Chapter 2

WATERSHED CHARACTERIZATION

APPROVED ASSESSMENT REPORT
for the
Grey Sauble Source Protection Area

October 15, 2015

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2.0 Watershed Characterization

The watershed characterization is a general assessment of the Grey Sauble Source Protection Area's (Grey Sauble SPA or GSSPA) fundamental natural and man-made characteristics, including current status and trends. It generally describes the physical and human qualities of the watershed by providing a compilation of existing information. Available background studies and documents were used in compiling the report and any major gaps requiring future research were identified.

A variety of land use activities occur throughout the region. Agricultural activities, such as livestock and crop farming, are common across the Source Protection Area (SPA). Forestry activities, aggregate extraction and recreational areas are also prominent in the SPA.

2.1 Source Protection Region

The Grey Sauble Source Protection Area is part of the Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region (SPR or planning region). The Saugeen, Grey Sauble, Northern Bruce Peninsula SPR consists of three Source Protection Areas (SPA): Saugeen Valley SPA; Grey Sauble SPA; and Northern Bruce Peninsula SPA (Figures 1.2.1 and 1.3.1). The Source Protection Areas and Region were established under the *Clean Water Act* by O. Reg. 284/07.

The Grey Sauble Conservation Authority Board sits as the Source Protection Authority in the Grey Sauble SPA. The Saugeen Valley Conservation Authority Board sits as the Source Protection Authority in the Saugeen Valley SPA and the Municipality of Northern Bruce Peninsula Council sits as the Source Protection Authority in the Northern Bruce Peninsula SPA. The three agencies have representatives on a Management Committee that helps to oversee the technical and financial aspects of the Drinking Water Source Protection work within the SPR.

The SPR represents approximately 8400 km^2 and has approximately 160,000 residents. The area is very diverse with two Conservation Authorities, two First Nations and 21 lower-tier municipalities. Activities by provincial, federal, and non-governmental organizations are prevalent within the region as well. The physical characteristics of the region are equally as varied. The climate is greatly influenced by Lake Huron, which includes Georgian Bay. Prominent features include the Niagara Escarpment, karst topography, various types of wetlands, and the Saugeen River system, to name a few.

Three other Source Protection Regions share a boundary with the Saugeen, Grey Sauble, Northern Bruce Peninsula SPR. To the south is the Ausable Bayfield Maitland Valley SPR, while to the east are the Lake Erie SPR and the South Georgian Bay Lake Simcoe SPR.

2.2 Grey Sauble Source Protection Area

The Grey Sauble SPA comprises approximately 3169 km^2 and corresponds with the jurisdiction of Grey Sauble Conservation. The population is about 64,000 people (Census, 2006). The Sauble River, with the largest catchment area in the Grey Sauble SPA, drains into Lake Huron. Four large watersheds drain into Georgian Bay, namely the Beaver, Bighead, Sydenham and

Pottawatomi Rivers. In addition, there are a number of fairly significant creeks draining into Georgian Bay, including Indian Brook, Little Beaver Creek, Centreville Creek, Sucker Creek (Meaford), Johnston Creek, Keefer Creek, Bothwell's Creek, Indian Creek, Big Bay Creek and Gleason Brook. The significant creeks draining into Lake Huron are Sucker Creek (South Bruce Peninsula) and Stoney Creek. Finally, there are long stretches of lake fringe that drain directly into Georgian Bay or Lake Huron (Map 2.3).

2.2.1 Jurisdictions

The area encompassed by the Grey Sauble SPA also comes under other jurisdictions, as detailed in the following sections.

2.2.1.1 Conservation Authorities

Conservation Authorities (CAs) are local environmental agencies that undertake a broad range of programs for watershed management. For more than 50 years, CAs have protected and restored resources in their watersheds using a science-based approach. CAs work in partnership with all levels of government, agricultural and rural organizations, environmental groups, landowners, businesses and residents to ensure the proper management of land and water resources. Areas of expertise and service include: watershed management; water quality and water quantity management; flooding and erosion; afforestation; natural heritage; recreation; environmental education; and agriculture and rural landowner assistance.

Grey Sauble Conservation (GSC) is the Conservation Authority within the Grey Sauble SPA. The two neighbouring Conservation Authorities are Saugeen Conservation and the Nottawasaga Valley Conservation Authority.

Grey Sauble Conservation was established in 1985 through the amalgamation of the North Grey Region Conservation Authority (est. 1957) and the Sauble Valley Conservation Authority (est. 1958). The GSC's vision is "a healthy watershed environment in balance with the needs of society" and its mission "in partnership with stakeholders of the watershed, to promote and undertake sustainable management of renewable natural resources and to provide responsible leadership to enhance biodiversity and environmental awareness" (GSC, 2005).

Flood damage prevention involves ensuring that new development is placed outside the floodplain. Flood protection is implemented through capital projects and maintenance of channels to alleviate the effects of flooding on existing structures. Significant flooding events occurred in 1947, 1948, 1967 and 1977. GSC operates several water control structures as part of its comprehensive water management program, including a flood forecasting network. In addition to its two flood control structures, Clendenan Dam and Taylor Street Detention Pond, the Authority

Figure 2.2.1 - Shallow Lake

owns and operates eight other water control structures, such as the Mill Dam in Owen Sound. These dams serve a variety of functions including recreation, waterfowl habitat, fisheries management and flow augmentation. Several have local historical significance.

Six major erosion control projects have been constructed by GSC, along with numerous smaller ones, at various locations across the watershed. The Authority continues to monitor and maintain these projects on an annual basis.

Saugeen Conservation (formally Saugeen Valley Conservation Authority) (SC or SVCA) was established in 1950 as a result of increased flooding problems in and around the communities that had developed along the Saugeen River. From its start in the Saugeen River watershed, Saugeen Conservation's jurisdiction has expanded over the years to include the Pine River, Penetangore River and several smaller watersheds draining into Lake Huron. Saugeen Conservation's vision is "a watershed where human needs are met in balance with the needs of the natural environment." In addition, its mission is "to provide leadership through co-ordination of watershed planning, implementation of resource management programs and promotion of conservation awareness, in co-operation with others" (SC, 2000).

The Nottawasaga Valley Conservation Authority borders the eastern edge of the GSC and a small section of the Saugeen Conservation jurisdiction. The jurisdictional boundaries mark the height of land that separates one watershed from another.

There is a history of cooperative activities with adjacent Conservation Authorities and this approach will be important to Source Protection. Examples of collaborative projects between neighbouring Conservation Authorities include: Healthy Futures from GSC and SC; and the Grey-Bruce Forestry Services program of GSC and SC. Due to shared issues in water sources, it is expected that CAs will work collaboratively in Source Protection.

Conservation Ontario is the provincial association of Conservation Authorities and plays a coordinating and administrative role regarding Source Protection. Regular meetings and workshop and working group activities are important in setting standards and sharing experience and approaches.

2.2.1.2 Municipalities

Municipalities are crucial to describing and assessing watersheds for the purposes of Source Protection planning. The municipalities provide drinking water, many treat sewage, and all have a range of activities and mandates which affect water quantity and quality.

There are 8 municipalities in the GSSPA. Many of these municipalities are also part of neighbouring Source Protection Areas: three in the Saugeen Valley SPA (part of the Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region); and two in the Nottawasaga Valley SPA (part of the South Georgian Bay Lake Simcoe Source Protection Region). The Grey Sauble SPA encompasses parts of Grey and Bruce Counties, with two municipalities in Bruce County and six in Grey County (Table 2.2.1). Map 2.1 shows jurisdictions and Map 2.2 shows municipal boundaries and the communities within those municipalities.

TABLE 2.2.1 – Municipalities within the Grey Sauble Source Protection Area

Municipality	*County*	*Conservation Authority Membership*
Municipality of Arran-Elderslie	Bruce	Grey Sauble SPA Saugeen Valley SPA
Town of South Bruce Peninsula	Bruce	Grey Sauble SPA
Township of Chatsworth	Grey	Grey Sauble SPA Saugeen Valley SPA
Township of Georgian Bluffs	Grey	Grey Sauble SPA
Municipality of Grey Highlands	Grey	Grey Sauble SPA Saugeen Valley SPA Nottawasaga Valley SPA
Municipality of Meaford	Grey	Grey Sauble SPA
City of Owen Sound	Grey	Grey Sauble SPA
Town of the Blue Mountains	Grey	Grey Sauble SPA Nottawasaga Valley SPA

2.2.1.3 Provincial Ministries

The Ministry of the Environment and Climate Change (MOECC) is the lead provincial Ministry for Drinking Water Source Protection. MOECC is responsible for legislation and regulations, such as the *Clean Water Act*, 2006, and *Safe Drinking Water Act*, 2002. A regional office is located in London, Ontario with an area office located in Owen Sound that houses both drinking water inspectors and environmental officers. The Ministry works to provide all Ontarians with safe and clean air, land and water. MOECC provides funding and guidance for wellhead protection area and intake protection zone delineation and drinking water systems. The MOECC is a source of information about municipal water systems and water well records.

A field office for the Ministry of Natural Resources and Forestry (MNRF) is located in Owen Sound, with the district office in Midhurst and the regional office in Peterborough. MNRF has a long working relationship with CAs in resource management, such as forestry and flood warning. The Ministry has a Conservation Authorities branch that oversees transfer payment allocation and guidance to CAs.

The Ministry of Municipal Affairs and Housing (MMAH) is responsible for the policies and programs of the Government of Ontario in relation to municipal affairs, including: coordination of programs of financial assistance to municipalities; community planning; community development; maintenance and improvement of the built environment and land development; and housing and related matters. The Western Municipal Services Office is located in London. MMAH's role in Source Protection is primarily in guidance on integrating recommendations of source protection plans into municipal by-laws and official plans.

The Ministry of Agriculture, Food and Rural Affairs (OMAFRA) provides services to rural communities, farmers and the agri-food industries. Among its roles are assisting farmers to

responsibly manage chemical inputs and animal waste to protect the environment, as well as administrating and enforcing the *Nutrient Management Act*. A resource centre is located in Clinton and satellite offices are in Walkerton and Owen Sound.

The Ministry of Northern Development and Mines (MNDM) develops and administers the *Mining Act* and provides valuable information about the province's geology. Quaternary and bedrock geology data from the Ministry will assist in the delineation of wellhead protection zones, aquifers and other groundwater features relevant to Source Protection. The nearest MNDM office is located in Sudbury.

2.2.1.4 Federal Government

Fisheries and Oceans Canada has signed an agreement with Grey Sauble Conservation to review proposed projects under section 35 of the *Fisheries Act*. Section 35 of the *Fisheries Act* deals with the management and protection of fish habitat. The Conservation Authority conducts the initial review of the project to identify any impacts to fish and fish habitat. As well, the Conservation Authority determines how the proponent can mitigate any potential impacts to fish and fish habitat. If impacts to fish and fish habitat can be mitigated, then the Conservation Authority issues a letter of advice. If impacts to fish and fish habitat cannot be fully mitigated, the project is forwarded to the local Department of Fisheries and Oceans (DFO) office for further review.

These agreements were developed to streamline day-to-day referrals in Ontario for projects that may have a shared regulatory interest between DFO and the Conservation Authorities. These agreements were put in place to improve client service with a one-window approach. Therefore, Conservation Authorities are the first point of contact for the majority of projects in and around water in Ontario (Fisheries and Oceans Canada, 2005).

Environment Canada has been an important partner in several wildlife management initiatives in the region. Perhaps the best known function of Environment Canada is weather forecasting. CA staff utilise weather data from Environment Canada to determine the likelihood of precipitation or snowmelt as part of the CA's flood forecasting program. As well, many of the streamflow gauges on local watercourses are operated by the Canadian Hydrographic Service of Environment Canada. The gauges provide real-time data on the water level and flows, which can be used, in turn, to assess when levels will peak and whether they may reach flood stage. Over the long-term, streamflow data can be used to model the behaviour of the river and improve flood forecasting abilities.

2.2.1.5 First Nations

The Chippewas of Nawash Unceded First Nation 27 reserve is at Neyaashiinigmiing (Cape Croker) near Wiarton and its related Hunting Ground 60B abuts the Bruce Peninsula National Park. The Chippewas of Saugeen First Nation 28 and 29 reserves are on the Lake Huron shoreline near Southampton and Sauble Beach, and its related Hunting Ground 60A also abuts Bruce Peninsula National Park.

The Chippewas of Saugeen First Nation and the Chippewas of Nawash Unceded First Nation, together known as the Saugeen Ojibway Nations, meet in joint council and share land claims.

They passed a resolution in joint council in September 2003 relating to Ontario's then proposed Source Protection framework. The resolution advocates for the use of the precautionary principle and traditional environmental knowledge in developing Source Protection Plans.

As part of the communication procedures for Drinking Water Source Protection, information is being provided to the First Nations about the program. To date this information has included agendas and minutes of Source Protection Committee meetings, notices about the terms of reference, notices about the Assessment Report and notices about the Source Protection Plan. The Source Protection Committee structure allows for two representatives from First Nations if the communities so choose.

2.2.2 Non-Governmental Organizations and the Public

Source Protection will use a broad scale, interdisciplinary approach to managing and protecting sources of drinking water. This implies bringing together a wide range of technical expertise, along with organizations and individuals with differing mandates and interests, in order to build a process that can incorporate analyses and values from the purely technical to the socio-political. The level of stakeholder involvement may range from invitations to contribute and the receipt of information/documentation up to extensive participation in plan development through committees and working groups.

Many non-governmental organizations (NGOs) have mandates and program activities that are relevant to Source Protection. Some will be significant stakeholders in the Source Protection planning process. A representative listing of NGOs in the Grey Sauble SPA is shown in Table 2.2.2. This list is not exhaustive, but is intended to show the range of groups interested in water- and land-related issues. The information about each organization was derived from their own websites wherever possible.

A contact database will be maintained and enhanced throughout the project to support engagement of NGOs and the public at large. There are many members of the public who have taken part in watershed-related activities and many possess extensive technical or local knowledge.

