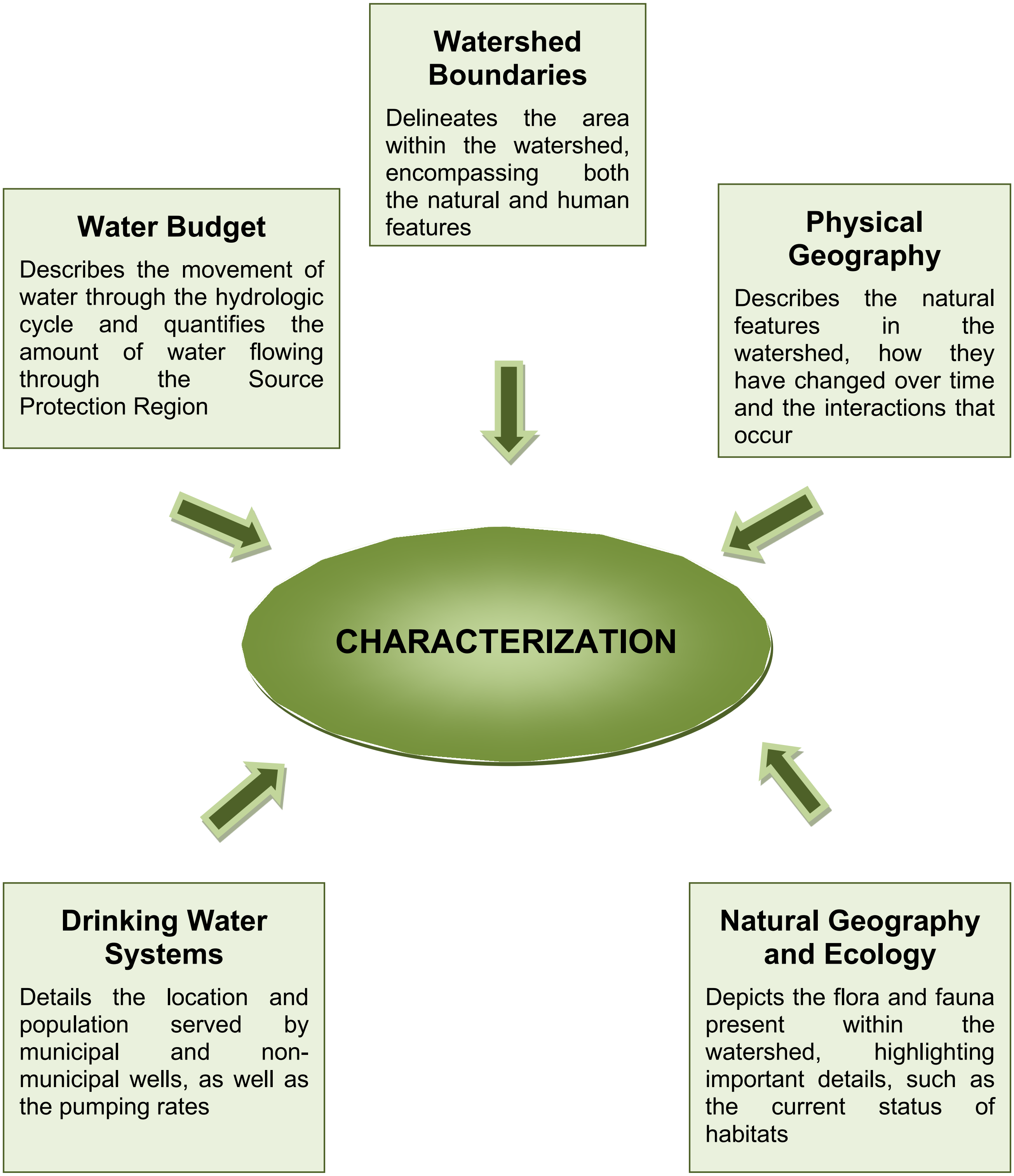
2.1 INTRODUCTION

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 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 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.


Watershed Boundaries
Delineates the area within the watershed, encompassing both the natural and human features
Water Budget
Describes the movement of water through the hydrologic cycle and quantifies the amount of water flowing through the Source Protection Region
Physical Geography
Describes the natural features in the watershed, how they have changed over time and the interactions that occur
CHARACTERIZATION
Drinking Water Systems
Details the location and population served by municipal and non-municipal wells, as well as the pumping rates
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; figures are located at the end of the chapter). The land portion of the Severn Sound watershed (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 provides the drainage areas of the subwatersheds and areas of major hydrologic features. The largest unit is 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.

Table 2-1: Drainage area of subwatersheds in the Severn Sound watershed (Data Source: SGBLS).

Subwatershed	Drainage Area (km^2)
North River	318.74
Coldwater River	191.40
Sturgeon River	98.30
Hog Creek	60
Wye River	208.15
Port Severn and Matchedash Bay North	19.71
Waubaushene and Matchedash Bay South	19.08
Lafotaine Creek	54.74
Tiny Coastal North East	46.46
Copeland Creek	23.56
Penetang Bay West	24.15
Penetanguishene and Tay Point	25
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**

2.3 PHYSICAL AND NATURAL GEOGRAPHY

2.3.1 Natural Vegetation – wetlands, woodlands and riparian areas.

During the period 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 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). 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).

Table 2-2 Natural Vegetative Cover in the Severn Sound Watershed (Data Source: SGBLS).

INSERT TABLE

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 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) Stations (Figure 2-4). Samples are collected 7 to 8 times a year, on a monthly basis during the ice-free period. 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).

Analysis of data collected between 2002 and 2009 shows the median concentration of total phosphorus is below the guideline with the exception of one station on the Wye River near Wyevale (Table 2-3, Station 203).

At three of the sites the median concentration of aluminum exceeds the objective (Stations 41 and 203 on the Wye River and Station 207 on the North River, Table 2-3).

All other parameters evaluated met the respective objective or guideline. 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 Creek and Stations 203 and 208 at Wye River).

When the results from 1988 to 1994 are compared to those from 2002 to 2009, a change in stream chemistry can be seen. Total phosphorus and suspended solids have decreased or remained the same between the two periods, while chloride and nitrate concentrations have increased between the two periods at all stations.

Table 2-3: Current Surface Water Quality Summary for the Severn Sound Watershed 2002-2009. Median concentration: red = >objective, green = <objective (Data Source: SSEA) ss=suspended sediment.

Monitoring Station.	Chloride	Phosphorus	Nitrate	SS	Iron	Zinc	Aluminium	Cadmium	Copper
Copeland Creek									
Stn. 201	8.4	0.011	0.425	3.0	114.5	0.321	53.8	0.176	0.449
Coldwater River									
Stn. 45	14	0.014	0.557	6.1	105.0	0.449	59.7	0.228	0.511
Stn. 206	20.7	0.014	0.523	5.4	128.5	0.456	71.0	0.074	0.489
Hog Creek									
Stn. 43	14.8	0.024	0.082	7.2	228.0	0.680	85.0	0.197	0.413
Stn. 204	9.7	0.023	0.281	5.4	183.5	0.717	90.6	0.155	0.596
North River									
Stn. 207	25.8	0.024	0.314	5.5	194.0	0.676	**114.0**	0.134	0.649
Stn. N3	83.3	0.020	0.881	5.4	124.5	0.708	53.4	0.128	0.485
Severn River									
Stn. PS2	25.0	0.011	0.008	0.8	34.1	0.642	14.5	0.139	0.431
Sturgeon River									
Stn. 205	9.3	0.014	0.626	4.9	105.0	0.378	44.0	0.231	0.332
Wye River									
Stn. 41	16.9	0.026	1.130	8.7	177.0	0.806	**125.0**	0.334	0.482
Stn. 203	19.4	**0.049**	1.460	19.4	297.5	1.845	**226.0**	0.196	1.070
Stn. 208	15.8	0.022	0.385	2.3	210.5	0.393	26.5	0.303	0.375
Objective	**210 mg/L**	**0.03 mg/L**	**2.9 mg/L**	**30 mg/L**	**300 ug/L**	**20 ug/L**	**100 ug/L**	**0.5 ug/L**	**5 ug/L**

Table 2-4: Surface Water Quality Summary for the Severn Sound Watershed 1988-1994. Median concentration: red = >objective, green = <objective (Data Source: SSEA).

Monitoring Station	Chloride	Phosphorus	Nitrate	SS
Copeland Creek				
Stn. 201	4.8	0.017	0.290	9.3
Coldwater River				
Stn. 45	10.9	0.018	0.538	10.9
Stn. 206	16.05	0.019	0.525	10.7
Hog Creek				
Stn. 43	11.3	0.036	0.125	9.45
Stn. 204	6.5	0.030	0.320	10.9
North River				
Stn. 207	13.2	0.024	0.405	8.7
Sturgeon River				
Stn. 205	6.4	0.017	0.440	12.1
Wye River				
Stn. 41	14.6	0.022	0.645	8.0
Stn. 203	16.8	0.080	1.230	25.3
Stn. 208	14.1	0.043	0.61	8.9
Objective	**210 mg/L**	**0.03 mg/L**	**2.9 mg/L**	**30 mg/L**

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.

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.

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 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 2-5: Major ion concentrations in private wells sampled throughout the Severn Sound area in 1995. TDS=Total Dissolved Solids.

	Sodium	Sulphate	Chloride	Nitrate	Iron	TDS	Hardness
Wells completed in Precambrian bedrock							
Number of samples	29	29	29	29	29	27	29
Minimum concentration	4	9	1.6	0.03	0.01	261	31
Mean concentration	110	149	132	0.85	0.45	743	267
Maximum concentration	450	600	1500	7.55	6.9	4040	1220
% exceeding ODWSOG	17	7	10	0	28	41	
Wells completed in Palaeozoic bedrock							
Number of samples	22	23	23	23	23	22	23
Minimum concentration	3.4	7.75	0.5	0.05	0.01	144	45
Mean concentration	42	175	53	0.23	0.43	557	327
Maximum concentration	187	1870	394	2.3	3.9	3890	2050
% exceeding ODWSOG	0	13	4	0	17	32	
Wells completed in overburden <20 m							
Number of samples	38	39	39	38	39	36	39
Minimum concentration	1	7.41	0.3	0.05	0.01	110	76
Mean concentration	8.36	22	18	4.5	0.29	339	240
Maximum concentration	116	59	285	58	4.8	898	458
% exceeding ODWSOG	0	0	3	11	18	11	

	Sodium	Sulphate	Chloride	Nitrate	Iron	TDS	Hardness
Wells completed in overburden >20 m							
Number of samples	90	96	97	96	97	92	97
Minimum concentration	1	0.5	0.4	0.05	0.01	137	22
Mean concentration	10.1	16	8.37	0.92	0.14	242	137
Maximum concentration	49	37	85	6.05	1	470	335
% exceeding ODWSOG	0	0	0	12	18	0	
Source: Singer et al. 1999. Groundwater resources of the Severn Sound RAP Area. MOE Severn Sound RAP Report.							

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 9 Provincial Groundwater Monitoring Network (PGMN) wells located within the Severn Sound watershed (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 and the results were compared to the Ontario Drinking Water Standards, Objectives and Guidelines (ODWSOG).

The results shown in Table 2-6 are based on 1 to 3 samples taken over the period 2004 to 2009, 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 9 wells sampled, none of the wells exceeded the ODWSOG for these parameters with the exception of the aesthetic objective for iron in two wells (W0313 and W0311).

Apart from the basic chemistry, however, Well W0441 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). Following the receipt of the initial sampling results, the Medical Officer of Health was immediately informed of the exeedance 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, but further work would be required to 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 2-6: PGMN Water Quality (2004-2009) (Data Source: SSEA and PGMN).

	Sodium	Chloride	Iron	Aluminum	Manganese	Nitrite	Nitrate +ite	Alkalinity total fixed
Units	**mg/L**	**mg/L**	**ug/L***	**ug/L***	**ug/L***	**mg/L**	**mg/L**	**mg/L CaCO3**
ODWSOG	**20 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**
Gratix Rd (W0483)								
20-May-09	1.72	0.2	0.006	2.7	0.42	0.005	0.26	63
Pinegrove (W0453)								
12-Nov-09	4	2.9		1.8	3.6	0.005	0.12	128
10-Nov-08	3.96	2.5	13	2.6	4.36	0.005	0.05	128
26-Sep-06	3.8	2	6	2.5	8.01	0.007	0.05	135
Min	3.80	2.00	6.00	1.8	3.60	0.01	0.05	128
Max	4.00	2.90	13.00	2.6	8.01	0.01	0.12	135
Median	3.92	2.47	9.50	2.3	5.32	0.01	0.07	130
HWY 93 & Ingram SD RD (W0444)								
4-Nov-09	4.62	0.6	170	0.9	22.9	0.005	0.05	185
3-Nov-08	4.6	0.3	177	1.1	24	0.005	0.05	183
16-Jun-05	5.8	1.1	115	1.7	26	0.005	0.05	184
Min	4.6	0.3	115	0.9	22.9	0.005	0.05	183
Max	5.8	1.1	177	1.7	26	0.005	0.05	185
Median	5.0	0.7	154	1.2	24.3	0.005	0.05	184
Line 5 off Mount ST, Louis RD (W0443)								
21-Oct-09	3.6	2.2		1.2	0.4	0.005	2.5	166
5-Nov-08	3.26	1.8	8	1.4	0.99	0.005	2.23	167
16-Jun-05	4.2	2.5	6	2.1	13.9	0.008	2.23	171
Min	3.26	1.8	6	1.2	0.4	0.005	2.23	166
Max	4.2	2.5	8	2.1	13.9	0.008	2.5	171
Median	3.7	2.2	7	1.6	5.1	0.006	2.32	168
Ingram SD RD past Line 3 (W0442)								
20-Oct-09	14.4	6.2	150	1.6	14.9	0.005	0.05	184
3-Nov-08	4.02	1.4	228	1.5	17.2	0.005	0.05	181
16-Jun-05	4.4	0.7	121	2.4	28	0.005	0.05	185
Min	4.02	0.7	121	1.5	14.9	0.005	0.05	181
Max	14.4	6.2	228	2.4	28	0.005	0.05	185
Median	7.6	2.8	166	1.8	20.0	0.005	0.05	183

	Sodium	Chloride	Iron	Aluminum	Manganese	Nitrite	Nitrate +ite	Alkalinity total fixed
Units	mg/L	mg/L	ug/L*	ug/L*	ug/L*	mg/L	mg/L	mg/L CaCO3
ODWSOG	20 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
Telford Ln & Stockdale Rd (W0441)								
27-Oct-09	4.16	8.9	40	0.5	22.5	0.020	4.64	228
4-Nov-08	4.68	12.6	30	0.7	37.8	0.021	4.68	230
23-Aug-05	4	8.9	68	2.5	43.7	0.036	5.22	225
14-Jun-05	4.8	10.3	205	2.3	62.8	0.054	5.1	161
Min	4	8.9	30	0.5	22.5	0.020	4.64	161
Max	4.8	12.6	205	2.5	62.8	0.054	5.22	230
Median	4.4	10.2	86	1.5	41.7	0.033	4.91	211
Bass Lake SD RD (W0439)								
28-Oct-09	19.8	0.3	100	2.3	13.6	0.005	0.05	140
4-Nov-08	19.5	0.5	88	1.7	14.7	0.005	0.05	141
15-Jun-05	18	0.7	136	2.6	15.9	0.006	0.05	140
Min	18	0.3	88	1.7	13.6	0.005	0.05	140
Max	19.8	0.7	136	2.6	15.9	0.006	0.05	141
Median	19.1	0.5	108	2.2	14.7	0.005	0.05	140
Forest Hill CRT (W0313)								
19-Oct-09	5.2	1.0	1420	0.2	16.8	0.005	0.05	163
29-Oct-08	5.0	1.2	1370	0.1	20.2	0.005	0.05	152
19-May-04	4.8	0.8	1480	0.4	25.1	0.005	0.05	161
Min	4.8	0.8	1370	0.1	16.8	0.0	0.1	152
Max	5.2	1.2	1480	0.4	25.1	0.0	0.1	163
Median	5.0	1.0	1423	0.2	20.7	0.0	0.1	159
Balm Beach RD & Sundowner (W0311)								
21-May-09	2.44	0.9	460	0.9	37.4	0.005	0.05	184
28-Jul-04	2.6	1	212	1.6	34.4	0.005	0.08	176
Min	2.44	0.9	212	0.9	34.4	0.005	0.05	176
Max	2.6	1	460	1.6	37.4	0.005	0.08	184
Median	2.52	0.95	336	1.2	35.9	0.005	0.065	180

Concentration exceeds Ontario Drinking Water Quality Standards, Objectives and Guidelines (ODWSOGs)

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

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 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.

Recently the Ministry of the Environment carried out a study that involved the collection and analysis of over 250 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 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 potential 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 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. Wastewater 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. 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 and nature groups in the Severn 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 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 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 warmwater species to replace coldwater species. Coldwater species also require high levels of dissolved oxygen (which is in higher concentration in coldwater) 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 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 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 Watershed are Largemouth Bass (*Micropterus salmoides)* and Smallmouth Bass (*Micropterus dolomiuei).*

Table 2-7: 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
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

Fish	Species	Thermal Status
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. 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). 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 sites in Severn Sound area tributaries have been recorded using temperature-loggers over the period 2006 to 2009. Thermal habitat was determined using the DFO/MNR protocol (Stoneman and Jones 1996) which calls for stream temperatures measurements made between 4 and 4:30 pm on days when air temperature exceeds 25 ^{o}C. Stream temperature regime is classified into warm, cool and cold water based on ranges provided in the protocol (Figure 2-7). 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 (identified to as low a taxonomic level as practical) at a number of sites across the watershed and to collect quantitative samples using a T-sampler at selected sites that would provide an indication of the year-to-year changes due to natural fluctuations and to remedial efforts.

The 18 long-term stream benthos stations from the Severn Sound area were used to assess changes in the benthic community from 1996 to 2005. Not all sites were sampled each year and data for more recent years is currently under preparation. 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 of restoration projects, modified conditions or potential contaminant sources. For the purposes of this characterization, Ephemeroptera, Plecoptera and Trichoptera (EPT) Richness were estimated at the family taxonomic level for each stream station sampled (Figure 2-9). These three insect orders have young life-cycle stages that live in streams for long periods before emerging as adults. 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 a few exceptions that related to local construction (Copeland Creek) or beaver dam removal (Hogg Creek) during some of years. The EPT Richness ranged between 1 and 15 families across the watershed. The highest EPT richness was consistently found at sites in the Coldwater, Sturgeon and North Rivers with widely fluctuating year-to-year values in the Wye R, Hog Creek and Copeland Creek. These latter streams are still affected by erosion and/or pollution sources.

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 (Table 2-8, Figure 2-10). 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.

Table 2-8: Municipal population and population density in the Severn Sound watershed.

Upper Tier Municipality	Lower Tier Municipality	2006 Population	2001 Population	% Change in Population 2001 to 2006	Est. 2006 population in Watershed	Area within Watershed (km²)	Density within Watershed (persons/km²)
City of Orillia		30,259	29,121	3.9	5,186	6	835
Simcoe County	Twp of Springwater	17,456	16,104	8.4	5,038	110	46
	Twp of Oro-Medonte	20,031	18,315	9.4	10,135	308	33
	Twp of Severn	12,030	11,135	8.0	7,707	286	27
	Twp of Tay	9,748	9,162	6.4	9,748	141	69
	Twp of Tiny	10,784	9,035	19.4	10,784	337	32
	Town of Penetanguishene	9,354	8,316	12.5	9,354	27	352
	Town of Midland	16,300	16,214	0.5	16,300	38	432
District of Muskoka	Georgian Bay	2,340	1,991	17.5	227	58	4
	Total	**128,302**	**119,393**		**74,479**	**1,310**	

Data Sources: 2006, 2001 Statistics Canada Census Data on populations, County of Simcoe/District of Muskoka for municipal areas, SSEA watershed areas

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, Figure 2-11). 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,
- 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 2-9: Land use in the Severn Sound watershed (Data Sources: OMNR, 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**

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, 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 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 2-9, 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 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 2-14.

Table 2-10: Livestock Density within the Severn Sound watershed (Data Source: Statistics Canada, 2006 Census).

Census Consolidated Subdivision (CCS)	% Municipal area within watershed	Livestock Density (number/km²)				
		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 (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, 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 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 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 2-11: Drinking Water Systems and the legislation they are protected under.

Drinking Water System	Definition	Legislative Protection
Large Municipal Residential System	• Municipal • Serves major residential development & more than 100 private residences	SDWA, CWA
Small Municipal Residential System	• Municipal • Serves a major residential development & fewer than 101 private residences	SDWA, CWA
Large Municipal Non-Residential System	• Municipal • Non-residential • Capable of supplying drinking water at a rate of more than 2.9 L/s	SDWA, HPPA
Small Municipal Non-Residential System	• Municipal • Non-residential • Not capable of supplying drinking water at a rate of more than 2.9 L/s	SDWA, HPPA
Non-Municipal Year-Round Residential	• Non-municipal • Year-round	SDWA

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

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, Figure 2-16). Locations of non-municipal and non-residential drinking water systems that are not included in this report are shown in Figure 2-17. 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.

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

	DWS				Well					
Municipality	**DWS Name**	**DWS Classification**	**Pop.**	**TOTAL POP**	**Well Name**	**Easting**	**Northing**	**Current Average Pumping (m3/a)**	**TOTAL AVG PUMPING (m^3/a)**	**Subwatershed**
The Town of Midland	Midland Well Supply	1	16430	16430	Well #11	586375	4956110	56210	2362645	Midland Area
					Well #14	586584	4956038	43800		
					Well #15	589276	4954994	313170		
					Well #16	586747	4956238	72635		
					Well #17	586853	4956277	101470		
					Well #6	586676	4956097	60955		Midland Area
					Well #7a	588714	4953130	669045		Wye River
					Well #7b	588715	4953150	656635		
					Well #9	586363	4954742	350035		Midland Area
The City of Orillia	Orillia Water Supply System	1	30908		Well #3 (West)	622904	4940267	6550	6550	North River
The Township of Oro-Medonte	Braestone Well Supply	1	802	3943	Well 1	612452	4937408	Data gap		
					Well 2	612460	4937400			
	Horseshoe Highlands subdivision Well Supply	1	1012		Well 1	605847	4934293	162790	379600	Coldwater River
					Well 2	605976	4934361			
	Medonte Hills Well Supply	1	352		Well #1	605943	4943393	26280		
					Well #2	605933	4943381			
	Robin Crest Well Supply	1	402		Well #1	606119	4945214	41610		
					Well #2	606097	4945201			
	Sugar Bush Well Supply	1	860		Well #1	609038	4935464	76650		
					Well #2	609405	4934971			
					Well #3	610037	4934822			
	Warminster Well Supply	1	515		Well #1	616622	4944518	72270		North River
					Well #3	616622	4944518			
The Town of Penetanguishene	Lepage Subdivision (Penetanguishene) Well Supply	2	64	6764	Well #1	582493	4958380	6205	1584830	Penetang Bay West
					Well #2	582489	4958380			