TABLE 2.2.2 – Non-Governmental Organizations in the Grey Sauble SPA

Name of Organization	***Main Interests and Activities***
Arboretum Alliance	- implementation of expansion of Arboretum at GSC office - trail development, tree planting, fundraising
Blue Mountain Watershed Trust	- coordinated Beaver River Water Quality Improvement Project - participate in tree planting initiatives - promote conservation of natural heritage features - promote landowner and public education - promote practical, efficient and ecological solutions to environmental concerns
Bruce County Federation of Agriculture	- promote best management practices - encourage stewardship

Name of Organization	Main Interests and Activities
Bruce County Woodlot Association	- encourage sustainable management of the forests in Bruce County - promote sustainable forest management by increasing awareness of the social, economic and environmental values - support community involvement in forest protection/conservation and sustainability - provide and support community workshops/activities and educational opportunities about the forest ecosystem and sustainable forestry
Bruce Peninsula Environment Group	- preserve the unique ecology of the Bruce Peninsula - promote a greater awareness of the diverse flora, fauna, geology, and cultural history of the Bruce Peninsula - encourage sustainable development - utilize education, presentations and open dialogue to communicate the importance of and the means to maintaining a healthy natural environment
Bruce Trail Conservancy	- public access to Niagara Escarpment - conservation corridor containing a public footpath along the Niagara Escarpment
Christian Farmers Federation of Ontario	- public policy development - enabling farmers to work out their Christian faith in their vocation as citizens - agricultural programs
Ducks Unlimited Canada	- wetland enhancement projects, such as Bognor Marsh - assist landowners with habitat improvement projects
East Grey Anglers and Hunters	- wildlife management - habitat enhancement
Escarpment Biosphere Conservancy	- preserve the landscape, ecology and wildlife of the Niagara Escarpment - develop and manage a system of nature reserves on which only ecologically sustainable recreational activities are permitted - secure significant habitat features through land purchase, donation or negotiation of conservation agreements
Friends of Oliphant Coastal Environments	- preserve the coastal environments of the Oliphant community - preserve the unique fen, alvar and beach/grassland ecosystems of the Oliphant mainland community and adjacent Fishing Islands.
Girl Guides	- environmental education and community service
Grey Association for Better Planning	- encourage better land use planning and policy in Grey County - identify and take action on land use that is unwise or illegal - inform the public on planning issues
Grey Bruce Children's Water Festival	- annual festival educates 2,000 Grade 4 students about water issues and the physical properties of water - promote maintenance of ground and surface water quality and quantity
Grey County Federation of Agriculture	- promote best management practices - encourage stewardship
Grey County Woodlot Association	- promote sustainable forest management by increasing awareness of the forest's inherent social, economic, and environmental values - provide technical advice about forest management and marketing

Name of Organization	*Main Interests and Activities*
Grey Sauble Conservation Foundation	- cultivate and enhance natural resource conservation - assist with purchase of environmentally sensitive, geologically unique and special natural areas - encourage research, public education and awareness of conservation related topics - trail development, interpretive signage, displays and conservation area improvements - wildlife habitat improvement - Wild Water (spring water and ice safety) Program for students
Lake Huron Centre for Coastal Conservation	- protect and restore Lake Huron's coastal environment - promote a healthy coastal ecosystem lake-wide - help local groups with environmental issues in their own communities
Nature Conservancy of Canada	- protect areas of biological diversity for intrinsic value and benefit of future generations - secure ecologically significant natural areas through purchases, donations, conservation agreements or other mechanisms - achieve long-term stewardship through management plans and monitoring arrangements
Ontario Nature	- conservation and restoration of natural habitats - education and advocacy, environmental projects, research - nature reserves
Owen Sound Field Naturalists	- natural history education - naturalization project - assist in purchase of environmentally sensitive lands - record local flora and fauna
Sauble Anglers and Hunters	- wildlife management - habitat enhancement
Saugeen Field Naturalists	- develop an appreciation and understanding of all aspects of nature - promote wise use and conservation of natural resources - encourage preservation of wild species and natural areas
Scouts Canada	- involve youth throughout their formative years in a non-formal educational process - assisting youth to establish a value system based upon spiritual, social and personal principles as expressed in the Promise and Law - environmental awareness, social responsibility, tree planting
Stewardship Grey-Bruce	- encourage individuals and local groups to be good stewards by planning and managing the natural resources on their land in a responsible manner - link landowners with information on best practices, expertise and modest resources for a wide range of environmental initiatives - restore, protect and enhance wildlife and fisheries habitat and the rich diversity of plants and animals found in Grey and Bruce counties - offer tools and resources to help landowners practice effective stewardship on the land
Sydenham Sportsmen Association	- fish ladder and artificial spawning channels on Sydenham River - fish hatchery - stream enhancement projects, including cattle fencing - wildlife management

2.3 Physical Description

A broad overview of the physical character of the Grey Sauble SPA is provided in this section. The topics include geology, topography and soils. A more in-depth analysis can be found in the Conceptual Water Budget Report for the SPR (SC, 2008). Two excellent information sources are the Grey and Bruce Counties Groundwater Study (Waterloo Hydrogeologic, 2003) and "Geology and Landforms of Grey and Bruce Counties" (Owen Sound Field Naturalists, 2004).

2.3.1 Surface Elevation

The topography (surface elevation) of the Grey Sauble SPA exhibits diversity from flat to heavily rolling, as shown on Map 2.4. Overall, elevations trend from higher ground in the southeast to lower in the west. The lowest surface elevation in the SPA is Lake Huron and Georgian Bay with a low water datum level of 176.0 masl (metres above sea level) (Canadian Hydrographic Service, 2010). The maximum elevations in the Grey Sauble SPA occur along the watershed boundary between the GSSPA and the Nottawasaga Valley SPA. The land rises to over 540 masl between Rob Roy and Singhampton near Grey Road 31 (MNR, Digital Elevation Model, 2007).

One of the dominant natural features of the Grey Sauble SPA is the Niagara Escarpment. Steep hills rise more than 200 m at the Blue Mountains, while other sections have sheer cliffs up to 60 m high that make for spectacular lookouts. The land on the lee side of the escarpment has a much gentler slope. The escarpment stays fairly close to the Georgian Bay shoreline as it winds its way through the region from Collingwood through Owen Sound and northward on the Bruce Peninsula to Tobermory. Exceptions are the deep re-entrant valleys of the Beaver, Bighead and Sydenham Rivers that extend southward for several kilometres.

The coastal fringe along Lake Huron is relatively flat and generally less than 220 masl. Central and eastern parts of the Grey Sauble SPA have lightly to heavily rolling terrain. The Bruce Peninsula consists of a rugged, bedrock plain dominated by the stark cliffs of the Niagara Escarpment along the Georgian Bay side. On the west side of the Peninsula, the land slopes very gradually toward Lake Huron. The Lake Huron coast is highly indented and numerous small islands and shoals are located offshore.

2.3.2 Bedrock Geology

Knowledge of bedrock geology is necessary for understanding bedrock aquifers and regional groundwater movement. Descriptions of the bedrock units, and an awareness of groundwater quality parameters like hardness and salinity, help to identify regional aquifers and aquitards. Information on bedrock geology in the Grey Sauble SPA includes mapping from the Ontario Geological Survey (OGS), reports on Paleozoic geology from various authors and well records in the Water Well Information System (WWIS).

General bedrock stratigraphy (that is, the character, thickness and sequence of rock units) in the Grey Sauble SPA is summarized in Table 2.3.1 (Stratigraphy) and illustrated in Map 2.5 and Figure 2.3.1. The bedrock layers shown on Map 2.5 represent the uppermost formation underlying a particular site and ranges from the Lindsay formation to the Salina formation. Other formations as shown on Table 2.3.1 lie below the uppermost formation.

Bedrock consists mainly of carbonate (limestone and dolostone) rocks, as well as some shale units that are interbedded with the limestone and dolostone. Dolostone is a hard, resistant rock and differs from limestone in that some of the calcium ions have been replaced by magnesium. The presence of dolostone promotes the formation of vertical cliffs and waterfalls as it acts to shield softer, underlying layers of rock from erosion.

The bedrock dips to the southwest at a regional slope of 5 to 7 m/km and there is a general thinning of the overburden from west to east, resulting in bedrock exposure along the Niagara Escarpment. An indication of the depth to bedrock is also shown in the distribution of historical quarry operations, which are found in the Grey Sauble SPA near Owen Sound and at numerous sites on the Bruce Peninsula.

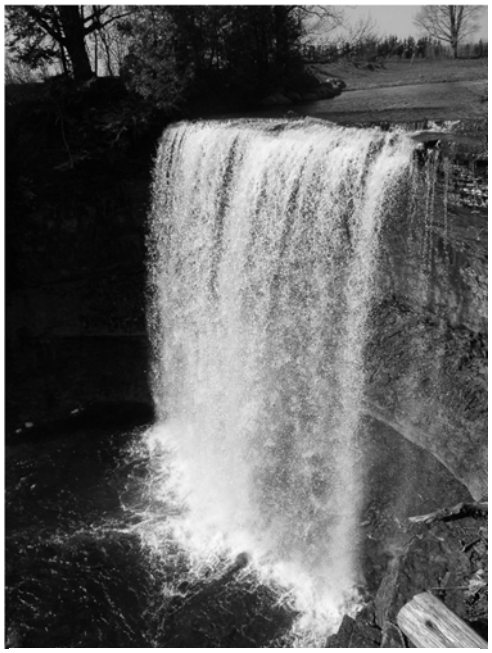

Figure 2.3.1 - Stratigraphy as seen in exposed bedrock layers at Indian Falls Conservation Area

TABLE 2.3.1 – Bedrock Stratigraphy in the Grey Sauble SPA (Waterloo Hydrogeologic, 2003)

Period	***Group***	***Formation***	***Material Type***
Quaternary	Overburden (glacially-derived gravel, sand, silt and clay)		
Upper Silurian		Bass Island	Dark-brown to buff dolostone
		Salina	Interbedded grey-brown limestone and bituminous shale
Middle Silurian		Guelph	Buff to brown medium-bedded dolostone
		Amabel	Blue-grey thick-bedded dolostone
		Fossil Hill	Buff to grey-brown fossiliferous dolostone
		St. Edmund	Cream-buff thin-bedded dolostone
		Wingfield	Olive-green argillaceous dolostone and shale
		Dyer Bay	Grey-brown dolostone
Lower Silurian	Clinton/ Cataract	Cabot Head	Maroon to green-grey non-calcareous shale
		Manitoulin	Grey fossiliferous dolostone
Upper Ordivician		Queenston	Maroon shale, interbeds of limestone and calcareous siltstone
		Georgian Bay	Blue-grey shale, interbeds of siltstone and limestone
		Blue Mountain	Blue-grey non-calcareous shale
Middle Ordivician	Simcoe	Lindsay	Limestone, argillaceous limestone, calcareous shale

Most of the limestone and dolostone units have the potential to supply adequate quantities of water. However, the water has elevated hardness due to the carbonate composition of the bedrock. The Guelph and Amabel Formations are important bedrock aquifers that occupy a band, up to 30 km wide, which extends northwest of Shelburne to Sauble Beach and up the western side of the Bruce Peninsula. Poor, natural water quantity and quality characterize the shale of the Queenston Formation, and poor, natural water quality characterizes the Salina Formation, which has elevated hardness, sulphate and chloride.

2.3.2.1 Karst Features

Karst is a distinctive type of topography, formed primarily by the dissolution of carbonate rocks, such as limestone and dolostone. These rocks are dissolved by the action of weak carbonic acid which is formed when carbon dioxide from the atmosphere or from within the soil environment dissolves in water (Owen Sound Field Naturalists, 2004). The chemical action pits the surface of rocks and enlarges vertical cracks and horizontal bedding planes. Over time, groundwater flow conduits increase in size and aquifers with large conduits are created, thereby lowering the water table below the level of surface streams. These surface streams and drains may begin to lose water to developing cave systems underground. As more surface drainage is diverted underground, streams may disappear and become replaced by closed basins called sinkholes. Sinkholes vary from small cylindrical pits to large conical or parabolic basins that collect and funnel runoff into karst aquifers (Ford and Williams, 1989).

Groundwater flow in karst areas is significantly different from that of other aquifers because of the solutionally enlarged conduits. Groundwater in bedrock aquifers generally moves slowly. In karst aquifers, groundwater flowing in enlarged conduits can have velocities approaching those of surface streams. The nature of this flow system makes karst areas highly susceptible to groundwater contamination (Ford and Williams, 1989).

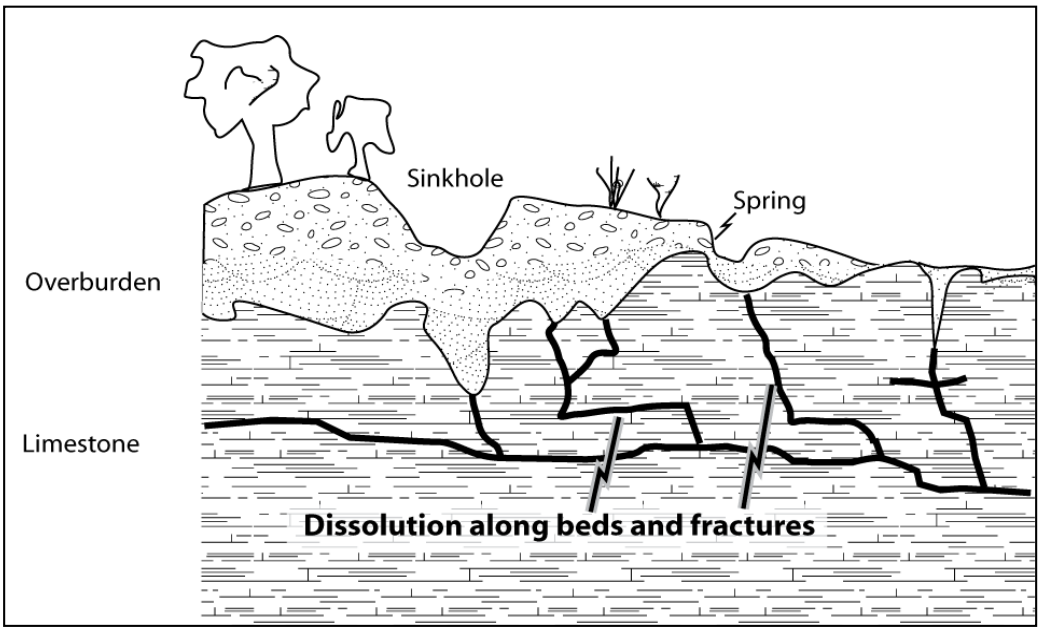

Figure 2.3.2 - Karst formation (after USDI, 2006)

Shallow karst aquifers are vulnerable to contamination because they can receive recharge in two ways. They can receive surficial recharge through the soil profile, and concentrated recharge from surface streams and drains that flow directly into the aquifer at sinkholes.