	DWS				Well					
Municipality	DWS Name	DWS Classification	Pop.	TOTAL POP	Well Name	Easting	Northing	Current Average Pumping (m3/a)	TOTAL AVG PUMPING (m^3/a)	Subwatershed
	Payette (Penetanguishene) Well Supply	1	6700		Well #1	584973	4959416	1578625		Penetanguishene and Tay Point
					Well #2	584982	4959438			
					Well #3	585063	4959422			
	Robert Street West Supply Well	0	0		Well #2	583030	4956991	0		Copeland Creek
					Well #3	582951	4956941			
The Township of Severn	Bass Lake Woodlands Well Supply	1	321	1685	Well #1	619710	4941726	35770	173375	North River
					Well #2	619724	4941700			
					Well #3	619722	4941708			
	Coldwater Well Supply	1	1364		Well 1	607198	4951172	137605		Coldwater River
					Well 2	607157	4951235			
					Well 3	607203	4951222			
The Township of Springwater	Pending (assumed Cassel Drive)	License/permit pending	-	2725	Well 1	600011	4934682	-		
			-		Well 2	599989	4934665	-		
	Elmvale Well Supply	1	1900		Well #1	590127	4937486	95995	333610	Wye River
					Well #2	590134	4937498			
	Hillsdale Well Supply	1	825		Well #1	599315	4938406	237615		Sturgeon River
					Well #2	599309	4938397			
					Well #3	599309	4938395			
The Township of Tay	Rope Subdivision Water Treatment Plant	2	70	7363	SW			12775	924180	
	Victoria Harbour Water Treatment Plant	1	7293		SW			911405		
The Township of Tiny	Bluewater Well Supply	1	872	7823	Well #18-1	579721	4940964	51830	734015	Tiny Coastal Area South
					Well #18-2	579711	4940957			
					Well #8-1	579691	4940077			

	DWS				Well					
Municipality	DWS Name	DWS Classification	Pop.	TOTAL POP	Well Name	Easting	Northing	Current Average Pumping (m3/a)	TOTAL AVG PUMPING (m^3/a)	Subwatershed
	Cooks Lake Well Supply	2	308		Well #12-1	581197	4962382	27740		Tiny Coastal North East
					Well #12-2	581195	4962389			
	Georgian Bay Estates Well Supply	1	781		Well #19-1	583059	4968176	46720		
					Well #19-4	583157	4968207			
					Well #19-5	583193	4968230			
	Georgian Highlands Well Supply	2	294		Well #4-1	568836	4957561	18250		Tiny Coastal Area North West
	Georgian Sands Well Supply	1	2275		Well #1-1	572817	4954184	269735		
					Well #14-1	573130	4954109			
					Well #2-1	572556	4954465			
					Well #2-2	572566	4954450			
	Lafontaine Well Supply	2	231		Well #23-1	574773	4956375	26280		Lafontaine Creek
					Well #23-4	574784	4956380			
	Lefaive Well Supply	2	235		Well #3-2	578130	4951498	13505		Tiny Coastal Area West Central
					Well #3-3	578115	4951492			
	Pennorth Well Supply	2	112		Well #7-1	575959	4952927	6570		Tiny Coastal Area North West

	DWS				Well					
Municipality	**DWS Name**	**DWS Classification**	**Pop.**	**TOTAL POP**	**Well Name**	**Easting**	**Northing**	**Current Average Pumping (m3/a)**	**TOTAL AVG PUMPING (m^3/a)**	**Subwatershed**
					Well #7-2	575959	4952927			
	Perkinsfield Well Supply	1	630		Well #11-2	581599	4951007	68985		Tiny Coastal Area West Central
					Well #22-3	581235	4950651			
					Well #26-4	584498	4949761			Wye River
					Well #26-5	584789	4949816			
	Rayko Water System Well Supply	2	123		Well #6-2	580881	4944033	5475		Tiny Coastal Area South
					Well #6-3	580877	4944033			
	Sand Castle Well Supply	2	123		Well #13-1	569654	4956063	10220		Tiny Coastal Area North West
					Well #13-2	569646	4956076			
	Sawlog Bay Well Supply	2	140		Well #16-2	583232	4967417	10220		Tiny Coastal North East
					Well #16-3	583220	4967408			
	Tee Pee Point Well Supply	2	319		Well #9-1	584637	4963183	19710		Penetang Bay West
					Well #9-2	584627	4963187			
	Thunder Bay Well Supply	2	70		Well #20-1	574245	4960453	6205		Tiny Coastal Area North West
					Well #20-2	574245	4960442			

	DWS				Well					
Municipality	DWS Name	DWS Classification	Pop.	TOTAL POP	Well Name	Easting	Northing	Current Average Pumping (m3/a)	TOTAL AVG PUMPING (m^3/a)	Subwatershed
	Tiny Cove Estates	0	0		Well 30-1	569129	4956880	25915		
					Well 30-2	569127	4956880			
	Vanier Woods Well Supply	2	172		Well #15-1	570797	4955410	10950		
					Well #15-2	570817	4955427			
	Whip-Poor-Whil II Well Supply	2	224		Well #21-1	582621	4954542	32850		Copeland Creek
					Well #21-2	582619	4954533			
	Woodland Beach Well Supply	2	102		Well #25-1	579254	4938686	8760		Tiny Coastal Area South
					Well #25-2	579242	4938678			
	Wyevale Well Supply	1	812		Well #17-1	585346	4945486	74095		
					Well #17-2	585332	4945508			
					Well #17-3	585351	4945484			
					Well #29-1	586297	4944949			Wye River
					Well #29-2	586309	4944926			

1 – Large Municipal System 2 – Small Municipal System 0 – Unknown

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 Township of Tiny and the Town of Penetanguishene have seen the most dramatic increase between the 2001 and 2006 census years with a 19.4% and 12.5% increase, respectively. 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 at 18 sites. Using Ephemeroptera, Plecoptera and Trichoptera (EPT) Richness as a preliminary assessment of stream quality, results showed that the highest EPT richness was consistently found at sites in the Coldwater, Sturgeon and North Rivers. The more widely fluctuating year-to-year values were found to be in the Wye River, Hog Creek and Copeland Creek. 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 that could be contributable 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 salts; tire residue; oil and gas; sediment; and nutrients and bacteria from pet and wild animal feces. The requirement for storm water management facilities 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 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.

Figure 2-1: South Georgian Bay-Lake Simcoe Source Protection Region

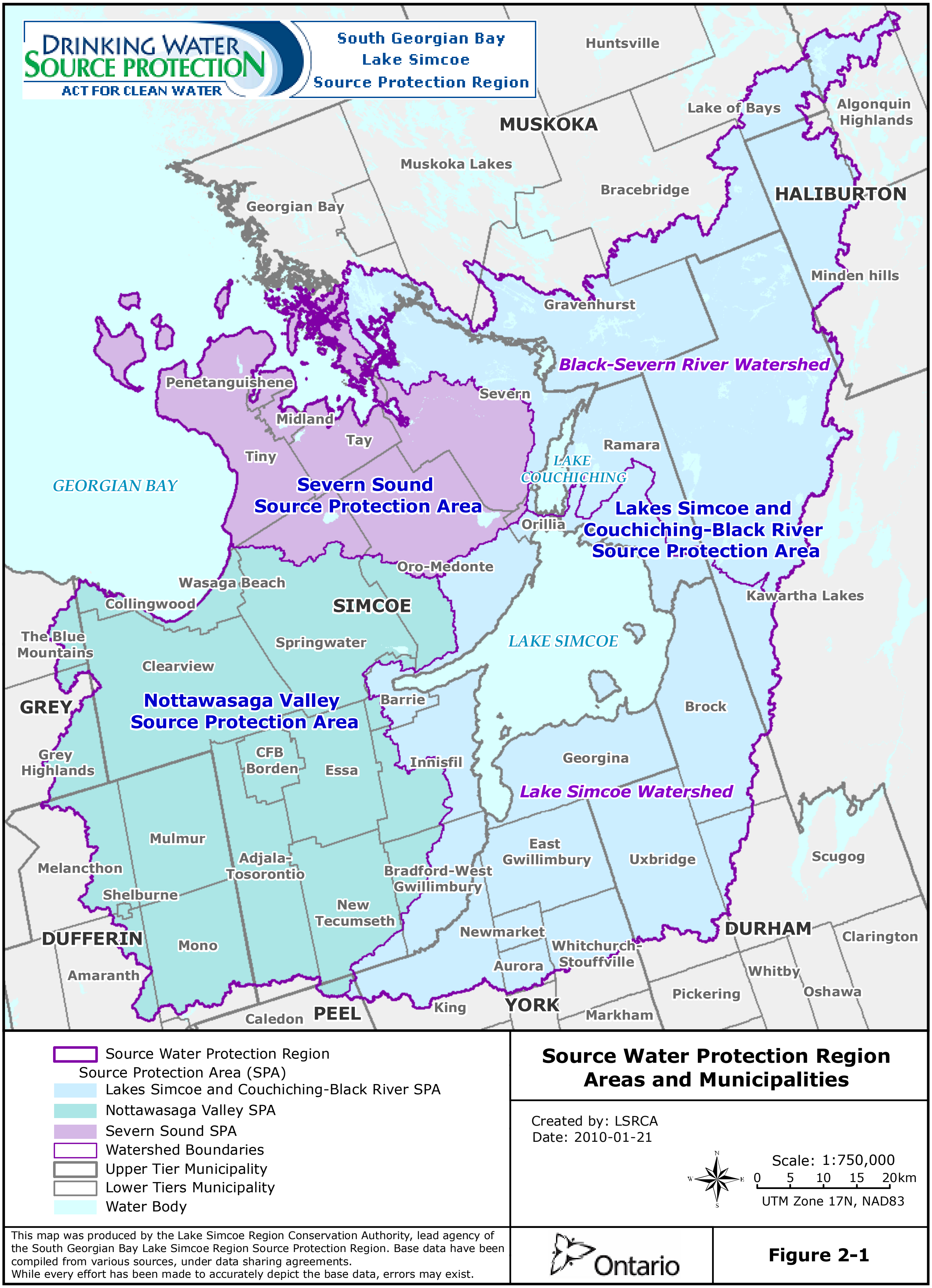


Figure 2-2: Severn Sound Watershed and Subwatershed Boundaries and Municipality Boundaries

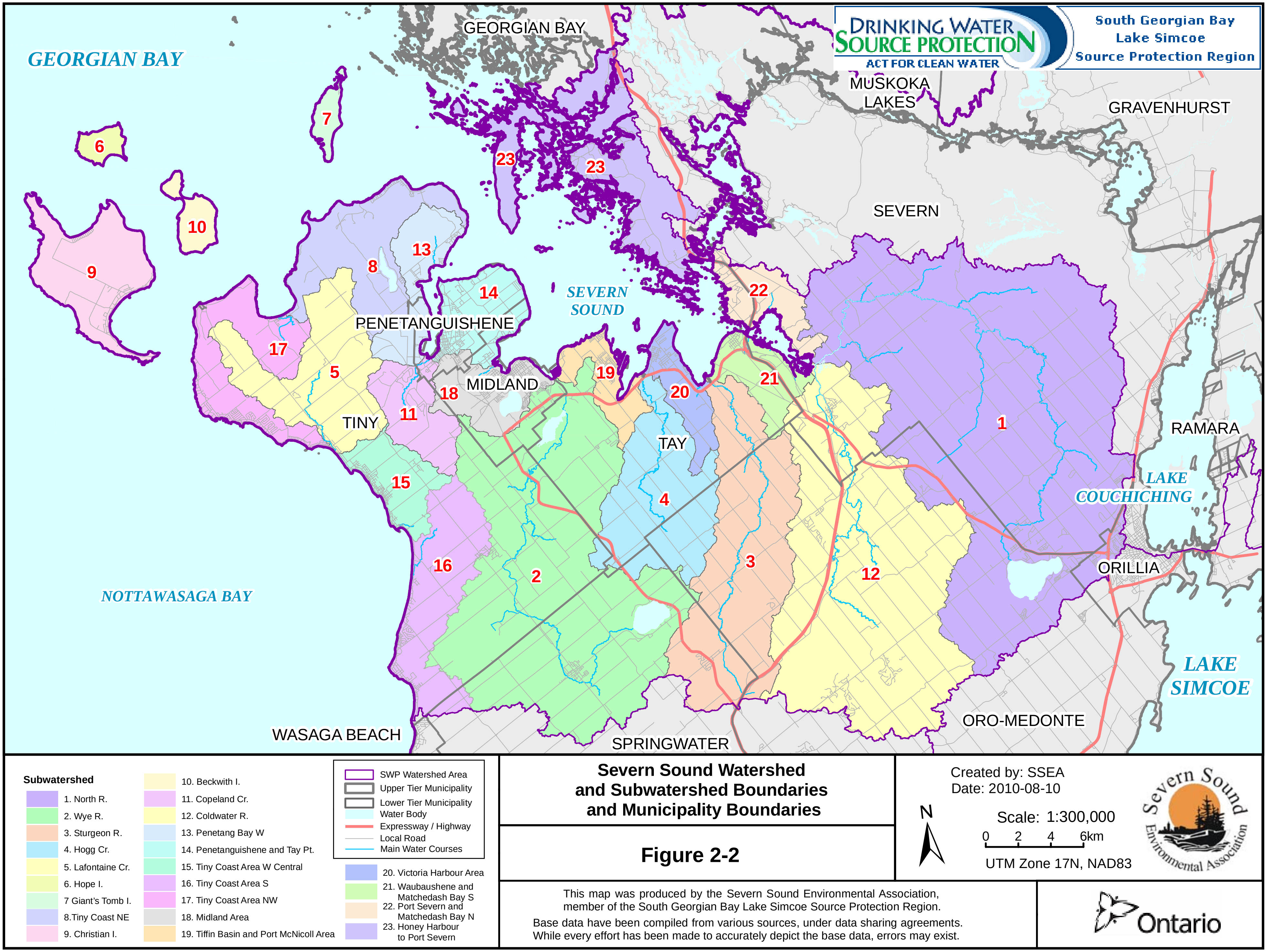


Figure 2-3: Location of Natural Vegetative Cover in the Severn Sound Watershed

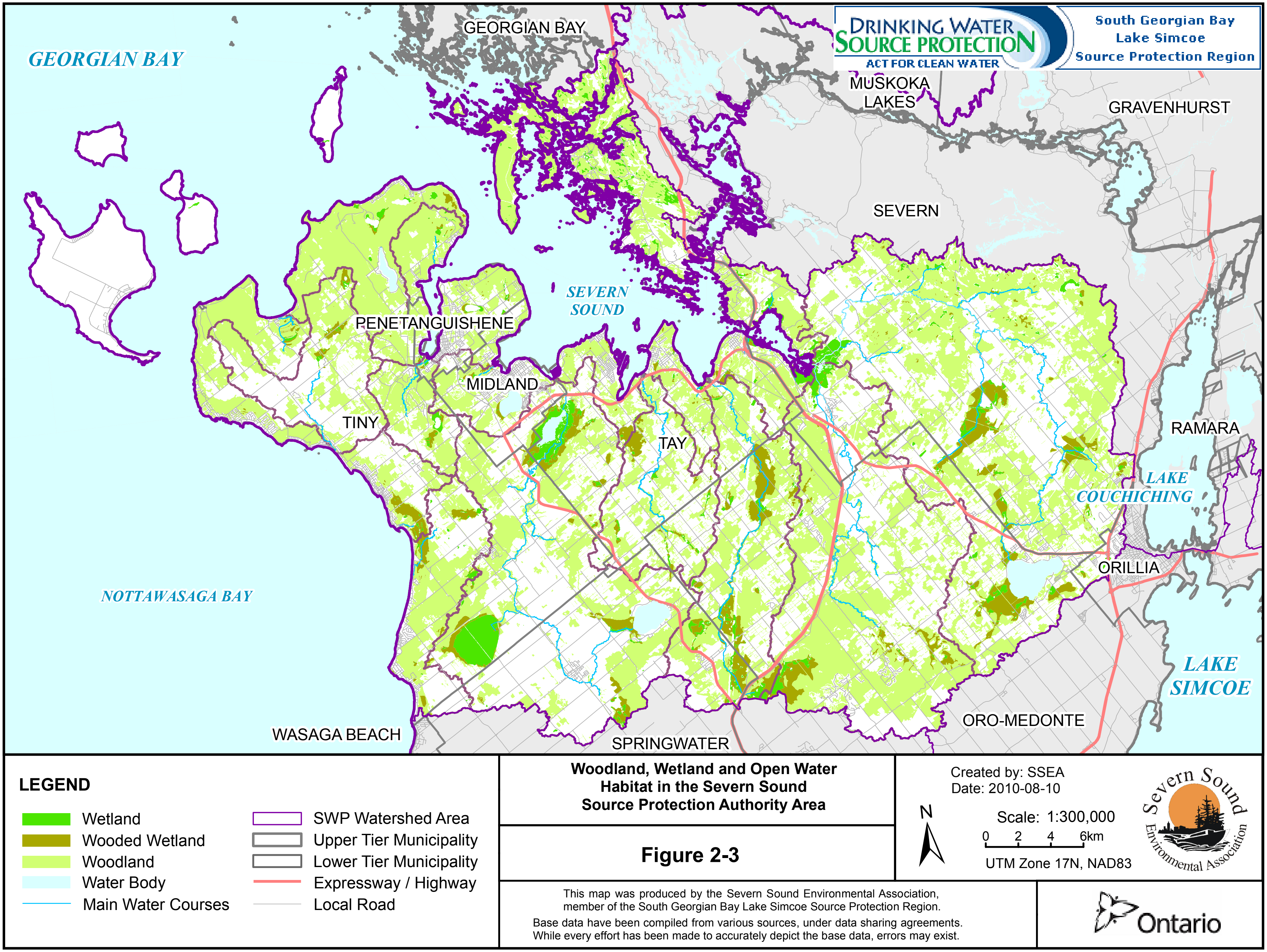


Figure 2-4: Groundwater and Surface Water Monitoring Stations

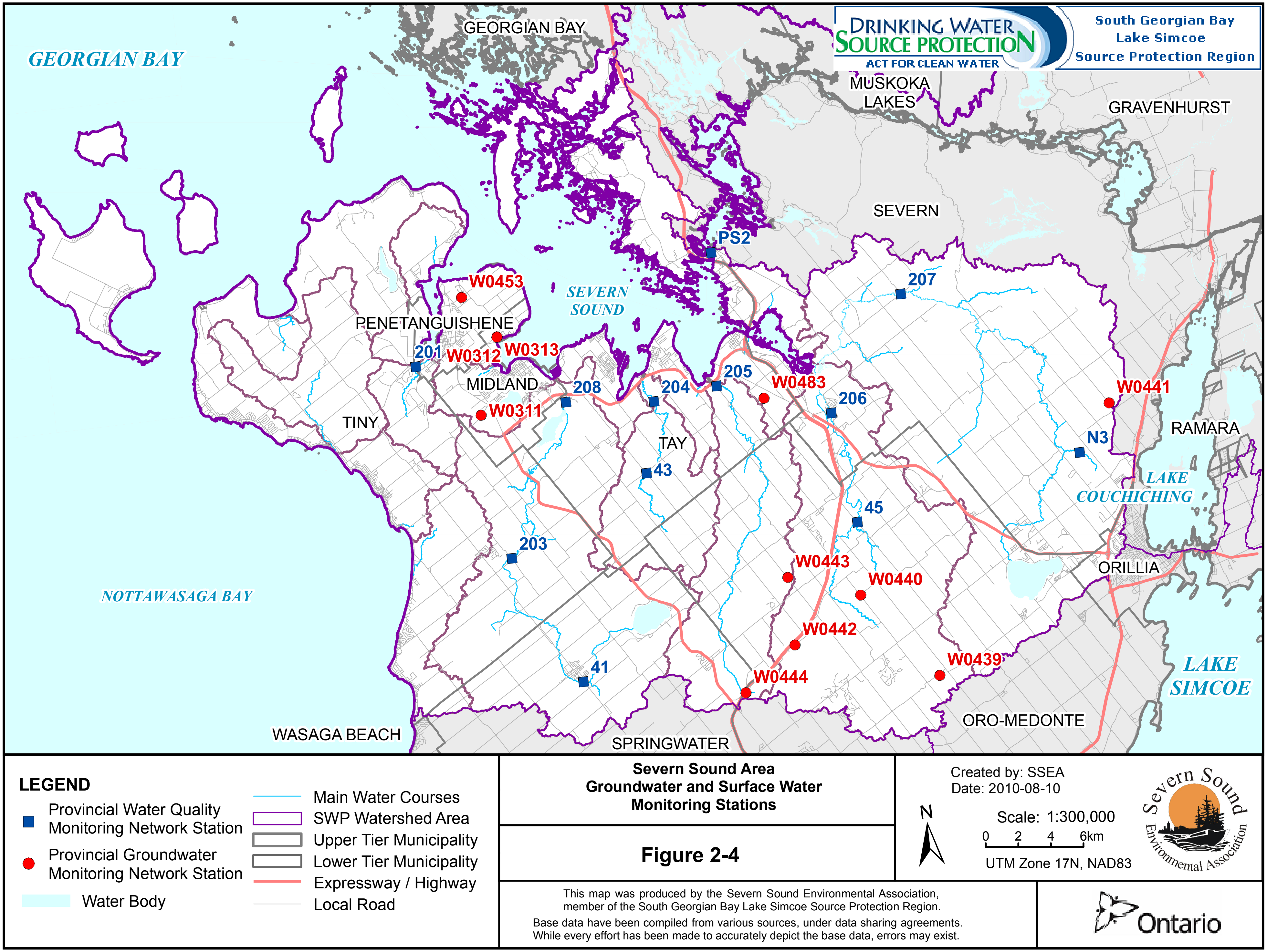


Figure 2-5
Trends in summer median chloride (a), total phosphorus (b) and nitrate (c) in Coldwater River at Coldwater, 1973 to 2009 (Data Source: MOE/SSEA)