Extensive areas of karst occur in the Grey Sauble SPA. The Niagara Escarpment has several large karst areas, such as: near the ski hills in The Blue Mountains; along the Beaver Valley; south of Meaford; between Meaford and Owen Sound; and to the north of Owen Sound. Other karst areas can be found near Shallow Lake, Walter's Falls and west of Kolapore. A study on karst in the planning region was completed by Waterloo Hydrogeologic (2005), which contains a Geographic Information Systems (GIS) database of karst areas. For a good description of karst landforms, see the Guide to the Geology and Landforms of Grey and Bruce Counties (Owen Sound Field Naturalists, 2004).

The Grey County Official Plan states: "A Special Policy Area is applied to those lands, which possess or are expected to possess shallow overburden with karst topography. The combination of the two features have the potential of being extremely sensitive, thus requiring further in-depth study through an Environmental Impact Study prior to any development being permitted" (Grey County Official Plan, 2.8.4).

2.3.3 Surficial Geology

Glacial deposits remaining after the last glaciation determine the current physiography of the region, the nature and distribution of surficial aquifers, groundwater discharge and recharge areas, and the sand and gravel deposits. Much of the Grey Sauble SPA is covered by till, which typically transmits water slowly (i.e. has a low hydraulic conductivity) because of its fine-textured character. In contrast, there are also sand plains and glaciofluvial sand deposits (spillways), which have higher hydraulic conductivities because of their coarse-textured character (Waterloo Hydrogeologic, 2003). A summary of the Quaternary deposits in the Grey Sauble SPA is presented in Table 2.3.2.

The surficial geology left by the glaciers is highly varied over the Grey Sauble SPA, as illustrated in Map 2.6. The physical features of the land surface are illustrated in Map 2.7, Physiography.

The majority of the Grey Sauble SPA is occupied by the Elma Till. The Elma Till, which is a carbonate-derived silty to sandy till, occurs as ground moraine and is associated with the Singhampton Moraine.

The Catfish Creek Till is the oldest till in the Grey Sauble SPA and outcrops near the boundary with the Saugeen Valley SPA and the Nottawasaga Valley SPA southeast of Maxwell. The Newmarket Till is a silty to sandy till that outcrops in a small area of the SPA near the boundary with the Nottawasaga Valley SPA. The St. Joseph Till is a glaciolacustrine-derived till that occurs in the Williscroft Moraine north of Chesley and forms the divide between the Grey Sauble SPA and the Saugeen Valley SPA from west of Dobbinton eastward to Holland Centre.

Glaciolacustrine shoreline deposits occupy substantial portions of the southern half of the Grey Sauble SPA, as well as near Meaford, Thornbury, Owen Sound and Sauble Beach. These are largely well-sorted glaciolacustrine sand deposits that host a fairly significant shallow aquifer.

TABLE 2.3.2 – Summary of Quaternary Deposits and Events in the Grey Sauble SPA (Waterloo Hydrogeologic, 2003; after Karrow, 1993 and 1977; also Metcalfe et al, 2005)

Deposit or Event	*Lithology*	*Morphologic Expression*
Modern alluvium and organic deposits	Silt, sand, gravel, peat, muck, marl	Present day rivers and flood plains
Lacustrine deposits	Silt and clay	Flat-lying surficial deposits
Outwash	Sand, gravel, some silt	Mainly buried (end moraine)
Ice Contact	Sand, gravel	Kames and eskers
St. Joseph Till	Calcareous, silt to silty clay till	Surficial till
Elma Till	Silt till	Lower stony till
Newmarket Till	Sandy silt to silt matrix, moderate to high in matrix carbonate content	Surficial till
Dunkeld Till	Calcareous silt till	Surficial till
Elma Till	Calcareous, silt, sandy silt and clayey silt till	Surficial till, ground moraine, Singhampton Moraine
Lacustrine deposits	Silts	Wildwood Silt deposits
Catfish Creek Till	Stoney, sandy silt to silt till	Buried

Glaciofluvial ice-contact and outwash deposits occur in southern parts of the Grey Sauble SPA. These deposits are generally composed of sand and gravel deposits that host numerous small, shallow aquifers.

A bedrock-drift complex occurs over large areas in the north of the Grey Sauble SPA where the bedrock is covered by a thin veneer of till. Modern alluvial deposits are found in the floodplains of many rivers in the Grey Sauble SPA, while lacustrine deposits occur along the Georgian Bay shore near Meaford and Owen Sound and east of Sauble Beach. Organic deposits are associated with wetlands.

2.3.3.1 Overburden Thickness

Overburden thickness is essentially the thickness of the unconsolidated glacial sediments over top of bedrock. Overburden thickness is an important hydrogeologic parameter to review, because it is one of the major parameters that control the amount of protection for underlying surficial and bedrock aquifers. Overburden thickness and grain size distribution control the infiltration rate, and the rate of movement of surface contamination, into these aquifers.

Areas of minimal overburden and exposed bedrock occur mainly along the Bruce Peninsula. Elsewhere, a maximum thickness of up to 80 metres is associated chiefly with bedrock depressions. Two such bedrock depressions underlie the Beaver and Bighead Valleys, with a maximum overburden thickness of 60 m and 80 m, respectively.

2.3.4 Physiography

The dominant surficial features of the Grey Sauble SPA are shown on Map 2.7, and are based on the Physiography of Southern Ontario (Chapman and Putnam, 1984).

The Bruce Peninsula consists largely of exposed dolostone plains, with thin overburden throughout. The irregular topography of the bedrock surface results in many small lakes and swamps on the Peninsula. Similarly, limestone plains can be found in the eastern part of the Grey Sauble SPA between the Bighead and Beaver River valleys and east of the Beaver Valley.

Beaches and shore cliffs extend along and parallel to the Georgian Bay shoreline and from Southampton through Hepworth. Coarse-textured glaciolacustrine deposits make up the sand plains of the Huron Fringe from Southampton to Pike Bay and inland as far as Hepworth. This area comprises wave-cut terraces of glacial Lakes Algonquin and Nipissing along the Lake Huron shore.

Shale plains, known as the Cape Rich Steps, are located between Owen Sound and Nottawasaga Bay. This area consists of Paleozoic bedrock overlain by shallow overburden, with the plain being incised by the Beaver Valley (in the Thornbury area) and the Bighead Valley (in the Meaford area).

The Port Huron Moraine system, consisting of glaciofluvial and ice-contact stratified deposits (kames), extends east and west from the head of the Beaver Valley. Moraines are also found between Tara and Owen Sound. An esker (a winding ridge of sand and gravel) extends from east of Dobbinton to east of Tara. Kames (hills composed of sand, gravel and till) occur south of Owen Sound and south of Flesherton.

The Arran drumlin field, at the base of the Bruce Peninsula, contains over two hundred drumlins (drop-shaped hills). Another large drumlin field occurs between Owen Sound and Meaford and as far south as Chatsworth and Walter's Falls. East and west of the Beaver Valley are drumlinized till plains, with a small drumlin field east of Lake Eugenia. The ground moraine is thin with many of the drumlins located directly on bedrock. The till is a stone-poor, carbonate-derived silty to sandy deposit.

Clay plains are found in small areas around Wiarton and in the Beaver River and Bighead River valleys. A very large clay plain occurs from Allenford south through Tara and east to Chatsworth.

2.3.5 Soil Characteristics

Soil conditions in the Grey Sauble SPA are illustrated in Map 2.8-Soil Texture. Texture refers to the size of the particles making up the soil, such as clay, silt and sand. Drainage describes the relative rate at which water will pass through the soil horizon. Soil type refers to the named categories of soil based upon texture, parent material, drainage and other characteristics.

The soils in the Grey Sauble SPA have developed under a temperate climate. A broad range of soil types are represented from the following soil groups: Dark Grey Gleisolic; Grey-Brown Podzolic; Brown Forest; and intergrades of the Grey-Brown Podzolic and Brown Forest.

The Breypen series does not consist of any particular soil type, but is largely exposed bedrock with small pockets of soil materials and muck. Drainage in this area is variable. In the Grey Sauble SPA, the Breypen series covers 11.1% of the landscape. Breypen is found in areas near the Niagara Escarpment from west of Meaford through Owen Sound and around to Wiarton, as well as northwest of Hepworth. Most of the Bruce Peninsula north of Wiarton has Breypen soils.

Close to the Lake Huron coast, sandy soils of the Plainfield and Fox series occur. Areas of organic soils are found near the coast also and in low-lying areas associated with the inland lakes, such as Boat Lake and Isaac Lake.

Southwestern areas of the Grey Sauble SPA are predominantly covered by the Harkaway series, which are well drained, loamy or silty soils that are susceptible to erosion. They are associated with drumlinized land and usually have a smooth, moderately sloping topography, but steep slopes occur where land has been dissected by streams. Pockets of the Elderslie series and Chesley series, which have more clay components than the Harkaway series, are also found in this area. Overall in the Grey Sauble SPA, the Harkaway series occurs over 16.5% of the area, while the Chesley series occurs over 3.0% of the area.

Southeastern portions are covered by the Osprey series, which is developed on stony till and is generally well drained. The topography consists of steep irregular slopes that are very susceptible to erosion. The Osprey series is also common in the central part of the Grey Sauble SPA. Areas extending along the Beaver and Bighead Rivers are predominantly covered by the Vincent series of soils. These soils are characterized by well-drained till with moderate to steep slopes (Hoffman & Richards, 1954). The Osprey series covers 14.7% of the Grey Sauble SPA, while the Vincent series covers 10.7%.

2.4 Surface Water Hydrology

Surface water hydrology refers to the way water flows over the land surface. Map 2.3 illustrates the watersheds in the Grey Sauble SPA, as well as the water control structures on the watercourses. Table 2.4.1 summarizes statistics about the watercourses. Section 3.2.1 of this report provides information about precipitation and temperatures. The Water Budget Report (SC, 2008) gives a thorough treatment of watercourses, aquifers, climatic normals and climatic trends.

The Grey Sauble SPA is drained by five major river systems and numerous smaller streams. The Sauble River is the largest of these watercourses. The main branch begins near Desboro within the Arran Drumlin Field and flows in a northwesterly direction to enter Lake Huron north of Sauble Beach. Several lakes are within the Sauble River's watershed, including Gould, Chesley and Arran Lakes. The main tributary is the Rankin River, which drains Berford, Sky, Issac and Boat Lakes, and joins the main Sauble River just upstream of Sauble Falls.

Other notable rivers within the Grey Sauble SPA are the Pottawatomi, Sydenham, Bighead, and Beaver Rivers. The Pottawatomi River flows from the southern parts of the Township of Georgian Bluffs in a northeasterly direction into the west side of Owen Sound and out to the harbour. The Sydenham River rises in the central part of the Township of Chatsworth and flows in a northerly direction. It plunges over Inglis Falls and flows through downtown Owen Sound before ending at the harbour. The Bighead and Beaver Rivers collect numerous small creeks,

headland swamps and spring-fed streams. The Bighead River begins in the northeastern part of the Township of Chatsworth. It travels north and then east through rolling terrain and enters Georgian Bay at Meaford. Finally, the Beaver River travels from its source east of Feversham westward into Eugenia Lake. It then descends over Eugenia Falls into a broad, deep valley on a northerly course to Georgian Bay at Thornbury.

TABLE 2.4.1 – River Systems in the Grey Sauble SPA (MNR, Digital Elevation Model, 2007)

Subwatershed	*Area of Sub-watershed (km^2)*	*Elevation at Headwaters (masl)*	*Elevation at Mouth (masl)**	*Change in Elevation (m)*	*Length of Stream (km)*	*Slope of Stream (m/km)*
Grey Sauble SPA						
Beaver River	617.5	510.1	176.0	334.1	76.1	4.4
Big Bay Creek	9.3	230.0	176.0	54.0	3.7	14.7
Bighead River	350.9	321.0	176.0	145.0	52.6	2.8
Bothwell's Creek	63.1	265.0	176.0	89.0	14.2	6.3
Gleason Brook	44.9	242.2	176.0	66.2	21.3	3.1
Indian Brook	34.0	473.4	176.0	297.4	16.5	18.0
Indian Creek	81.1	230.0	176.0	54.0	14.2	3.8
Johnson Creek	19.0	298.1	176.0	122.1	12.0	10.2
Keefer Creek	38.8	287.5	176.0	111.5	13.7	8.1
Little Beaver River	14.4	356.5	176.0	180.5	6.5	27.7
Orchard Creek	14.1	324.9	176.0	148.9	10.1	14.8
Pottawatomi River	113.2	244.3	176.0	68.3	18.4	3.7
Rankin River	221.8	205.1	180.1	25.1	21.7	1.2
Sauble River	692.8	244.5	176.0	68.5	86.1	0.8
Stoney Creek	31.2	218.5	176.0	42.5	15.1	2.8
Sucker Creek (S. Bruce Peninsula)	46.4	205.5	176.0	29.5	15.5	1.9
Sucker Creek (Meaford)	36.7	304.1	176.0	128.1	14.5	8.9
Sydenham River	198.7	322.7	176.0	146.7	40.9	3.6
Waterton Creek	57.1	352.8	176.0	176.8	20.8	8.5

* Chart Datum for Lake Huron and Georgian Bay is 176.0 m based on IGLD 1985 (Canadian Hydrographic Service, 2007)

2.5 Naturally Vegetated Areas

Wetlands, wooded areas and vegetated buffers are part of a healthy watershed. The natural capacity to filter or alter contaminants, as well as trap sediments and soil, can help protect drinking water sources.

The extensive river systems of the Grey Sauble SPA, and the lands adjacent to them, are home to a diverse and abundant variety of plant and animal species. The zones where water meets land, the riparian zones, are of particular importance, as these areas can be among the richest and most

productive ecological zones within a watershed. The riparian zone protects a river by providing a buffer between the river and the intensively used urban and farm land on which much of our economy depends. They also protect people and property by keeping floodplain land intact.