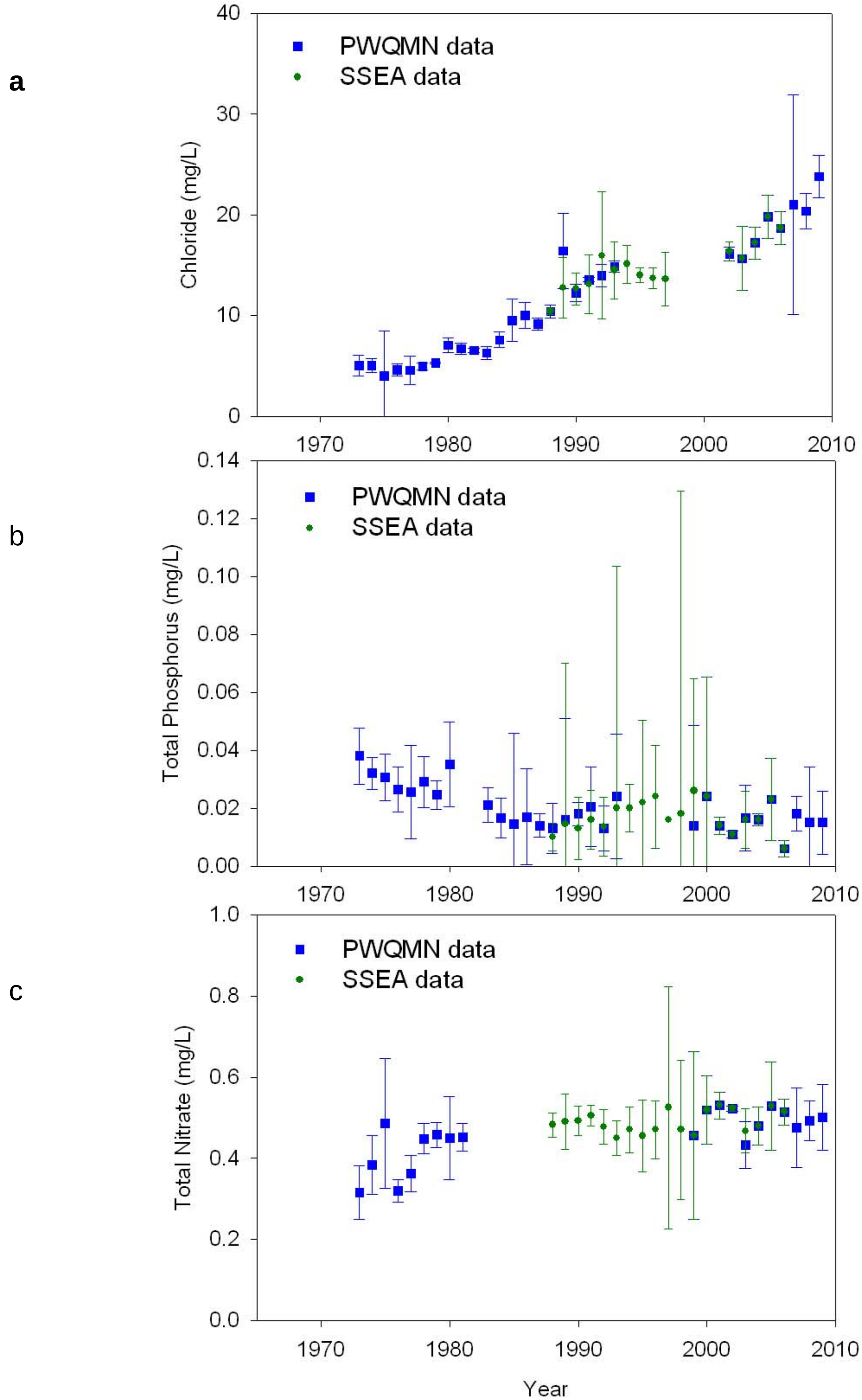


Figure 2-6
Trends in summer median chloride (a), total phosphorus (b) and nitrate (c) in the Severn River at Port Severn, 1968 to 2009 (Data Source: MOE/SSEA)

a

b

c

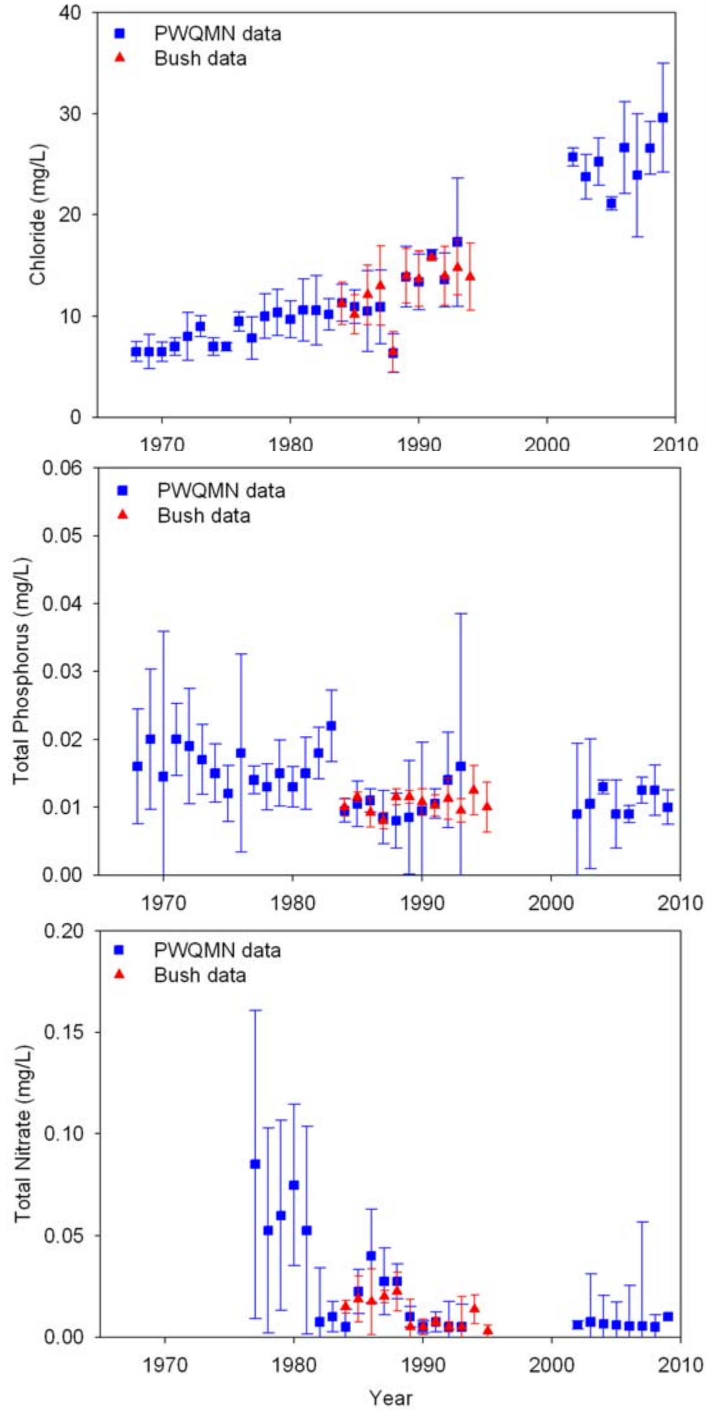


Figure 2-7: Location and Types of Aquatic Habitat in the Severn Sound Watershed

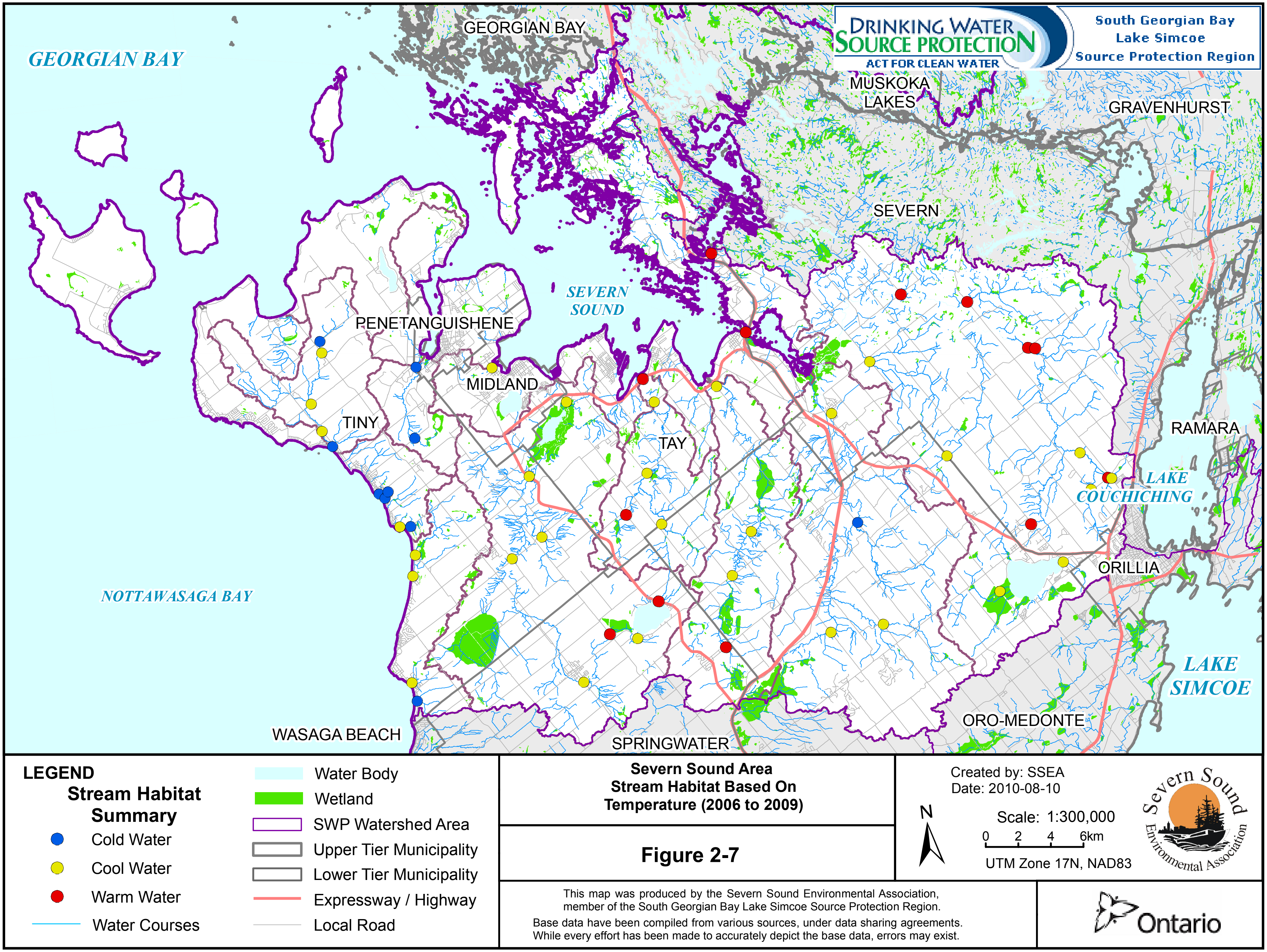


Figure 2-8: Coldwater fish species present in Severn Sound tributaries

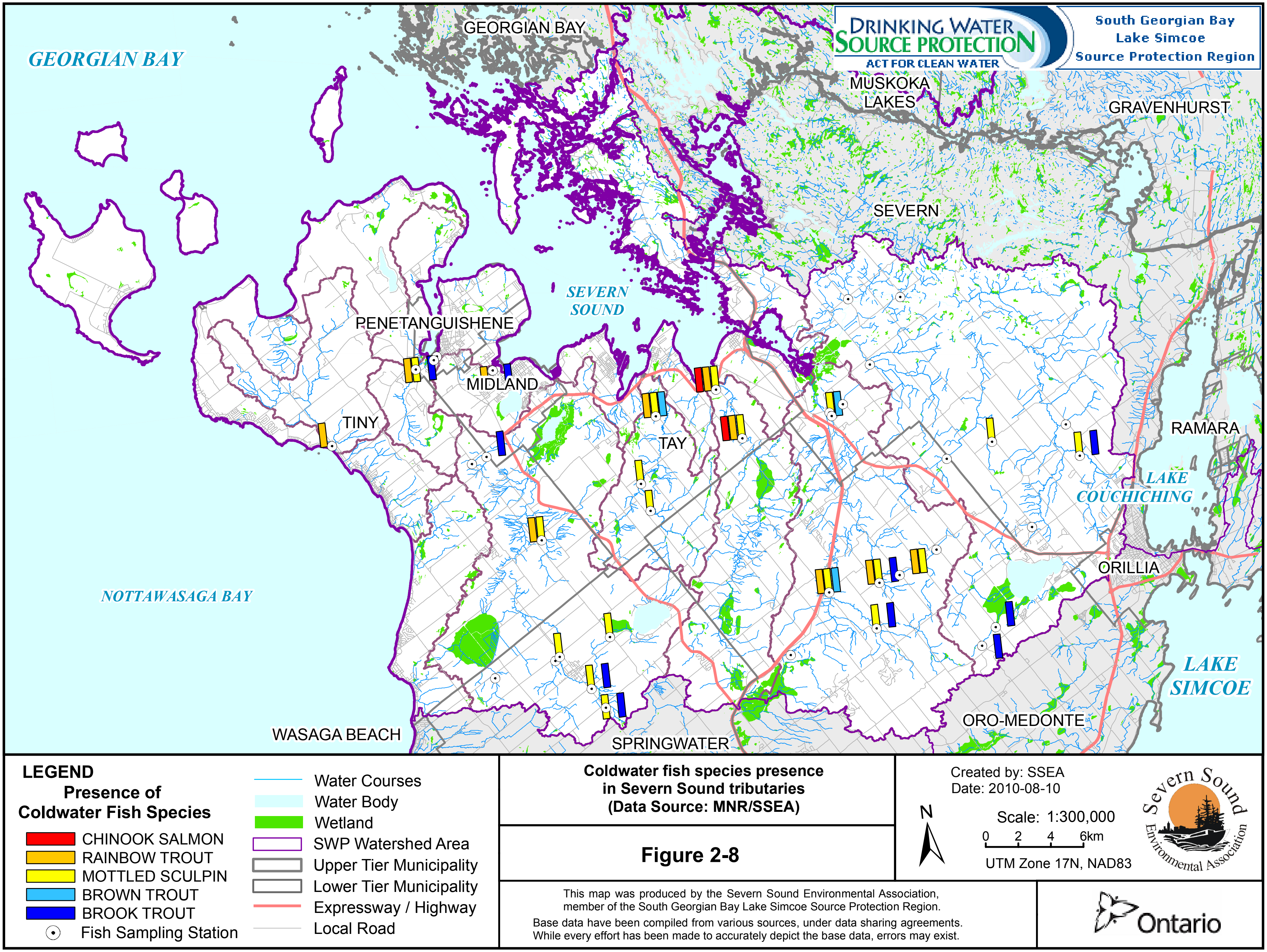
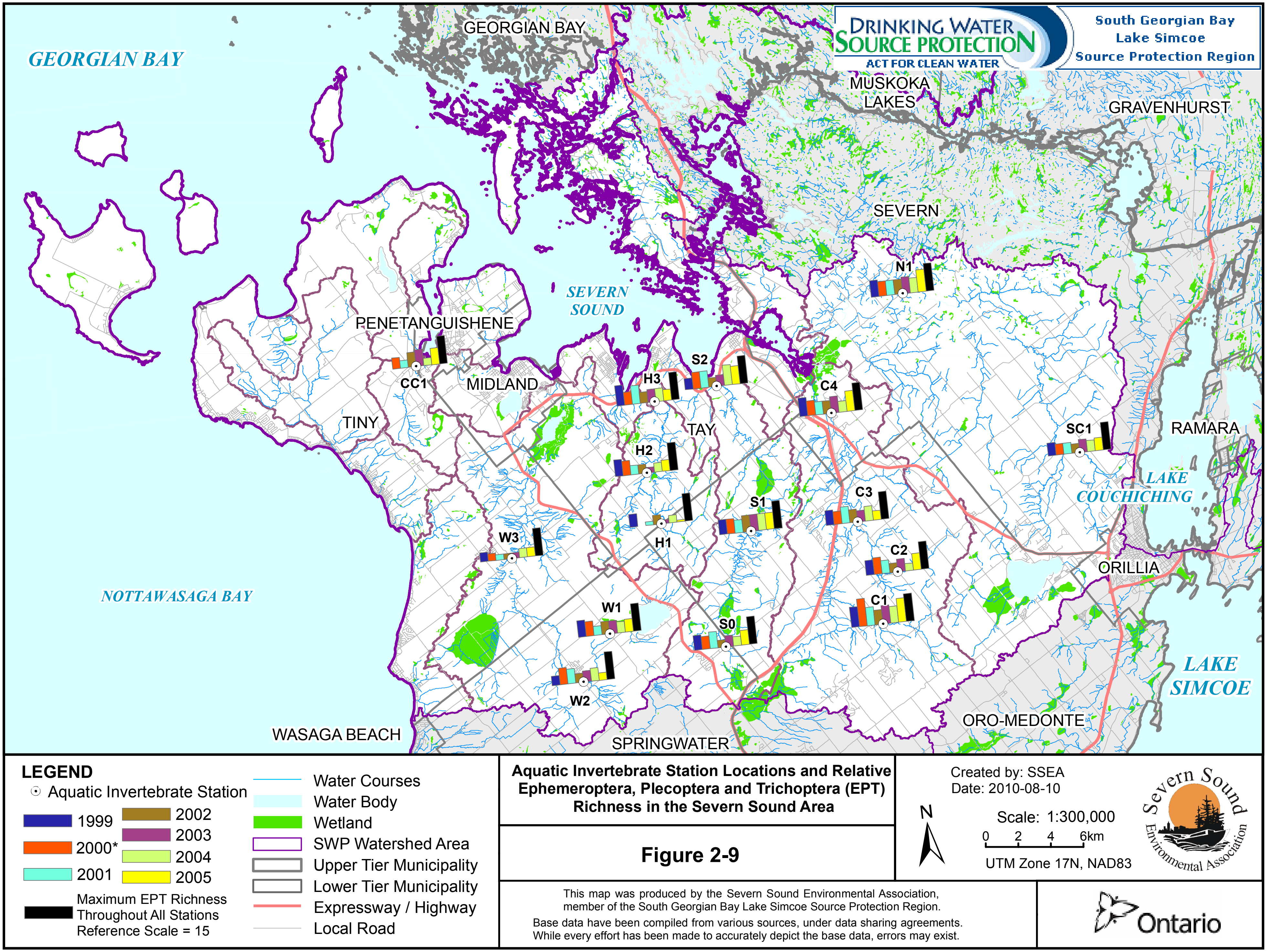


Figure 2-9: Aquatic Invertebrate Station Locations and Relative EPT Richness in the Severn Sound watershed