Riparian zones are ecological water users. The health and extent of all the plant and animal components of these zones rely on the water. A better quality of water available to the species within these zones makes for healthier riparian zones.

Like the riparian zones along our shorelines, the wetlands throughout the watershed region are also important ecological features and an ecological water user. They provide habitat for an array of plants and animals. Wetlands play a role in preventing floods and droughts and also improve the quality of water.

Our society has not always respected riparian zones and wetlands. Over the years, many of the wetlands and riparian zones have been cleared and farmed or built upon. It has been estimated that 70% of the wetlands within the region have been lost. In some cases, cultivated land extends to the very top of stream and river banks. This situation provides no natural erosion protection and provides an opportunity for direct runoff from agricultural land into rivers and streams. Many farm operations still provide cattle access to watercourses, which further accelerates erosion rates and degrades water quality. Many of our urban areas have also degraded riparian zones by filling and developing these areas, thus making them prone to erosion and flooding from either the river or from storm water.

By working to protect, preserve, and rehabilitate these ecological features and users of water, and by providing them with exceptional water quality, we in turn will have a healthier watershed where sources of water are more easily protected.

2.5.1 Wetlands

The Grey Sauble SPA has a diverse mix of wetland types that cover approximately 235 km^2 (7.4% of the SPA) as shown on Map 2.9. Table 2.5.1 lists the percentage of land area that wetlands occupy in the subwatersheds of the SPA. There are several sites that have been classified as provincially significant and are highly regarded for their natural features.

Four types of wetlands are recognized under the Ontario Wetland Classification System: bog, fen, marsh and swamp. Swamps are wooded wetlands with 25% cover or more of trees or tall shrubs. Standing to gently flowing water occurs seasonally or persists for long periods on the surface. Marshes are wet areas periodically inundated with standing or slowly moving water, and/or permanently inundated areas characterized by robust emergents and, to a lesser extent, anchored floating plants and submergents. Fens are peatlands characterized by surface layers of poorly to moderately decomposed peat, often with well-decomposed peat near the base. The waters and peat in fens are less acid than in bogs. Bogs are peat-covered areas or peat-filled depressions with a high water table and a surface carpet of mosses, chiefly *Sphagnum*. The water table is at or near the surface in the spring, and slightly below during the remainder of the year.

Only about two-thirds of the wetland areas shown on Map 2.9 are classed by the four types, while the remainder have not been delineated under the classification system.

TABLE 2.5.1 – Wetlands as a Percentage of Land Area in Subwatersheds in the Grey Sauble SPA (Derived from data in MNR's Natural Resources Values Information System (NRVIS))

Subwatershed	*Area of Subwatershed (km^2)*	*Total Area of Wetlands (km^2)*	*% of Subwatershed Covered by Wetlands*
Grey Sauble SPA			
Beaver River	617.51	52.01	8.42
Big Bay Creek	9.33	1.61	17.26
Bighead River	350.89	15.24	4.34
Bothwell's Creek	63.10	0.49	0.78
Gleason Brook	44.92	4.41	9.83
Indian Brook	33.96	0.10	0.30
Indian Creek	81.07	8.73	10.77
Johnson Creek	19.03	0.08	0.44
Keefer Creek	38.82	1.97	5.06
Little Beaver River	14.36	0.00	0.00
Orchard Creek	14.08	0.02	0.16
Pottawatomi River	113.22	21.72	19.18
Rankin River	221.76	29.08	13.11
Sauble River	692.80	59.73	8.62
Stoney Creek	31.22	4.89	15.67
Sucker Creek (S. Bruce Peninsula)	46.39	4.28	9.23
Sucker Creek (Meaford)	36.73	0.12	0.34
Sydenham River	198.72	15.76	7.93
Waterton Creek	57.10	0.11	0.20
TOTAL	2685.0	220.3	8.21

There are few coastal marshes in the SPA, with the exception of the Howdenvale and Oliphant areas. The Lake Huron and Georgian Bay shorelines in general are exposed to wave action and do not afford the shallow and sheltered waters that promote marsh development. Lacustrine marshes are located along the margins of many lakes in the SPA, such as: Eugenia Lake Wetland (287 ha marsh); Arran Lake Wetland (390 ha marsh); McNab Lake Wetland north of Shallow Lake (205 ha marsh); and the Mountain Lake-Skinners Marsh Complex, also north of Shallow Lake (370 ha marsh). The largest marshland in the SPA is the Rankin River Wetland northeast of Sauble Beach, of which 60% or 1639 ha is classified as marsh and the remainder as swamp.

Swamp is the most abundant wetland type and is a component of the majority of wetland complexes in the SPA. Pockets of swamp can be observed in low-lying areas near watercourses where they provide storage capacity and alleviate downstream flooding in times of high water. The Long Swamp, located west of Springmount and north of Highway 21, covers over 1300 ha. Other notable sites are: Arran Lake Wetland (840 ha swamp); Beaver Valley Lowlands Wetland

(719 ha swamp); Eugenia Lake Wetland (1016 ha swamp); Rankin River Wetland (1008 ha swamp); and Shouldice Wetland east of Shallow Lake (868 ha swamp). (Map 2.9)

Very few bogs are located in the Grey Sauble SPA. The only evaluated bogs in the SPA are within the Rankin River Wetland (3 ha bog), Shouldice Wetland (9 ha bog) and Little Germany Wetland Complex to the north of Lake Eugenia (3 ha bog).

Fens are found at more than twenty sites in the Grey Sauble SPA, although the fens are generally less than 10 ha in size and occur as part of larger wetland complexes. The largest fen areas are found at: Chiefs Point Wetland on the Saugeen First Nation (30 ha fen); Oliphant Wetland (33 ha fen); and Sucker Creek Wetland near Owen Sound (27 ha fen). The Sangs Creek Fen, located east of Southampton and south of Highway 21, has a 14 ha component with buckbean and pitcher plants.

Table 2.5.2 contains a listing of the features of evaluated wetlands in the SPA. The table was compiled from information from the Natural Heritage Information Centre of the MNR and includes information only about those wetlands in the Grey Sauble SPA for which evaluations have been completed.

TABLE 2.5.2 – Wetlands Database for the Grey Sauble SPA (Natural Heritage Information Centre, 2010)

Name	*NHIC ID*	*Area (ha)*	*Significance*	*UTM Centroid (Zone 17)*		*County*
				Easting	*Northing*	
Albemarle Brook Wetland	7903	239.1	Provincial	484500	4966500	Bruce
Allenford Station Wetland	7904	446.4	Provincial	489000	4931000	Bruce & Grey
Arran Lake Wetland	7905	1235.6	Provincial	478800	4922500	Bruce
Bannister Swamp Wetland Complex	10526	413.6	Provincial	480000	4941000	Bruce
Beaver Valley Lowlands Wetland	10495	744.6	Provincial	537500	4920500	Grey
Beaverdale Bog Wetland	10494	124	Provincial	529000	4918000	Grey
Big Mud/Little Mud Lakes Wetland	7906	215.2	Provincial	487000	4960000	Bruce
Bognor Marsh Wetland	8132	146.9	Provincial	516700	4932400	Grey
Chesley Lake Wetland	10527	204.5	Local	482000	4933000	Bruce
Chiefs Point Wetland Complex	7419	167.6	Provincial	478800	4948200	Bruce
Clavering Creek Wetland	8106	160.2	Provincial	488500	4945500	Bruce
Congers Creek Wetland	10493	185.6	Local	509200	4920300	Grey
Eugenia Lake Wetland	8108	1303.1	Provincial	546000	4908000	Grey
Flesherton Swamp	10496	337.8	Provincial	533300	4904000	Grey

Name	NHIC ID	Area (ha)	Significance	UTM Centroid (Zone 17)		County
				Easting	Northing	
Gleason Lake Wetland	10522	81.8	Provincial	497900	4957800	Grey
Gould Lake Wetland	8111	189	Provincial	482500	4936800	Bruce
Headwaters to Pottawatomi River Wetland	8112	304.8	Provincial	494500	4930000	Grey
Hell Hole Wetland	8113	106.5	Provincial	481000	4945000	Bruce
Hoath Head Wetland	8992	139	Local	513200	4929500	Grey
Howdenvale Bay Wetland	7185	36.5	Provincial	476700	4962800	Bruce
Indian Creek Wetland	8114	257.8	Provincial	502000	4954000	Grey
Little Germany Wetland Complex	8118	343.4	Provincial	542000	4914400	Grey
Long Swamp	8119	1439.6	Provincial	497700	4934700	Grey
Marshall's Lake Wetland	10488	74.9	Local	510900	4926500	Grey
McGill Lake Wetland	8121	152	Provincial	514000	4926000	Grey
McNab Lake Wetland	8124	431.8	Provincial	493400	4943500	Grey
Mountain Lake Skinner Marsh Wetland Complex	8127	1092.6	Provincial	496000	4950000	Grey
North Spey Wetland Complex	10491	261.4	Local	509500	4926400	Grey
Oliphant Wetland	177	173	Provincial	478000	4953000	Bruce
Oxenden Creek Wetland	10524	345.1	Provincial	493500	4954500	Grey
Rankin River Wetland	7880	2749.6	Provincial	483000	4955400	Bruce
Red Bay Wetland Complex	7457	353.1	Provincial	477800	4961500	Bruce
Rocklyn Swamp	10483	318.8	Provincial	533000	4925000	Grey
Sangs Creek Fen	10478	179.1	Provincial	477600	4927400	Bruce
Shallow Lake Wetland	7881	449	Provincial	493100	4938500	Grey
Shouldice Wetland	7882	886.4	Provincial	498000	4941000	Grey
Skipness Complex and Manchester Lake Wetland	7883	157.3	Provincial	485000	4934700	Bruce
Slough of Despond Wetland	10505	172	Local	502000	4957500	Grey
Sucker Creek (Owen Sound) Wetland	7191	146	Provincial	475500	4964500	Bruce
Swamp North of Beattie Lake	10499	109.7	Provincial	477300	4966800	Bruce
Sydenham River Lowlands Wetland	10482	500.4	Local	505000	4926000	Grey
Tara Wetlands	7885	131.2	Provincial	492300	4917400	Bruce & Grey

Name	NHIC ID	Area (ha)	Significance	UTM Centroid (Zone 17)		County
				Easting	Northing	
The Glen Wetland	7886	384.6	Provincial	501500	4944500	Grey
Townline Lake Wetland	8998	118	Local	494500	4933600	Grey
Unnamed (Sutherland Project) Wetland	10504	1.8	Local	500700	4942500	Grey
Walters Creek Wetland	10487	106	Local	523500	4923500	Grey
Wiarton Wetland Complex	10525	213.7	Local	489000	4950000	Bruce & Grey
Wodehouse Marsh Wetland	10486	516	Local	531500	4918000	Grey

2.5.2 Woodlands and Vegetated Riparian Areas

Woodlands can increase infiltration to shallow groundwater areas and decrease the speed of overland flow. Map 2.10 shows the naturally vegetated areas in the Grey Sauble SPA.

The riparian zone is the land adjacent to rivers and streams. The riparian zone has no definite boundaries, but is the larger transitional area between the water surface and the upland (Ontario Cattlemen's Association, 2005). Vegetation contributes to the functions of the riparian zone and can vary greatly from lush forest or dense brush to grassy meadow or muddy bank. Riparian areas control the flow of water, sediments, nutrients and organisms between the upland and aquatic communities. They act as wildlife corridors, help in-stream water quality, serve as reservoirs for flood waters, control erosion and may contribute to groundwater recharge.

2.5.2.1 Woodlands

The SPA features hardwood forests characteristic of the Great Lakes-St. Lawrence Lowlands forest type. Prior to, and at the time of settlement, extensive forests covered the SPA. Across a large portion of the watershed, forests were removed to make way for agricultural crops. As a result, by the early 1880's these once-forested areas were reduced to the farm woodlots that can be observed today. In many places, the cleared land proved to be marginal farm land and was later abandoned or removed from farming. Natural regeneration and tree planting programs have returned some of this land to forest cover.

The western half of the Grey Sauble SPA has more than 35% forest cover according to the Grey Sauble Watershed Report Card (GSC, 2009). In southwestern and eastern parts of the Grey Sauble SPA, land clearing has created a more fragmented set of woodlands. The Sauble River watershed (southern portion) has "fair" forest cover of 15 to 25%, while the Bighead River and Beaver River watersheds had "good" coverage of 25 to 35%. The lowest percent of forest cover is in the Little Beaver River watershed west of Thornbury with less than 15% forest cover. In general, steep hillsides and swampy lowlands remain forested. The remaining pockets of forest in the agricultural areas tend to be isolated woodlots back in from roadways, sometimes referred to as "the back forty". These smaller blocks do not provide "interior" habitat that is

preferred by certain wildlife and plant species; however, the woodlands still provide valuable ecological functions.

2.5.2.2 Vegetated Riparian Areas

More than half of the GSC's watershed has treed riparian zones along 25 to 50% of the length of the streams. Waterton Creek and the southern portion of the Sauble River have the least proportion of treed riparian zone at between 12.5 to 25% according the Grey Sauble Watershed Report Card (GSC, 2009). The Sydenham River, the Rankin River and the northern portion of the Sauble River have between 50 and 75% treed riparian zone.

Extension programs and the promotion of best management practices have increased the occurrence of vegetated riparian buffers and reduced the number of farms where cattle are allowed to directly access watercourses and riparian areas. A buffer strip is a strip of vegetation that has been planted or left beside a natural area to protect it from surrounding land uses. A buffer strip has many important functions and benefits. A properly functioning buffer strip acts as a living filter, trapping and treating sediments and other minerals. Buffer strips also help in stabilizing stream banks and preventing soil erosion. They also increase the soil's water-holding capacity, reducing the impacts of flooding and droughts. A healthy riparian and buffer zone provides fish and wildlife habitat through added shade, cleaner and cooler water and superior plant variety (Ontario Cattlemen's Association, 2005).

Map 2.10 shows riparian areas in the Grey Sauble SPA. Forest and other vegetation classes were intersected with stream corridors throughout the watershed to determine the spatial extent of the riparian areas that had vegetative cover.