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

Figure 2-10: Municipal Population Density in the Severn Sound watershed

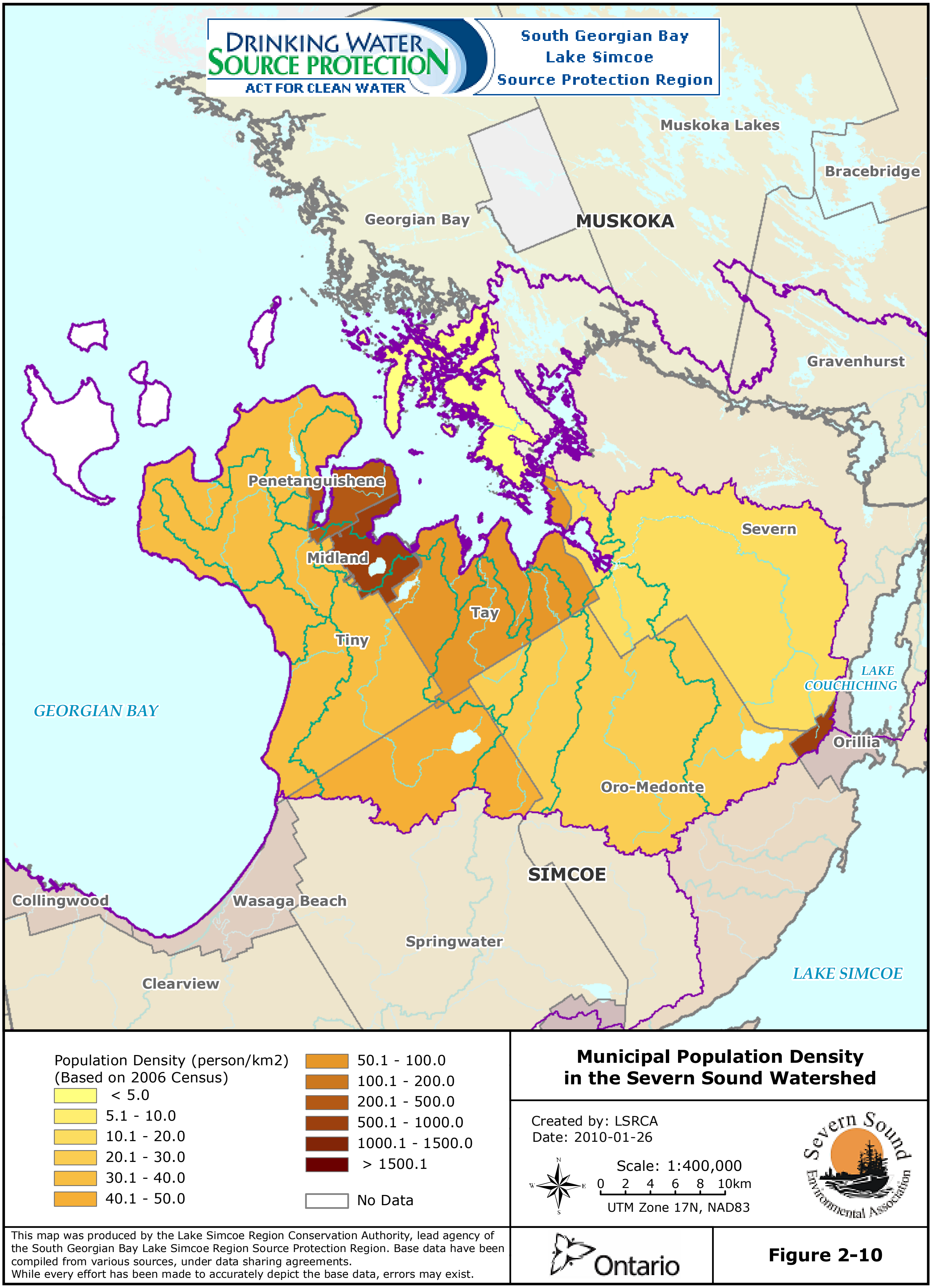


Figure 2-11: Areas of Land Use within the Severn Sound Watershed

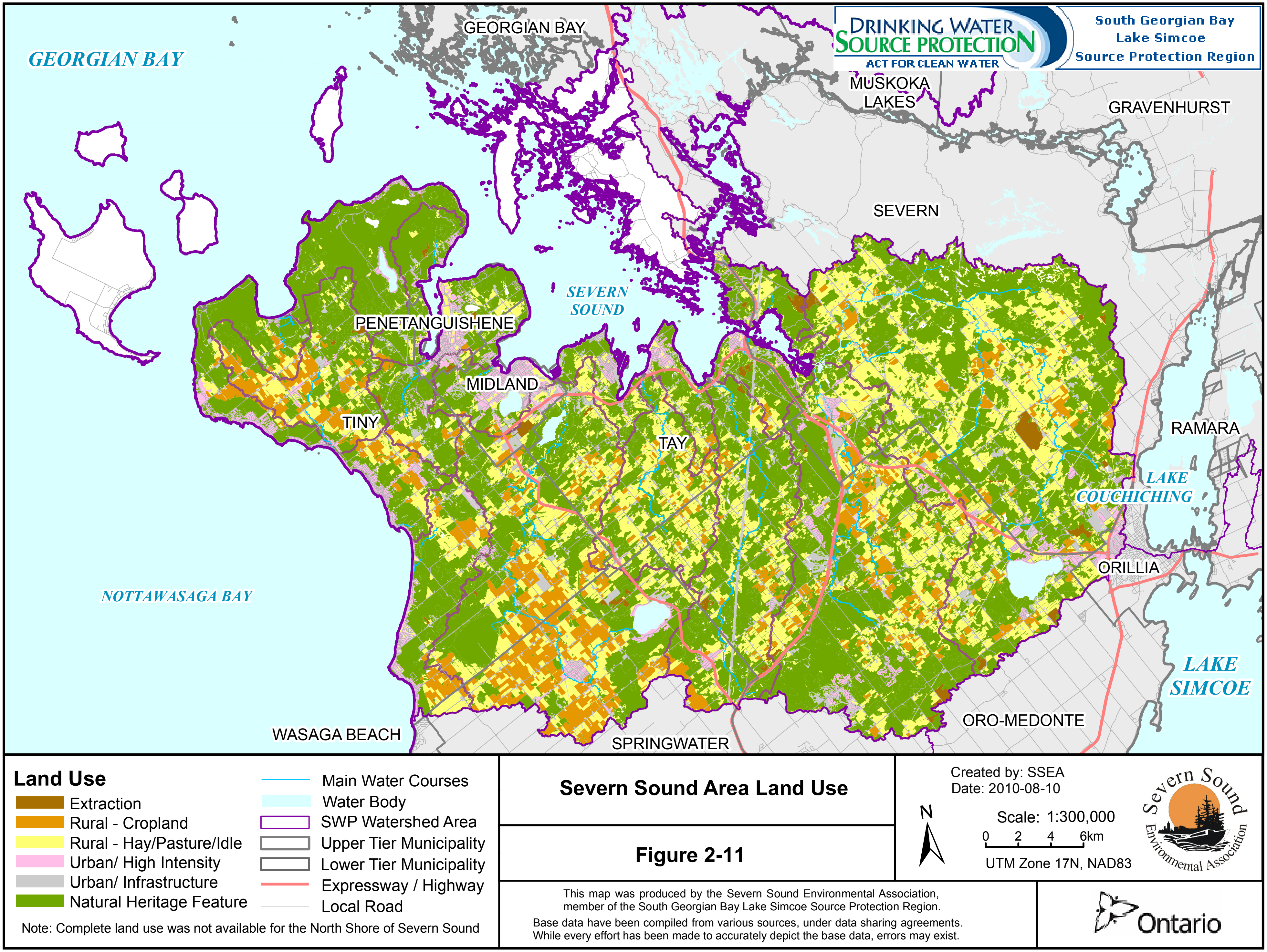


Figure 2-12: Areas of Settlement and Land Owner in the Severn Sound Watershed

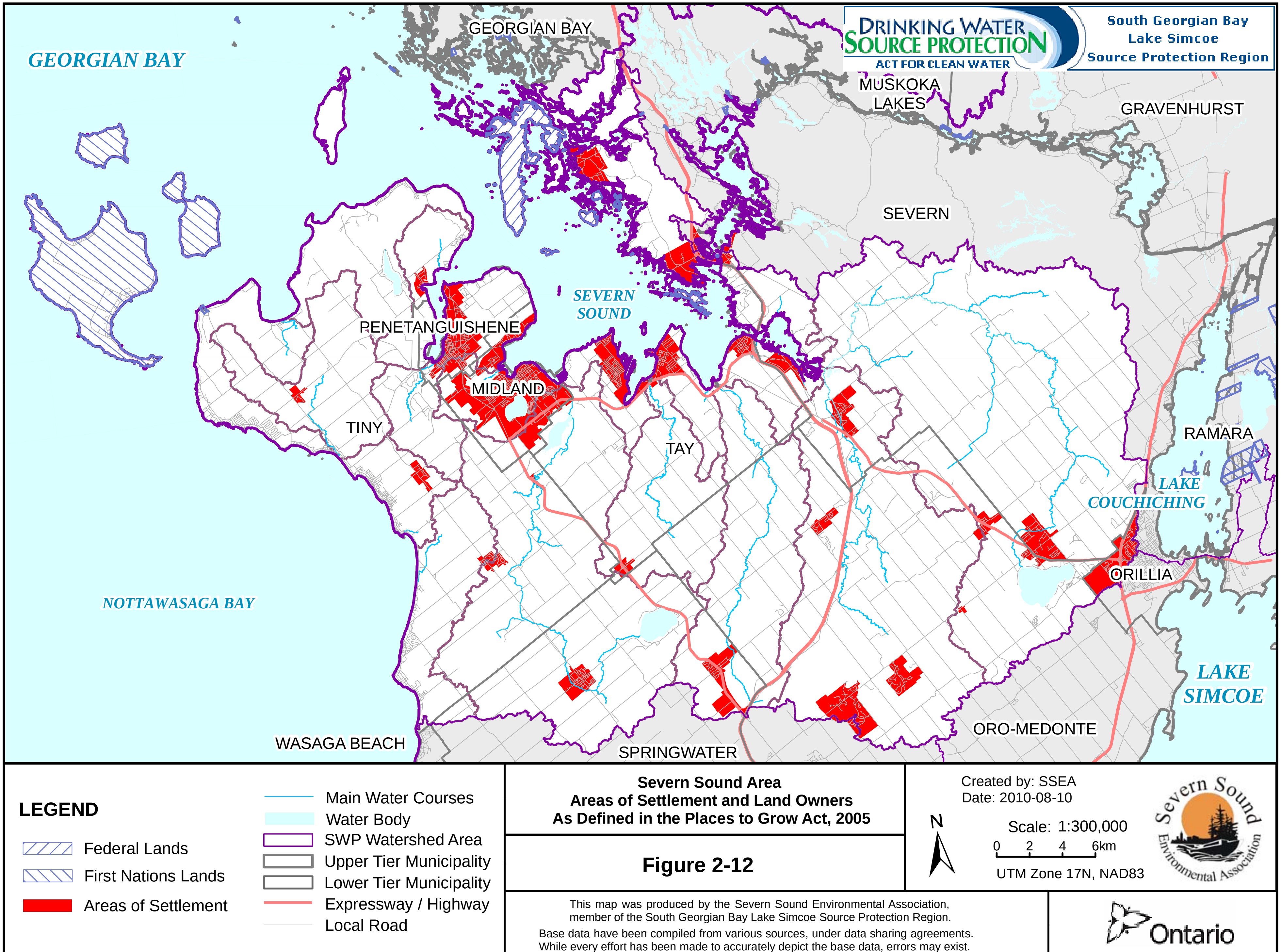


Figure 2-13: Impervious Areas in the Severn Sound Watershed

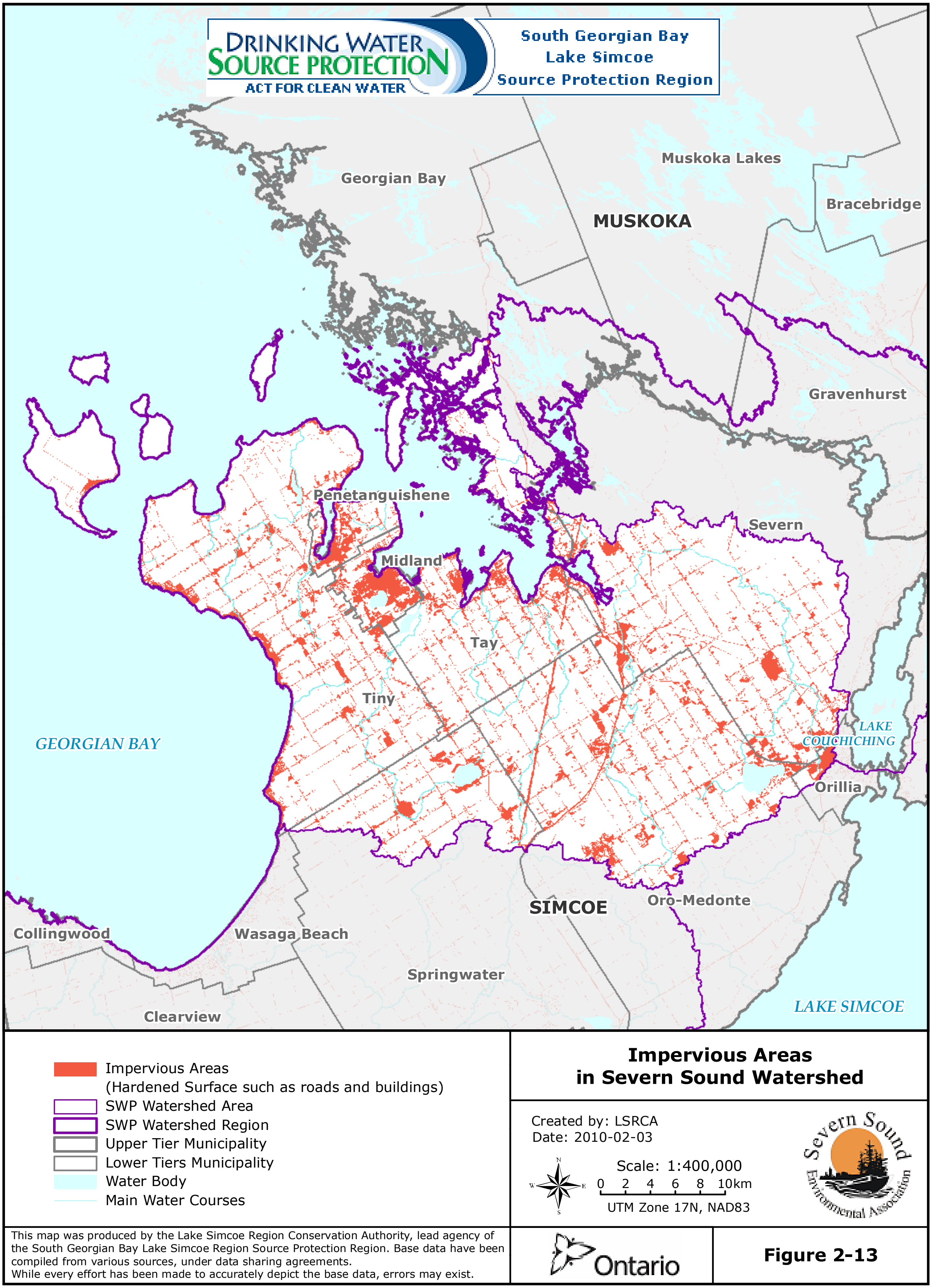
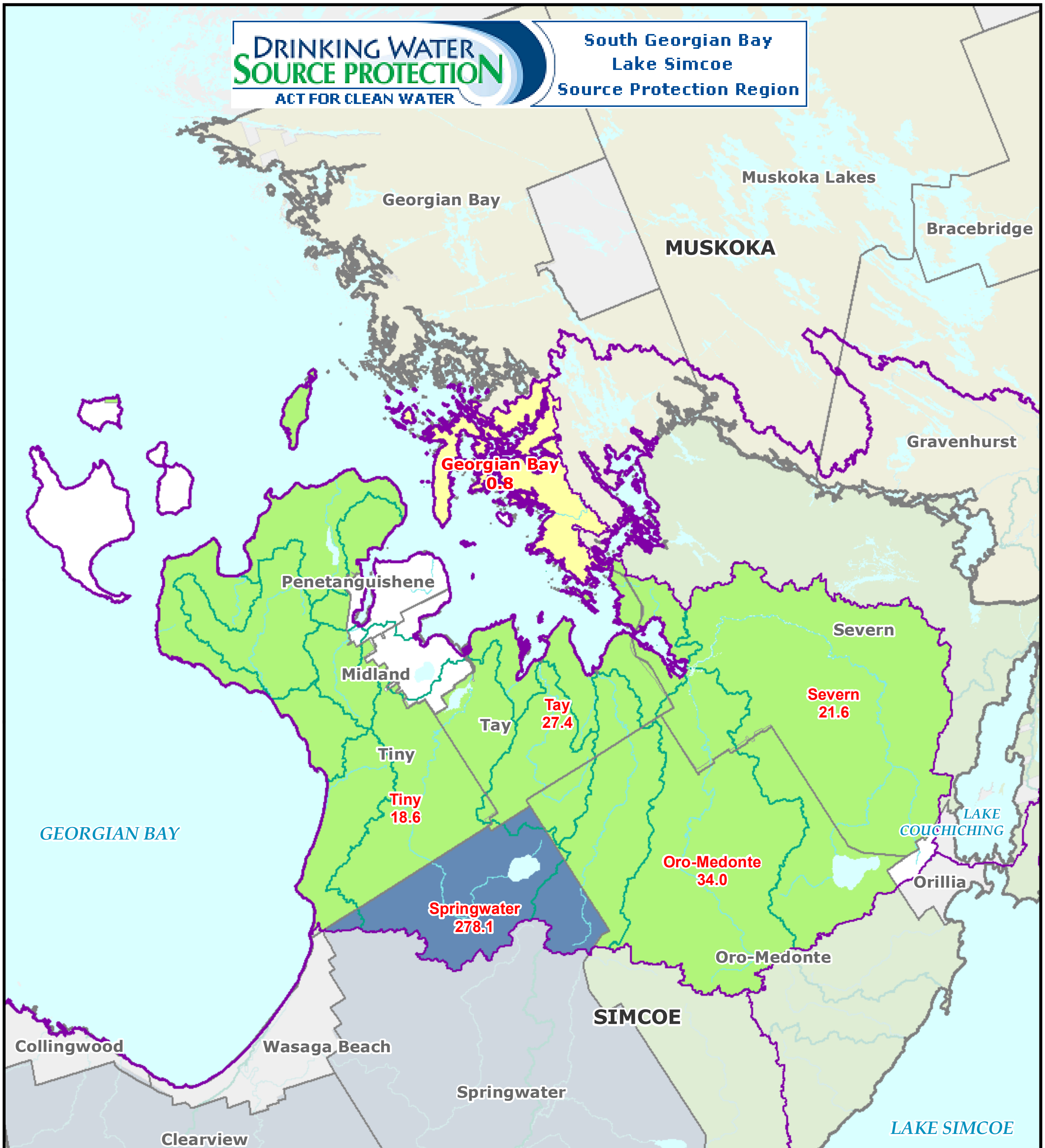


Figure 2-14: Location and Density of Livestock in the Severn Sound Watershed



Livestock Density (heads/km2)

- < 10
- 11 - 50
- 51 - 100
- 101 - 200
- 201 - 500
- 501 - 1000

- SWP Watershed Region
- SWP Watershed Area
- Upper Tier Municipality
- Lower Tiers Municipality
- Water Body
- Main Water Courses

Location and Raising of Livestock

Created by: LSRCA
Date: 2010-08-19

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

Severn Sound Environmental Association

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

Ontario

Figure 2-14

Figure 2-15: Managed Lands in the Severn Sound Watershed

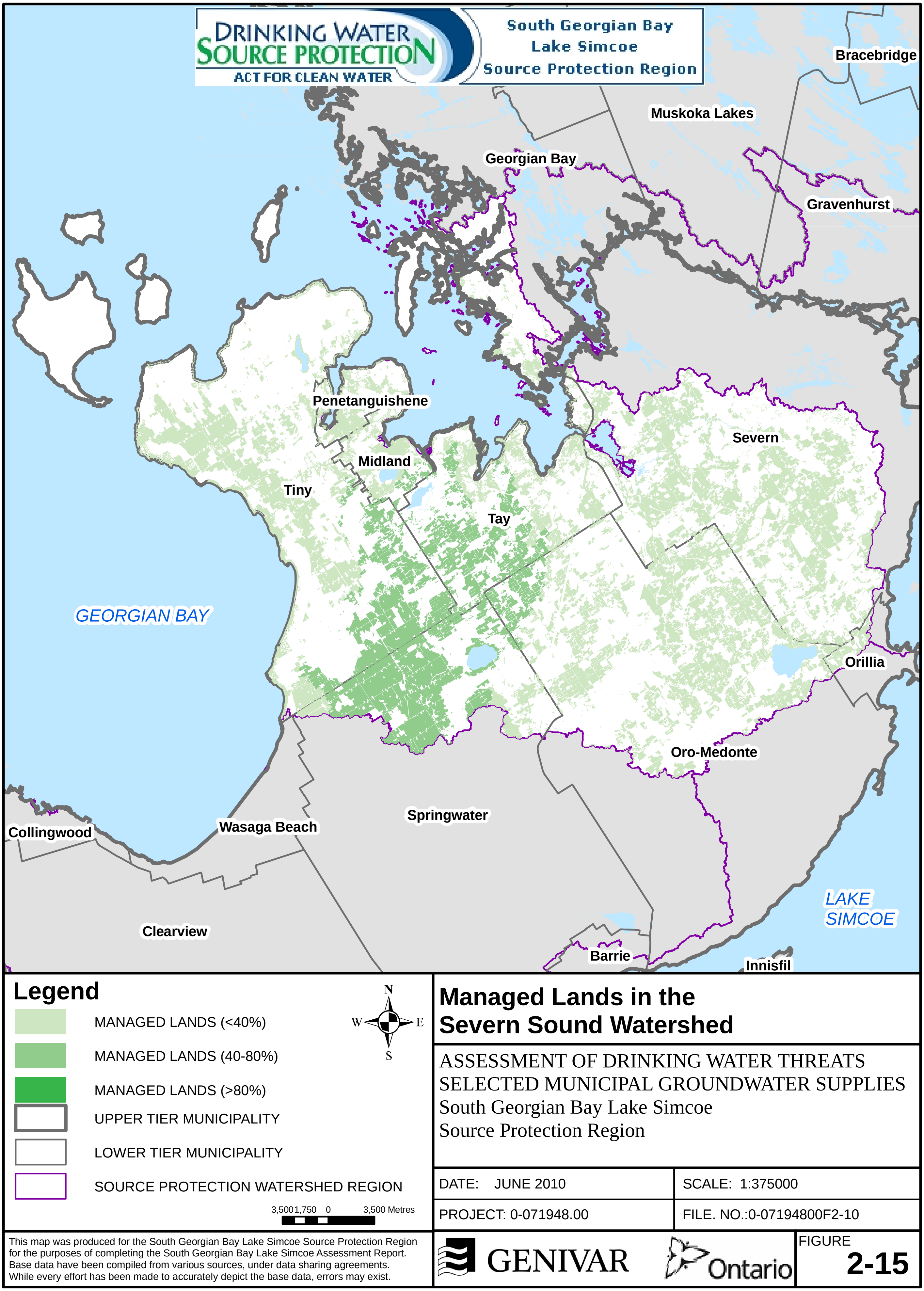


Figure 2-16: Drinking Water System- Intakes, Supply Wells and Monitoring Wells- in the Severn Sound Watershed

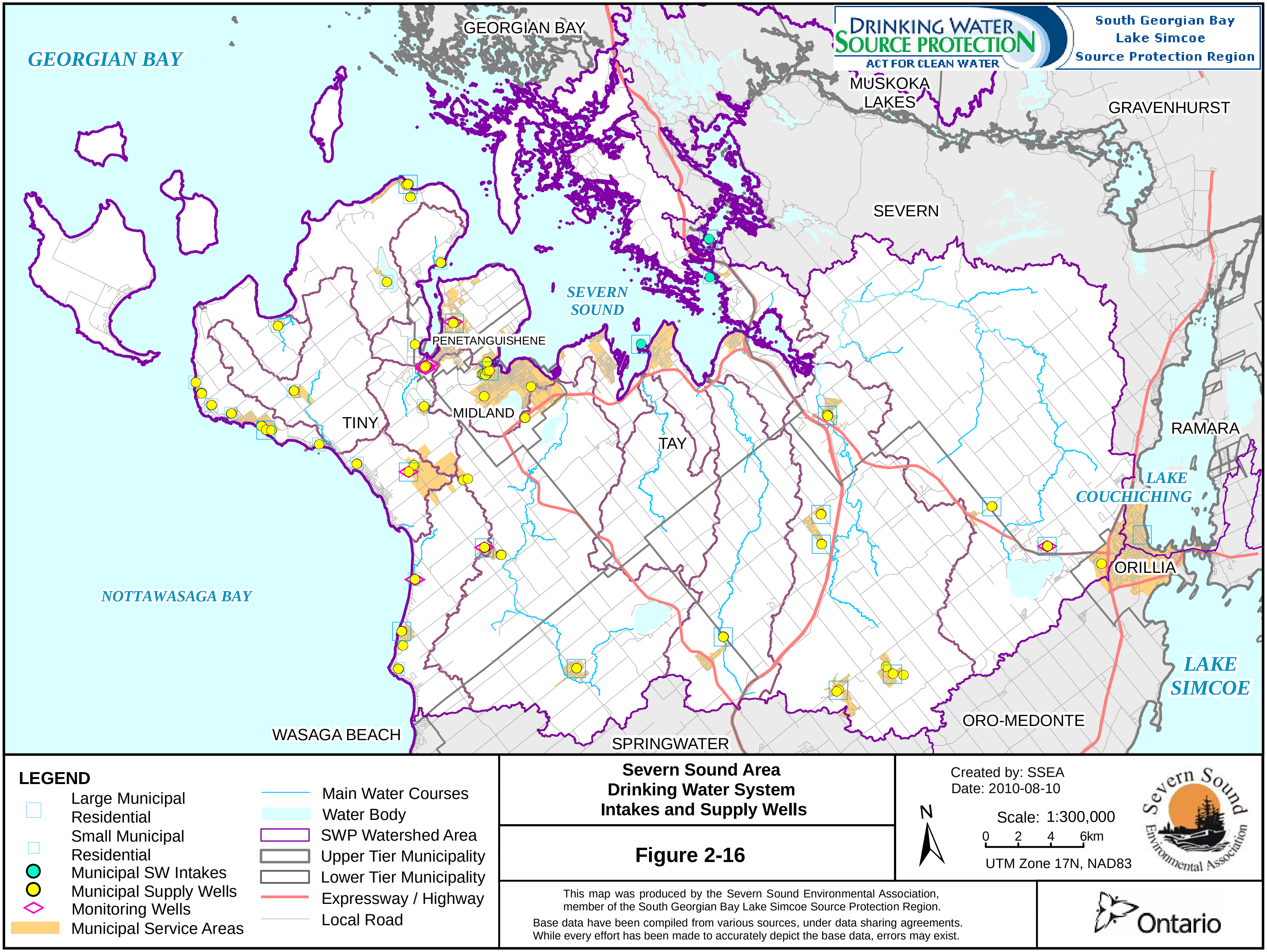


Figure 2-17: Non-Municipal Drinking Water Systems in the Severn Sound Watershed