2.6 Aquatic Ecology

Comprehensive Source Protection offers ancillary benefits beyond protecting water for drinking purposes. Maintaining high standards for drinking water also provides a necessary medium for healthy aquatic flora and fauna, terrestrial wildlife, and recreational opportunities. Aquatic plants and animals (fish, macroinvertebrates) serve as a feedback, or indicator, of present water quality characteristics. Having a good understanding of species richness and diversity provides information on water quality trends within streams over time based on the presence and/or absence of aquatic organisms. Aquatic organisms can be an initial indication of perturbations within a stream network.

2.6.1 Fisheries

The fisheries studies completed in the SPA are done by the MNR, the federal Department of Fisheries and Oceans and consultant companies. Grey Sauble Conservation does not have a fisheries department. The SPA has a diverse amount of fish inhabiting the water. Categorization (i.e. coldwater vs. warmwater) of streams in Grey and Bruce Counties is provided in the Owen Sound District Fisheries Management Plan, 1986-2000, Ontario Ministry of Natural Resources. This document serves as the primary tool for planning purposes in this region.

The thermal regime for streams in the Grey Sauble SPA is illustrated in Map 2.11 and listed in Table 2.6.1.

TABLE 2.6.1 – Classification by Thermal Regime of Streams in the Grey Sauble SPA (MNR, 2000)

Grey Sauble SPA	
Subwatershed Name	***Thermal Regime: Streams***
Beaver River	**Cold:** Beaver River, Black's Creek, Blind Creek, Eugenia Falls, Flesherton Creek, Kolapore Creek, Little Beaver River, Mill Creek **Cold/Cool**: Boyne River, Wodehouse Creek **Cool:** Lake Eugenia Tributary, Wilcox Lake Tributary **Cool/Warm**: Duncan Lake Tributary
Big Bay Creek	**Cool:** Big Bay Creek
Bighead River	**Cold:** East Minniehill Creek, Minniehill Creek, Rocklyn Creek, Walter's Creek **Cold/Cool**: Bighead River
Bothwell's Creek	**Cold:** Bothwell's Creek
Gleason Brook	**Cold:** Gleason Brook
Indian Brook	No data
Indian Creek	No data
Johnson Creek	**Cool:** Johnson Creek
Keefer Creek	**Cool:** Keefer Creek
Little Beaver River	No data
Orchard Creek	**Cold:** Orchard Creek
Pottawatomi River	**Cold:** Davidson Creek, Maxwell Creek **Cold/Cool**: Pottawatomi River **Cool:** Kilsyth Creek
Rankin River	**Cold:** Albemarle Brook, Clavering Creek, Givens Creek **Cool:** Rankin River
Sauble River	**Cold:** Arkwright Creek, Cashore Creek, Desboro Creek, Grimston Creek, Keady Creek, Maryville Creek, Sauble River, Spring Creek, Tara Creek **Cool:** Hepworth Creek, Kirkland Creek, Parkhead Creek, Sauble River Tributary
Stoney Creek	**Cold:** Stoney Creek
Sucker Creek (S. Bruce Peninsula)	**Cold:** Sucker Creek
Sucker Creek (Meaford)	No data
Sydenham River	**Cold:** Armstrong Creek, Conger's Creek, Marshall's Lake Tributary, North Spey River, Spey River, Sydenham River
Waterton Creek	**Cold:** Waterton Creek
Lake Fringe	**Cold:** Colpoy's Creek, Mallard Creek, Sunnyside Beach Creek, Walser Creek

Most streams and inland lakes in the SPA would be categorized as coldwater from the significant input of groundwater in the SPA. Although coolwater and warmwater fish species are important from a management perspective, the most desirable and the highest level of management typically required in streams and inland lakes is for coldwater species. The Fisheries Management Plan strives for ideal conditions that support healthy fish stocks, which indirectly helps maintain stream water quality by providing essential forest cover, protection of recharge areas, wetlands, and other natural features. As the regime of the stream changes, most often the

fish species will change, which may be an indicator of degradation in suitable aquatic and drinking water conditions.

Limited thermal studies exist in the watershed region and few are recent. There are ongoing temperature studies being done by Grey Sauble Conservation, which commenced in 1999; however, they are not directly related to fisheries but do help indicate coldwater and warmwater streams. One such study was completed on the Bighead River in Grey County (Henderson, Paddon and Associates Ltd., 1999). The purpose of the study was to evaluate the thermal stability within the watershed. The study concluded that coldwater and coolwater fish habitat, typically first and second order streams, are few and are sensitive to external stresses such as human-made and beaver dams, vegetative cover, and interference from livestock. The study identified varying rates of thermal change and classified the warming rates.

2.6.2 Aquatic Macroinvertebrates

Macroinvertebrates (MIs) are easy to study and serve as a good indicator of water quality conditions. MIs are readily available within the stream network, exhibit different responses among species, are not highly mobile, and can provide evidence of conditions over time. Bio-monitoring of this sort is not without its problems. Although most problems can be overcome with the correct experimental design, MIs may not necessarily react to all stresses within the stream, and distribution and abundance can be affected seasonally and by multiple unknown perturbations.

Map 2.11 shows the location of bio-monitoring sites in the Grey Sauble SPA. Benthic data collection has taken place on various tributaries of the larger watersheds within the Grey Sauble SPA. The various ranges of water quality indices and stream widths have corresponding letter grades that provide a measure of water quality. Benthic data has been collected by GSC and reported on, but GSC uses the BioMAP – Bio-assessment of Water Quality (Griffiths, 1999) protocol. This index provides a measure of water quality based on the type and abundance of benthic macroinvertebrate species. All taxa are assigned sensitivity values and ranked from highest sensitivity to lowest. The BioMAP(q) water quality index (WQI) is calculated as the average of the top 25% of taxa.
The BioMAP scores have been summarized by subwatersheds in the Grey Sauble SPA. Temporally, in the Grey Sauble SPA, benthic data has been collected in the late 1970s to mid-1980s, and more consistently from 2000 to present. Spatially, the data collection has occurred in the watersheds of the Beaver River, Bighead River, Bothwell's Creek, Colpoy's Creek, Gleason Brook, Indian Brook, Indian Creek, Johnson Creek, Keefer Creek, Pottawatomi River, Rankin River, Sauble River, Sydenham River, and Waterton Creek.

Typically, water quality conditions in the Beaver River watershed have scored quite well. Over 50% of the samples collected have been graded as "excellent", while less than 10% have qualified as poor or very poor. The majority of the samples from the Bighead River have scored good to excellent (59%), with the exception of the Northwest Tributary and Oxmend Creek, both consistently scored as very poor. Bothwell's Creek and one of its tributaries have seventy percent of the samples score good or higher, which demonstrates good water quality conditions. Overall, the water quality conditions in the Pottawatomi River and tributaries have scored well, with the exception of the Kilsyth tributary, which has scored poorly.

Water quality conditions in the Sauble River watershed have scored quite poorly. Approximately 76% of the samples have scored from fair to very poor. The Rankin River, which is a main branch of the Sauble River, has a majority of samples indicating fair to poor water quality conditions.

Five tributaries of the Sydenham River and the main stem have been sampled. Overall, the water quality conditions have scored quite well, with 83% scoring either good or excellent.

Limited data has been collected in Colpoy's Creek, Gleason Brook, Indian Brook, Indian Creek, Johnson Creek, Keefer Creek, and Waterton Creek. Colpoy's Creek water quality conditions received a score of excellent, while Gleason Brook scored a grade of good and Indian Brook scored from fair to excellent. Results from both Indian Creek and Johnson Creek indicated excellent water quality conditions. Keefer Creek results ranged from good to excellent, while Waterton Creek scored fair to excellent. (GSC, 2009)

2.6.3 Species and Habitats at Risk

Recovery and management of species population and conservation of vital habitat are essential to preventing the loss of biodiversity. In Ontario, the Committee on the Status of Species at Risk in Ontario (COSSARO) is responsible for assessing whether plant and animal species are at some risk of disappearing from the wild in Ontario. After research and careful consideration by the committee, species classified as "at risk" are placed on the Species at Risk in Ontario (SARO) list. The various designations are: endangered - regulated; endangered - not regulated; threatened; and special concern (formerly vulnerable). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses species across Canada.

Sustainable development is necessary to prevent degradation and loss of habitat for the species at risk, and help to prevent extinction. The greatest stressors now facing the region's natural communities and wildlife are those related to human activity. Development, water management conflicts, invasive species, agricultural runoff and climate change each have major consequences for species, ecosystems, and habitats throughout the region.
Sources of information about species at risk within the Grey Sauble SPA include: Natural Heritage Information Centre; Species at Risk website of the Ministry of Natural Resources; and the Royal Ontario Museum's species at risk website. Range maps and species descriptions were used to compile Table 2.6.2 – Species at Risk in the Grey Sauble SPA. The list includes species of bird, fish, insect, mollusc, mammal, plant and reptile.

The redside dace is a species at risk in Ontario and inhabits streams within the Grey Sauble SPA. Maintaining adequate water quality and understanding water quantity within areas that provide habitat for the redside dace is paramount in protecting the species.

While not officially designated as "at risk" in Ontario, the Hungerford's Crawling Water Beetle is only found in Canada at sites in the Grey Sauble SPA and Saugeen SPA, such as in the North Saugeen River near Chesley. This beetle species is classified as endangered by the U.S. Fish and Wildlife Service.

TABLE 2.6.2 – Species at Risk in the Grey Sauble Source Protection Area (Species at Risk webpage, Ontario Ministry of Natural Resources, 2010)

Status	Endangered	Threatened	Special Concern
Bird	• Henslow's Sparrow *(Ammodramus henslowii)* • Piping Plover *(Charadrius melodus)* • Loggerhead Shrike *(Lanius ludovicianus)* • King Rail *(Rallus elegans)*	• Whip-poor-will *(Caprimlugus vociferous)* • Chimney swift *(Chaetura pelagic)* • Peregrine Falcon *(Falco peregrines)* • Least Bittern *(Ixobrychus exilis)*	• Short-eared Owl *(Asio flammeus)* • Black Tern *(Chlidonias niger)* • Common nighthawk *(Chordeiles minor*) • Cerulean Warbler *(Dendroica cerulean)* • Bald Eagle *(Haliaeetus leucocephalus)* • Yellow-breasted Chat *(Icteria virens)* • Red-headed Woodpecker *(Melanerpes erythrocephalus)* • Louisiana Waterthrush *(Seiurus motacilla)*
Fish	• Redside Dace *(Clinostomus elongates)* • Shortnose Cisco *(Coregonus reighardi)* - likely extirpated	• Lake Sturgeon *(Acipenser fulvescens)*	• Northern Brook Lamprey *(Ichthyomyzon fossor)*
Insect			• Monarch Butterfly *(Danaus plexippus)* • West Virginia White *(Pieris virginiensis)*
Mammal	• Mountain Lion or Cougar *(Puma concolor)*		
Mollusc		• Rainbow Mussel *(Villosa iris)*	
Plant	• Pitcher's Thistle *(Cirsium pitcher)* • Butternut *(Juglans cinerea)* • American Ginseng *(Panax quinquefolius)*	• Hill's Thistle *(Cirsium hillii)* • Dwarf Lake Iris *(Iris lacustris)* • Houghton's Goldenrod *(Solidago houghtonii)*	• Tuberous Indian-plantain *(Arnoglossum plantagineum)* • Hart's-tongue Fern *(Asplenium scolopendrium americanum)* • Hill's Pondweed *(Potamogeton hillii)*
Reptile	• Spotted Turtle *(Clemmys guttata)*	• Blanding's Turtle *(Emydoidea blandingii)* • Queensnake *(Regina septemvittata)* • Massasauga Rattlesnake *(Sistrurus catenatus)* • Butler's Gartersnake *(Thamnophis butleri)*	• Snapping turtle *(Chelydra serpentine)* • Milksnake *(Lampropeltis triangulum)* • Eastern Ribbonsnake *(Thamnophis sauritus)*

Excerpted from http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/276503.html

2.6.4 Invasive Species

Non-native, aquatic species have been introduced over the years into Ontario's lake and stream systems. Typically, these species can affect water quality negatively, compete for food resources and damage vegetation and stream substrate that serves as habitat. The potential result is a decrease in the numbers of native species, which can upset the "natural" interaction amongst trophic levels.

More than 160 non-indigenous species have become established in the Great Lakes Basin, including species of plants, invertebrates, insects, and fish. Little is known about the number of species or distribution in this SPA. This lack of knowledge can be considered a data gap and makes it difficult to identify potential areas that are subject to the indirect degradation of water quality. Invasive species that have been identified in this SPA are listed in Table 2.6.3.

TABLE 2.6.3 – Invasive Species in the Grey Sauble SPA (OFAH, MNR, 2010)

Latin Name	***Common Name***
Gymnocephalus cernuus (fish)	Ruffe
Cyprinus carpio (fish)	Common Carp
Osmerus mordax (fish)	Smelt
Neogobius melanostomus (fish)	Round Goby
Petromyzon marinus (fish)	Sea Lamprey
Bythotrephes longimanus (planktonic crustacean)	Spiny Water Flea
Dreissena polymorpha (mollusk)	Zebra Mussels
Dreissena bugensis (mollusk)	Quagga Mussels
Myriophyllum spicatum (plant)	Eurasian water-milfoil
Lythrum salicaria (plant)	Purple Loosestrife
Phragmites australis (plant)	Common Reed
Heracleum mantegazzianum (plant)	Giant Hogweed
Alliara petiolata (plant)	Garlic Mustard

2.7 Human Characterization

Land use and population are significant elements in Source Protection Planning. A spatial analysis of what human activities are occurring in relation to sources of drinking water will help reveal potential risks. As well, understanding the distribution of people will further show the reliance on particular water sources and potential impacts.

2.7.1 Population Distribution and Density

Approximately 70,000 people live in the Grey Sauble SPA (StatCan Census, 2006). The population figures for each municipal jurisdiction that lies wholly or partially within the SPA are given in Table 2.7.1. The City of Owen Sound is the most populous municipality in the Grey Sauble SPA with two other municipalities also being over 10,000 in population. With the exception of Owen Sound, each municipality is comprised of settlement areas surrounded by extensive rural areas.

Population density is illustrated in Map 2.12. The largest concentration in the SPA occurs in Owen Sound where there are more than 880 people per square kilometre. Similar concentrations can be found in the larger urban centres, such as Markdale, Meaford and Thornbury. The vast majority of the Grey Sauble SPA averages less than 20 people per square kilometre.
The role of topography, hydrology, soils, transportation and historic settlement are reflected in the present distribution of population. The importance of water-based transportation in the 1800's and 1900's resulted in the emergence of communities with good natural harbours and river links to inland areas. These natural features are uncommon on the Lake Huron and Georgian Bay shorelines, but can be found at Owen Sound, Meaford and Thornbury. Water was also a significant source of power for industries, such as sawmills, grist mills and manufacturing plants. Many small and medium size communities in the SPA owe their beginnings to the water power afforded by their riverside setting.

Population growth in the western part of the Grey Sauble SPA is expected to be modest through 2021. The Town of South Bruce Peninsula's projected growth is 5.1%, while an 11.9% decrease in population is forecast for the Municipality of Arran-Elderslie. The First Nations on-reserve population is expected to more than triple in number (SHS Consulting, 2009). In the eastern portion of the Grey Sauble SPA, the Grey County Growth Management Strategy (Malone Given Parsons, 2008) projected an average population increase of 24.6% by 2031, as compared to 2006 population levels. The growth rate is forecast to be highest in the Town of the Blue Mountains and the Municipality of Grey Highlands at over 35%, while Owen Sound is expected to have the lowest at 10.2%.

TABLE 2.7.1 – Population and Densities for Municipalities and First Nations in the Grey Sauble SPA (StatCan Census, 2006)

Municipality	***Total Population*****	***Total Area (km²)*** # +	***Population Density*** *(people per km²)*
City of Owen Sound	21,753	24.63	883.29
Municipality of Arran-Elderslie*	6,747	466.36	14.47
Municipality of Grey Highlands*	9,480	891.89	10.63
Municipality of Meaford	10,948	936.69	11.69
Town of South Bruce Peninsula	8,415	1695.26	4.96
Town of the Blue Mountains	6,825	826.66	8.26
Township of Chatsworth*	6,392	600.07	10.65
Township of Georgian Bluffs	10,506	815.99	12.88
Neyaashiinigmiing 27 First Nation (Cape Croker)	591	63.86	9.25
Saugeen 29 First Nation	758	41.43	18.30

Notes for Table 2.7.1

***** Population figures, area and population density are for the entirety of the municipality and do not reflect the fact that only a portion of the municipality lies within the Grey Sauble SPA.

****** Population figures derived from the Statistics Canada 2006 Census of Population: Statistics Canada GeoSuite 2006 Census.

\# Area of municipalities derived from the Statistics Canada 2006 Census of Population Census Subdivision Cartographic Boundary File. Statistics Canada 2006 Cartographic Boundary Files. © Minister of Industry, 2007

\+ The cartographic boundary files provided with the census data are not intended for detailed and accurate mapping. The reader is cautioned that values for municipal surface areas shown in the above table may differ from those used elsewhere in this document.

2.7.2 Land Use

Assessing the current and future land use needs of our society in general or even within a particular region, such as the Grey Sauble SPA, is a difficult task. The task may be further complicated when the different and conflicting values related to land use, including ecological values, are also taken into account.

As this region is developed, and land use changes are made, they are followed by other changes on the landscape. Infrastructure must be improved and utility corridors upgraded and expanded. Development also means more demand on our resources. Not only will we require more water from our current sources, we may also need to find additional sources of water. Greater efforts will be required to protect these sources of water as we continue to generate waste requiring more landfill facilities and waste water treatment systems.

Land use in Ontario is guided by several pieces of legislation and accompanying regulations. The *Planning Act* and Provincial Policy Statement (PPS) are two significant components of the planning system and have application across Ontario. The *Planning Act* sets out the ground rules

for land use planning in Ontario and describes how land uses may be controlled, and who may control them (MMAH, 2010).

The Provincial Policy Statement is issued under the authority of Section 3 of the *Planning Act*. It provides direction on matters of provincial interest related to land use planning and development, and promotes the provincial "policy-led" planning system. The Provincial Policy Statement recognizes the complex inter-relationships among economic, environmental and social factors in planning and embodies good planning principles. It includes enhanced policies on key issues that affect our communities, such as: the efficient use and management of land and infrastructure; protection of the environment and resources; and ensuring appropriate opportunities for employment and residential development, including support for a mix of uses (MMAH, 2010).

One of the most important tools available when making land use decisions is the Official Plan document. Official Plans are produced by upper and single-tier municipalities in Ontario and are used to guide development in the area over which the municipality has jurisdiction. They also guide future economic, social and land use changes within a municipality. They provide a broad policy framework for other planning documents such as bylaws.

It is important that Official Plans strive to consider and protect all interests in our society, including environmental, social, and economic, by integrating them into the decision making process. Respecting the natural environment, minimizing adverse impacts on the environment, and protecting significant features and water quality are goals of Official Plans in the Source Protection Region.

Official Plans also have a stated objective to establish policies that will protect groundwater recharge areas, coldwater streams, lakes and other surface waters for their habitat, recreational, ecological and drinking water benefits (Grey County Official Plan, 1997).

Numerous classes and sub-classes are designated, but can generally be divided into residential, commercial, industrial, institutional, agricultural, rural and environmental. Permitted uses and other development controls are described in the Official Plans and zoning by-laws.

Map 2.13 illustrates land use in the Grey Sauble SPA. Note that some land use classes have been harmonized to account for differing categories between the various counties' Official Plans.

2.7.2.1 Settlement Areas

Settlement areas are the built-up areas of municipalities and the lands that have been designated for future development in an Official Plan. Rural lands separate the built-up pockets within the SPA. Settlement areas are characterized as having a high population to area ratio (density). They are distinguished by an increased percentage of impervious surfaces and a greater demand on water resources, although the density often means per capita water costs are lower and infrastructure is more efficient where these services are available. The urban areas enjoy the normal amenities of paved roads, sidewalks, street lighting, gas, cable, sewer and water. They also act as service centres for the rural areas.

There are about five communities in the Grey Sauble SPA with over one thousand residents and more than a dozen with several hundred residents. Only a small percentage of land in the SPA is classed as 'urban residential'. Interspersed with the residential are the other urban land uses. Parks and amenities are located nearby for the enjoyment of the urban residents, as well as people in the outlying areas.

A diverse mix of residential housing stock occurs in the larger centres where turn-of-the-century brick homes, modern bungalows, townhouses, duplexes and apartment blocks are located.

2.7.2.2 Rural Areas

Rural areas are lands outside settlement areas. The Grey Sauble SPA is predominantly rural. The population is widely dispersed in the rural areas, which is reflected by the low population densities discussed in Section 2.7.1 and shown in Map 2.12. In the Official Plans, the most productive agricultural land classes are distinguished on the maps and subject to more development constraints than the more generic 'rural' land use classification. Other land use designations, such as extractive, rural commercial, rural industrial and resort, occur in the rural areas.

The historic settlement pattern was rectangular blocks of land with a farmhouse and barn at the end of the lane. In the last few decades, the trend has been to sever a parcel from the road frontage for residential construction and for homes to be built on previously undeveloped blocks of rural land. This has had the effect of distributing more people (and their wells) into agricultural areas.

2.7.2.3 Rural Residential

Dozens of small settlement areas with up to a few hundred people occur in the Grey Sauble SPA. The typical configuration may include a church, a few commercial establishments and several homes focussed near a crossroads. Alternatively, houses on estate-size lots line sections of the county roads. Nearly all of these rural residential sites are serviced by private wells and septic fields.

2.7.2.4 Cottage and Camp Development

The wonderful recreational opportunities and scenic beauty of the area have attracted tourists and seasonal residents for many years. This brings a large influx of people during the warmer months, particularly to shoreline areas. In the winter, skiers and snowmobilers are drawn to the area. In many parts of the SPA, the population increases significantly seasonally. This presents different water protection challenges, especially since many of the users are not on municipal systems but are taking water directly from shallow or deep wells, or surface water in some instances. In addition, some areas planned for seasonal use now have year-round occupancy.

Cottage communities exist along Lake Huron and Georgian Bay as well as the inland lakes. Some of the larger sites occur at Sauble Beach and the bays at Howdenvale, Red Bay and Oliphant. Commercial campgrounds up to a hundred sites or more in size also occur.

Small lots serviced by wells and septic fields can create potential risks in these cottage areas for water quality in the lakes and for drinking water supplies. Proper maintenance and site selection, as well as appropriate sizing of septic fields, are crucial.

Some of the older wood-frame cottages are being torn down and replaced by larger, permanent homes. The change in use places substantial additional demands on water supply and increases the volume of septage needing treatment.

2.7.2.5 Planned Development

Planned development areas are areas within the municipal boundary that are designated for future development but have not yet been developed. The proposed uses in these areas are important because they will add to water demand.

Growth can occur in vacant land parcels, through redevelopment or by conversion to denser uses. Often it is land fringing the urban areas that is designated for residential, commercial and industrial use in anticipation of future growth. In some cases this is contentious because of neighbouring land uses or encroachment onto prime agricultural land.

2.7.2.6 Industrial/Commercial Sectors Distribution

Major industries are located on the east side of Owen Sound as well as the other urban centres of the SPA and rural areas in some instances. Industrial parks have been developed in many of the larger centres. A cross-section of this sector would include: Transcontinental Printing (Owen Sound); Tenneco Automotive (Owen Sound); Ice River Springs (Feversham); BTI (Thornbury); and Lallemand (Tara). This list is by no means exhaustive, but serves to illustrate the diversity of firms operating in the SPA.

The traditional downtowns still thrive in the communities throughout the SPA. The big box stores, strip malls and shopping centres are limited in scope, with the exception of Owen Sound.

2.7.2.7 Quarries and Aggregate Extraction

Quarries and aggregate extraction locations are important to consider, as they can have potentially significant impacts on the surrounding natural and physical environment. In terms of Source Protection, it is necessary to have an understanding of the locations of these operations, as they have the potential to create adverse effects on local wetlands and can cause disturbances to the water table. Aggregate operations typically represent constructed preferential pathways to aquifers. Sand and gravel deposits, which make up the resources used for mining and aggregate extraction, also play a role in the formation of the aquifers for groundwater storage and recharge. Generally, there is a great deal of uncertainty about the overall effects of aggregate operations on groundwater flows (Baker et al, 1995).

In addition to the effects that aggregate operations could have on groundwater sources, these types of operations can also require significant amounts of water-taking for their day-to-day activities. Several pit or quarry locations in the Grey Sauble SPA currently have permits to take water for aggregate washing purposes. The majority of these operations are located in the Beaver River watershed and draw water from surrounding rivers, lakes, and groundwater sources.

Water-takings for these types of operations are generally discharged back into groundwater and surface water systems after use. This recycled water has the potential to be high in suspended solids, which could have associated impacts on nearby streams and aquatic life.

Table 2.7.2 provides a summary of the total land area composed of pits and quarries for each subwatershed in the SPA. Map 2.14 illustrates the locations of pit and quarry activities in the Grey Sauble SPA. As shown in this map, active quarry operations are scattered across the SPA with some concentrations: to the southwest of Owen Sound; from Shallow Lake to Wiarton; and in the far southeast.

TABLE 2.7.2 – Pits and Quarries by Subwatershed in the Grey Sauble SPA

Subwatershed	*Area of Subwatershed (km^2)*	*Area of Active Pits/Quarries (km^2)*	*% of Subwatershed Used for Pits/Quarries*
Grey Sauble SPA			
Beaver River	617.51	3.97	0.64
Big Bay Creek	9.33	0.00	N/A
Bighead River	350.89	1.40	0.40
Bothwell's Creek	63.10	1.12	1.78
Centreville Creek	14.08	0.00	N/A
Gleason Brook	44.92	0.00	N/A
Indian Brook	33.96	0.80	2.35
Indian Creek	81.07	0.67	0.82
Johnson Creek	19.03	0.00	N/A
Keefer Creek	38.82	0.00	N/A
Little Beaver Creek	14.36	0.00	N/A
Centreville Creek	14.08	0.00	N/A
Pottawatomi River	113.22	3.68	3.25
Rankin River	221.76	4.61	2.08
Sauble River	692.80	7.49	1.08
Stoney Creek	31.22	0.18	0.56
Sucker Creek (S. Bruce Peninsula)	46.39	3.76	8.11
Sucker Creek (Meaford)	36.73	0.00	N/A
Sydenham River	198.72	4.96	2.49
Waterton Creek	57.10	0.32	0.55
Lake Fringe	472.76	4.23	0.89
TOTAL and Average%	3157.77	37.19	1.18

Source: Ontario Ministry of Natural Resources "Pit or Quarry" data layer, 2005

Baker, Douglas and Darryl Shoemaker. Environmental Assessment and Aggregate Extraction in Southern Ontario: The Puslinch Case. University of Waterloo: Waterloo, Ontario, 1995.

Ministry of Northern Development & Mines (MNDMF).). http://www.mndmf.gov.on.ca/mines/mg/dimstone/default_e.asp. Last modified: 07/11/03. Last accessed: 08/05/06.

Current controls on pit and quarry development are covered in the *Aggregate Resources Act*, which was implemented in January 1990. This Act controls pit development and rehabilitation through a licensing system that is administered by the Ontario Ministry of Natural Resources. Under the Act, a Class "A" license is issued for extractions of aggregates in excess of 20,000 tonnes, while a Class "B" license is issued for extractions below this amount. Under the Bruce County and Grey County Official Plans, proposals for expansions or new operations are to be accompanied by the appropriate license, as well as a detailed report on the related impacts to adjacent land uses, to the physical and natural environment, to ground and surface water sources, as well as impacts to potential and existing municipal supply systems (Grey County Official Plan – Section 2.7; Bruce County Official Plan – Section 4.8).

2.7.2.8 Transportation

The road network is illustrated on Map 2.2 - Settlement Areas and Communities. The principal north-south roadway is Highway 6 in the central and northern portion of the SPA. The Highway 21 corridor extends westward from Owen Sound to the Lake Huron shore, while Highway 26 runs along the Georgian Bay shore from Owen Sound to the eastern most edge of the SPA. County roads provide vital links between communities, while municipal roads provide the access to businesses and properties across rural and urban areas.

Railway access across the SPA was fairly extensive at one time, but these routes have since been abandoned. Some of the former railway corridors have been converted to trail systems for recreational purposes.

Water transportation continues to play both a commercial and recreational role in the SPA. The nearest commercial facilities for lake freighters and ocean-going vessels are Owen Sound and Goderich to the south. Fishing tugs operate from Wiarton and Thornbury. Marinas are located in Owen Sound, Wiarton, Meaford and Thornbury.

Two airports are located in the Grey Sauble SPA. The Wiarton Airport offers small charter and passenger flights, sightseeing tours, as well as a flying school. Owen Sound's Billy Bishop Airport is located east of the city. Both airports offer storage and services for privately-owned planes.

2.7.2.9 Utilities

Utilities and the associated corridors and infrastructure extend across the SPA to supply electricity, gas, phone, cable and water to businesses and residents. A hydroelectric plant is operated by Ontario Power Generation in the Beaver Valley. Water drawn from Lake Eugenia at the top of the Escarpment powers the turbines. Wind power has the potential to grow significantly with the development of several proposed wind turbine projects near the Lake Huron shore and at other sites.

2.7.2.10 Institutional Lands

Institutional properties occur in nearly every community in the SPA and include churches, schools and community halls. As well, municipal and government offices form part of the institutional land use. These facilities are significant because of their public functions and role as a venue for community events. The buildings are often considerable in size and are also situated

on large parcels of land. In rural portions of the SPA, institutional facilities may operate on their own well and septic system.

2.7.2.11 Hazard and Natural Environment Land Use

Planning policies contain a broad class of land use that encompasses hazard lands and natural features that pose a barrier to development or have significant environmental values worth protecting from development. The Grey County Official Plan states that Hazard Land includes "…floodplains, steep or erosion prone slopes, organic or unstable soils, poorly drained areas, and lands along the Georgian Bay shoreline impacted by flooding, erosion, and/or dynamic beach hazards" (Sec 2.8.1). Similar wording can be found in the Bruce County Official plan (Sec. 5.8). Use of the land may still occur, such as forestry or recreation, but the construction of buildings is generally not permitted. Provincially significant wetlands (class 1 to 3) and Areas of Natural and Scientific Interest are also included.

Conservation Authorities regulate development near watercourses, slopes and wetlands. Under the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation, permits may be required for works within or adjacent to rivers, streams, wetlands, and the shorelines of Lake Huron, Georgian Bay and inland lakes. The intent of the regulation is to ensure public safety with regard to natural hazards.

2.7.2.12 Other Land Use

Zoning maps and official plans can contain categories of land use other than those described in Section 2.7.2. Educational properties, such as Scout camps and church camps, can be found near some of the lakes and rivers in the Grey Sauble SPA. Reference should be made to the Official Plans for complete land use categories and their current application.

2.7.3 Wastewater Treatment

Wastewater that is generated from toilets, showers, tubs, sinks and other uses requires treatment before it can be discharged. Primary and secondary settlement areas tend to have wastewater treatment plants, whereas tertiary settlement areas and rural areas depend on septic systems.

Serviced Areas

In serviced areas, wastewater is discharged through a sanitary sewer system to municipal wastewater facilities, where it is undergoes a number of treatment processes. Various treatment technologies are used in municipal wastewater treatment facilities to achieve a significant reduction in the amount of organic matter, solids, nutrients, and pollutants prior to the effluent re-entering a body of water or being applied to land. The processes may involve screening, filtering, biological digestion, settling, chemical treatment, UV treatment and other methods.

There are eight municipally-owned wastewater treatment facilities in the Grey Sauble SPA. Sewage lagoons are used by most communities in the Grey Sauble SPA, such as Tara and Thornbury. The Owen Sound treatment plant uses primary treatment methods, although major upgrades and improvements will be constructed over the next several years.

Non-Serviced Areas

In non-serviced areas, waste is typically discharged to private septic systems and holding tanks. Septic systems are suitable for treating household septage provided that the system is properly constructed and maintained. In Ontario, septic systems are regulated by the Ministry of Municipal Affairs and Housing under the Building Code. Typical septic systems have a tank where solid materials settle to the bottom and lighter wastewater stays at the top. The liquid drains out of the tank and passes through a leaching bed made up of perforated pipes buried underground. Bacteria and other organisms help to digest the wastewater and the water slowly filters into the ground. Several other septic system designs are also available on the market.

The matter that is pumped from holding tanks is raw and untreated and is classified as hauled sewage. This septage may be land applied or disposed of at a sewage treatment plant, waste stabilization lagoon or landfill site (MOE, www.ene.gov.on.ca, 2008). Determining locations and conditions of these septic systems is of importance to Source Protection planning. Inadequate systems or improper treatment of sewage can lead to infiltration of pollutants and bacteria into ground and surface water sources, which may have adverse effects on overall water quality within the region.

Stormwater Management

Another area of importance to Source Protection in terms of wastewater treatment is stormwater management policies and procedures. Stormwater is the term used to describe the rainfall and other sources of water that are generated by urban runoff from areas such as streets, parking lots and roof drains on houses and other buildings. During storm events or floods, water flows across impervious surfaces, such as asphalt and concrete, and often comes into contact with several contaminants, such as oil, fertilizers, sediment and animal waste. Prior to discharging to a creek, wetland, pond, or lake, stormwater should be treated.

Stormwater management is the application of practices that are designed to protect downstream receiving waters from negative impacts of urban development, such as flooding, erosion, and degraded water quality (MMAH, 2010). There are many benefits to stormwater pollution prevention including: minimizing or avoiding the creation of pollutants; using materials more efficiently; minimizing health risks; avoiding costly clean-ups; and enhancing the local environment (MOE). Stormwater management practices are much more prevalent in larger urban centres than in small rural locations.

2.7.4 Brownfields

Brownfields are abandoned, idle, or under-utilized industrial and commercial properties where the previous property use caused environmental contamination. The land may need to be cleaned up before it can be redeveloped (MOE, 2007). Brownfields are often in desirable locations, such as in communities, near downtown or along the waterfront. Some of the old tanneries, mills, and factory sites for furniture and other goods are to be found in most medium- to large-size communities across the Grey Sauble SPA. Derelict gas stations and other places that are possibly contaminated with petroleum or chemical residues would also be classed as brownfields.

The provincial government encourages the redevelopment of brownfield sites as a way of putting the land back into productive use. As many brownfield sites are located on serviced, urban

property, finding new uses reduces the need for municipalities to expand services. Additional benefits include new employment, increased economic development and, in some cases, greater retail, tourism or housing opportunities.

The Brownfields Environmental Site Registry was established under O.Reg. 153/04 and is administered by the MOECC. Property owners may file a Record of Site Condition to show that a brownfield has been appropriately remediated and the required technical documents submitted. Once the Record is approved by the MOECC, the property owner will get general protection from environmental cleanup orders for historic contamination. The public can access information about brownfields that have been registered.

As of March 2010, twelve such sites in the Grey Sauble SPA were in the Brownfields Environmental Site Registry. Four former industrial sites were converted to residential use. Two sites were reused for commercial purposes after rehabilitation work, while two residential sites were rehabilitated. Two former commercial sites became residential and one commercial site became community use. One community use site was converted to commercial use.

2.7.5 Oil, Gas and Salt Facilities

Boreholes that have been abandoned and wells with unknown status can be seen as potential areas of concern for groundwater contamination. Boreholes create a direct path into groundwater aquifers and are potentially high risk areas for contamination, particularly in the event that these wells were not properly sealed and capped.

The locations of oil, gas and salt wells in the Grey Sauble SPA are shown on Map 2.14. A total of 124 sites are scattered cross the Grey Sauble SPA. Heavier concentrations of wells are found near Thornbury, Hope Bay, Hepworth and Shallow Lake. Two-thirds of the wells have a current status of unknown, while the remainder are abandoned. Only one well, located 10 km northwest of Owen Sound, is listed as active.

2.7.6 Agricultural Resources

Agriculture is a prevalent land use in the Grey Sauble SPA. Map 2.13 shows the extent of agricultural land use as compared to other land use classes in the SPA. Cattle ranching and its associated pasture and forage crops is common, particularly in the southwestern section of the SPA. The northeastern part of the SPA is known for its abundance of orchards, and makes up about one-quarter of the total provincial output of apple crops. A wide range of other agricultural commodities are also grown in the Grey Sauble SPA.

Land capability for agriculture has been measured by the Canada Land Inventory, which is based on soil characteristics derived from various soil surveys. This data indicates that thirteen percent of the Grey Sauble SPA has no capability for agriculture, which has been attributed to issues with surface stoniness and bedrock outcrops, topography, and excess water due to poor soil drainage.

Table 2.7.3 presents the number of farms from the 2006 Census of Agriculture by Statistics Canada for municipalities in the Grey Sauble SPA. The acreage of crop types is shown in Table 2.7.4 and the number of livestock is presented in Table 2.7.5.

TABLE 2.7.3 – Number of Farms by Commodity in the Grey Sauble SPA (StatCan Census of Agriculture, 2006)

Commodity (Number of Farms)	***Census Subdivision***							
	Arran-Elderslie	Saugeen Shores	South Bruce Peninsula	Grey Highlands	Chatsworth	Blue Mountains	Meaford	Georgian Bluffs
Dairy cattle and milk production	21	2	6	29	13	3	13	25
Beef cattle ranching and farming, including feedlots	211	31	78	215	150	24	117	135
Hog and pig farming- # of farms	9	1	0	15	2	2	2	0
Chicken egg production	1	0	1	3	2	0	2	0
Broiler and other meat-type chicken production	3	1	0	0	3	1	0	0
Turkey production	0	0	0	1	0	0	0	0
Poultry hatcheries	0	0	0	0	0	0	0	0
Combination poultry and egg production	0	0	0	0	0	0	0	0
Other poultry production	0	0	1	1	0	0	1	2
Sheep farming	7	4	1	12	18	2	18	15
Goat farming	4	3	0	1	5	0	1	0
Apiculture	4	2	0	1	5	2	2	2
Horse and other equine production	12	6	11	28	32	15	34	25
Fur-bearing animal and rabbit production	0	1	0	2	2	0	0	0
Livestock combination farming	10	0	5	36	40	6	13	11
All other miscellaneous animal production	0	0	3	9	4	0	3	4
Other animal production and Oilseed and grain farming	26	9	19	76	83	23	52	42
Soybean farming	9	11	1	4	5	7	4	2
Oilseed (except soybean) farming	0	0	0	2	0	0	1	0
Dry pea and bean farming	0	0	0	0	0	0	0	0
Wheat farming	1	4	0	4	0	0	2	2
Corn farming	4	3	2	1	0	0	0	1
Other grain farming	8	8	0	15	6	5	5	4
Potato farming	1	0	0	2	0	1	1	0
Other vegetables (except potato) and melon farming	2	3	1	1	5	1	1	2
Fruit and tree-nut farming	2	3	2	4	3	45	26	0
Mushroom production	0	0	1	1	1	0	0	1
Other foods grown under cover	0	0	0	0	0	1	1	0

Commodity (Number of Farms)	*Census Subdivision*							
	Arran-Elderslie	Saugeen Shores	South Bruce Peninsula	Grey Highlands	Chatsworth	Blue Mountains	Meaford	Georgian Bluffs
Nursery and tree production	3	0	7	9	5	6	4	2
Floriculture production	0	1	1	3	2	1	3	4
Tobacco farming	0	0	0	0	0	0	0	0
Hay farming	33	10	21	85	53	16	40	43
Fruit and vegetable combination farming	1	0	2	1	0	0	0	1
All other miscellaneous crop farming	9	5	3	22	19	2	22	10
Total area of farms								
#of farms reporting	355	99	147	507	375	140	316	291
Hectares	42,885	8,477	21,628	46,897	28,879	10,786	26,811	30,796
Land use Table 4.3-2								
#of farms reporting	316	88	125	469	332	124	286	260
Hectares	23,102	5,512	7,240	25,668	14,227	6,920	14,179	13,896

+ data is for entire municipality and not just the portion that lies within the Grey Sauble SPA.

x data suppressed to meet the confidentiality requirements of the Statistics Act

Source: Statistics Canada, 2006 Census of Agriculture, Farm Data and Farm Operator Data, catalogue no. 95-629-XWE.

TABLE 2.7.4 – Agricultural Crops by Acreage in Grey Sauble SPA (StatCan Census of Agriculture, 2006)

Crop (values in acres)	*Census Subdivision*							
	Arran-Elderslie	Saugeen Shores	South Bruce Peninsula	Grey Highlands	Chatsworth	Blue Mountains	Meaford	Georgian Bluffs
Annual Crops								
Total wheat	6,650	2,543	384	3,295	1,246	1,827	1,915	1,872
Oats	1,015	91	237	1,151	814	202	820	569
Barley	3,021	906	747	5,895	2,302	619	1,503	1,836
Mixed Grains	3,027	409	681	5,741	2,704	672	2,122	2,156
Total corn	9,975	1,456	1,128	4,007	2,708	627	1,587	3,640
Total Rye	42	x	x	x	97	x	x	98
Canola	x	0	x	347	0	x	305	x

Crop (values in acres)	*Census Subdivision*							
	Arran-Elderslie	Saugeen Shores	South Bruce Peninsula	Grey Highlands	Chatsworth	Blue Mountains	Meaford	Georgian Bluffs
Soybeans	7,103	2,924	x	2,117	2,399	2,388	1,763	1,714
Flaxseed	0	0	0	104	x	x	0	0
Dry field peas	0	0	0	x	0	0	0	0
Dry White Beans	x	x	0	x	0	0	x	0
Other Dry Beans	x	0	0	x	0	0	0	0
Potatoes	9	x	23	36	10	x	x	x
Sunflowers	0	0	0	x	x	0	0	0
Triticale	x	0	0	91	0	0	0	0
Other field crops	x	x	0	350	170	0	x	0
Total vegetables (excluding greenhouse vegetables)	127	x	42	38	44	38	24	47
Perennial Crops								
Alfalfa and alfalfa mixtures	18,389	3,616	7,236	31,339	16,784	5,635	16,931	15,830
All other tame hay and fodder crops	7,075	694	6,983	8,212	5,735	1,827	6,114	6,458
Total area of fruits, berries and nuts	19	46	17	128	31	2,892	1,403	6
Tame or seeded pasture	25,574	2,499	11,144	16,089	11,560	2,073	8,934	15,046
Natural land for pasture	8,175	1,375	8,133	9,982	7,049	1,781	8,948	10,210
Summerfallow land	x	155	45	239	72	156	50	114
Land in crops	57,086	13,621	17,891	63,426	35,155	17,099	35,037	34,337

+ data is for entire municipality and not just the portion that lies within the Grey Sauble SPA.
x data suppressed to meet the confidentiality requirements of the Statistics Act
Source: Statistics Canada, 2006 Census of Agriculture, Farm Data and Farm Operator Data, catalogue no. 95-629-XWE.

TABLE 2.7.5 – Number of Livestock in Grey Sauble SPA (StatCan Census of Agriculture, 2006)

Livestock (number of animals)	***Census Subdivision***							
	Arran-Elderslie	South Bruce Peninsula	Northern Bruce Peninsula	Grey Highlands	Chatsworth	Blue Mountains	Meaford	Georgian Bluffs
Calves Under 1 Year	7,816	3,207	3,299	7,219	4717	822	3,815	5,354
Steers 1 year and over	15,455	3,330	1,606	5,055	4603	102	718	4,700
Total heifers 1 year and over	16,251	1,329	949	5,179	2053	235	2,071	2,570
Beef Cows	4,602	x	3,938	6,884	3987	1,018	4,633	4,475
Dairy Cows	1,005	x	0	1,485	825	112	709	1,156
Bulls 1 year and over	202	172	168	320	220	61	218	224
# of Rams	69	x	x	82	100	18	107	60
# of Ewes	1,439	x	x	2,019	1965	367	1,874	1,742
# of Lambs	1,297	x	x	1,985	1646	280	1,738	1,734
Goats	747	x	x	272	2,012	32	189	24
Horses and Ponies	510	382	147	1,133	941	234	526	424
Wild Boars	0	x	0	x	0	0	0	0
Bison	0	0	x	x	x	x	x	x
Llamas and alpacas	x	24	0	99	45	x	57	x
Deer (excluding wild deer)	x	x	0	x	x	0	x	0
Elk	0	0	0	x	0	0	0	x
Boars	x	x	0	41	16	x	4	x
Sows and gilts for breeding	x	x	0	968	x	x	111	46
Nursing and weaner pigs	x	x	0	5,582	x	x	81	x
Grower and finishing pigs	x	x	0	7,314	x	x	38	192
Broilers Roasters and Cornish hens	x	x	0	x	21,905	x	163	262
Pullets under 19 weeks	x	x	x	x	519	0	x	25
Laying Hens 19 weeks and over	7,863	843	x	16,644	13,444	213	1,766	722
Turkeys	x	x	x	3,312	263	x	x	16
Other Poultry	265	179	0	6,330	1,168	x	1,736	x

x=suppressed to meet the confidentiality requirements of the Statistics Act

1. "Total heifers 1 year and over" includes "Heifers for slaughter or feeding," "Heifers for beef herd replacement" and "Heifers for dairy herd replacement."

Bulls assumed a NU of 1 as per OMAFRA staff

Mink and Fox did not have any values for this region

Source: Statistics Canada, 2006 Census of Agriculture, Farm Data and Farm Operator Data, catalogue no. 95-629-XWE.

2.7.7 Forestry

Harvesting of forest resources has occurred since settlement times when wood was a primary source of fuel and building materials. Numerous sawmills, operated by the abundant waterpower of the region, helped establish communities across the landscape. In the middle part of the twentieth century, many woodlots were 'high-graded' through the removal of large healthy trees. As a result, some of the remaining forests contain many poor quality trees. More recently, careful forest management has been undertaken in an attempt to improve forest health and residual tree quality.

The location of forested areas in the Grey Sauble SPA is shown in Map 2.10.

Grey Sauble Conservation owns approximately 11449 ha of land, of which 6550 ha are actively managed. As well, Grey Sauble Conservation and Saugeen Conservation have a long-standing partnership in Grey Bruce Forestry Services, which offers tree planting, managed forest plans, tending and pest control.

The County of Grey owns 3475 hectares of forest property in more than forty different tracts. These areas are managed for multiple purposes, including wildlife habitat, recreation, aesthetics, environmental protection, economics and sustainable timber supply. Bruce County owns 4850 hectares of land under its "Bruce County Forest" program. Grey County has passed a Forest Management By-law, and Bruce County has a Forest Conservation By-law to encourage the use of good forestry practices.

2.7.8 Protected Areas

Within the Grey Sauble SPA, specific areas are protected and managed in order to deter development changes that could alter the natural character of the region. These protected sites are typically designated through national parks, provincial parks, crown lands, county forests and conservation areas. Map 2.15 identifies the locations of parks and protected areas throughout the Grey Sauble SPA. Map 2.16 illustrates lands that have been designated as Areas of Natural and Scientific Interest (ANSI) or are under the jurisdiction of the Niagara Escarpment Commission (NEC).

Provincially Owned Lands

Provincial Parks are scattered across the Grey Sauble SPA. Within the SPA are two nature reserves: Duncan Escarpment in the Beaver Valley; and Bayview Escarpment, just south of the Land Force Central Area Training Centre Meaford. Parks with the nature reserve classification are generally established to represent and protect natural habitat and land formations. Due to the fragility of the natural environment, these sites are usually intended for education and research purposes, or passive recreational activities such as hiking or nature appreciation. (MNR, 2009)

Craigleith Provincial Park is located on the shores of Georgian Bay in the Town of the Blue Mountains. The park features a campground and interesting fossiliferous bedrock along the shore. Sauble Falls Provincial Park is situated just north of Sauble Beach and takes its name from the small waterfalls on the Sauble River.

Other Provincially-owned crown lands also occupy portions of land in the Grey Sauble SPA. There is a clustering of these lands in the Beaver River subwatershed, most of which comprise the Beaver Valley Lowlands and the Kolapore Uplands. These crown lands are managed by the Ontario Ministry of Natural Resources (MNR), who facilitates government control over land uses in these areas. The primary goals associated with these management policies are to protect terrestrial and aquatic ecosystems, preserve wildlife and habitat, ensure access by the public and resource-based industries, and ensure the sustainable development of natural resources on crown lands (MNR, 1993).

Conservation Authority Properties

In addition to lands which are provincially or federally protected are those which are managed by the local Conservation Authorities. These properties provide a broad range of benefits including habitat, wetland conservation, flood control, education, recreation and forest management.

Grey Sauble Conservation currently holds a total of approximately 11,449 hectares of land, of which 880 hectares are classed as Conservation Areas, 10,480.9 hectares are Management Lands and 86 hectares are nature preserves. Conservation Areas are available to the public and provide outdoor recreational facilities, such as waterfalls, scenic look-outs, caves, and trails. All Conservation Areas operated by Grey Sauble Conservation are day-use sites.

Properties are designated for specific management and conservation purposes. Management Areas in the Grey Sauble SPA are properties that are managed for a variety of uses including forest management, fish and wildlife management, recreation and watershed protection. Grey Sauble Conservation also holds five properties that are designated as nature preserves. Located mainly on the shores of Lake Huron and Georgian Bay, these lands have been left unmanaged in order to preserve them in a natural state, protect against further development and preserve sensitive natural features (Grey Sauble, 2006).

Non-Government Organization Protected Areas

Ontario Nature (Federation of Ontario Naturalists) is a non-government organization that is actively involved in the protection and restoration of natural habitats through research, education, and conservation. The Petrel Point and Malcolm Kirk nature reserves in the Grey Sauble SPA serve to protect open bogs, fens, and forested wetlands with unique vegetation and wildflower communities. These properties are open to the public for activities such as hiking and snowshoeing on marked trails, photography, and scientific research. Activities such as hunting, use of motorized vehicles, camping, cycling, and trimming of vegetation are not permitted in these areas (Ontario Nature, 2010).

Another non-profit organization with protected land holdings in the planning region is the Nature Conservancy of Canada (NCC). The agency is the largest private steward of lands conserving species at risk in Canada. The main goal of this organization is to protect threatened or ecologically rare sites through the application of conservation sciences on properties that have been donated by private land owners or purchased outright by the agency. The NCC also works with individual landowners to secure conservation easements, which limit or restrict certain types of development in order to protect the natural features of an area. Restrictions are tailored

to fit the particular property, the interest of the landowner and the natural features that are to be protected (Nature Conservancy of Canada, 2010).

The Bruce Trail Conservancy seeks to provide public access to the Niagara Escarpment. The organization is best known for the Bruce Trail, which is a public footpath along the Niagara Escarpment from Tobermory to Niagara Falls. Their goal is for the Bruce Trail route to be part of a conservation corridor. In places, the Bruce Trail Conservancy has purchased the land parcels through which the trail passes. Many sections traverse private property and the Conservancy has secured agreements with the property owners. In the Grey Sauble SPA, the Bruce Trail crosses many protected areas, including the Bayview Escarpment Nature Reserve and many Grey Sauble Conservation properties.

Areas of Natural and Scientific Interest

Areas of Natural and Scientific Interest (ANSIs) are significant natural features that have been identified by the Ministry of Natural Resources (MNR). These areas may represent either geological features (earth science ANSI) or biological features (life science ANSI). Earth science ANSIs include areas that contain examples of rock, fossil and landform features. Life science ANSIs are areas that contain examples of the many natural landscapes, communities, plants and animals found in the 14 natural regions of the province (MNR, www.mnr.gov.on.ca, Oct23, 2009). Map 2.16 shows the location of ANSIs in the Grey Sauble SPA.

Niagara Escarpment Commission Plan Area

A significant protected area in the Grey Sauble SPA is the Niagara Escarpment, which is protected under the *Greenbelt* legislation. The escarpment is a provincially significant geological formation stretching from Niagara Falls to Tobermory at the northern tip of the Bruce Peninsula. The *Niagara Escarpment Planning and Development Act*, passed in 1973, identifies seven land-use zones within the Niagara Escarpment planning region. These zones are intended to ensure that the natural features of the escarpment are maintained and that development practices within the area are compatible with the natural environment.

The Niagara Escarpment planning area covers a corridor through the entire length of the Grey Sauble SPA as shown on Map 2.16. Escarpment Natural Area is the most protective designation under the plan. This core area includes escarpment cliffs, forested lands, river and stream valleys, and significant ANSIs and allows for very limited types of development in these areas. Away from the cliff face, other land-use designations are identified, which are intended to minimize the impacts of certain land uses, while at the same time maintain the natural features of the area. Certain types of development and land uses are permitted within these zones, but are subject to some restrictions (Niagara Escarpment Commission, 2009).

2.7.9 Recreation

Recreation and tourism is very prevalent in the Grey Sauble SPA, as it offers a wealth of opportunity for outdoor activities year round (see Map 2.17). With both the Lake Huron and Georgian Bay shorelines, the region offers tourists numerous water activities during the summer months including swimming, sailing, boating, fishing, canoeing and cottaging. Beaches can be

found along Lake Huron, Georgian Bay and the various inland lakes. Major fishing tournaments are hosted along Lake Huron and Georgian Bay, such as at Owen Sound.

The area is also particularly attractive to hikers as it is home to several large trail networks, including County Forest trails, Provincial Park trails and the Bruce Trail (see section 2.7.8 above). High-quality mountain bike trails have been developed at the Bruce Peninsula Mountain Bike Adventure Park north of Wiarton. Spelunking can be enjoyed at numerous cave sites along the Niagara Escarpment, such as Bruce's Cave, Grieg's Caves, Scenic Caves and Duncan Caves.

An extensive network of dedicated snowmobile trails attracts enthusiastic sledders to the region. Some of the walking trails are also used during the winter months for cross-country skiing activities. Downhill skiing is a popular winter activity, particularly on the steep slopes surrounding the Beaver River Valley and Blue Mountain.

Camping is a popular pastime in the region. There are dozens of privately operated campgrounds, a municipal campground in Owen Sound and provincial campgrounds at Sauble Falls and Craigleith Provincial Parks.

While these activities offer both residents and tourists of the SPA a wide variety of recreational opportunities, it is important to note the effects that some of these activities have on water sources. Some recreational activities may have adverse effects on water quality, such as fuel, oil, and other pollutants entering water systems from boating or other water-based activities.

Other activities may require large-scale water-takings for their operations. Downhill skiing facilities, for example, require large amounts of water for snowmaking operations. These types of facilities are concentrated mainly in the northeastern portion of the Grey Sauble SPA near the shores of Georgian Bay between Craigleith and Collingwood. There is also one downhill skiing facility in the south end of the Beaver River watershed near Kimberley. Currently, there are six facilities in the Grey Sauble SPA with permits to take water for snowmaking operations. The majority of these sites draw from surface sources, namely Nottawasaga Bay and the Beaver River.

Golf courses also require large water-takings for irrigation of greens and fairways. There are numerous golf courses spread across the SPA (see Map 2.17) with permits to take water for irrigation purposes. Courses located along the shorelines tend to draw their water from surface sources including Georgian Bay, Lake Huron and local rivers, while inland courses tend to draw from groundwater sources.

2.8 Water Quality

The purpose of the water quality section is to compile, organize, and present an anthology of significant sources of water quality data within the Grey Sauble SPA. These sources represent sampling programs that have produced reliable and extensive water quality data. The data serves to identify potentially problematic areas that may be susceptible to less than desired water quality.

Understanding the quality of water within the study area is an essential part of Source Protection Planning. For the purposes of defining water quality for Drinking Water Source Protection, the salient properties are chemical and biological. Chemical properties are most commonly measured as instantaneous concentrations of a given parameter, and guidelines for both human health and ecological functions are generally based on the effects of a given concentration on the suitability of the water for a chosen use.

A more detailed examination of water quality information is provided in the Water Quality chapter of the Watershed Characterization Report (SC, 2008)

2.8.1 Indicator Parameters

Water chemistry parameters were selected based on the Conservation Ontario Discussion Paper: Recommendations for Monitoring Ontario's Water Quality (March 2003). To address the potential for human health issues associated with the chosen indicator parameters, the corresponding acceptable concentrations (for human health or aesthetic purposes) are given in Table 2.8.1. Aesthetic objectives are not considered to be health related, but can make drinking water undesirable for drinking and other domestic uses. The Canadian Drinking Water Quality Guidelines (DWQG) and the Ontario Drinking Water Standards (ODWS) are specific to human consumption while the Canadian Water Quality Guidelines and the Ontario Provincial Water Quality Objectives (PWQO), and the Canadian Environmental Quality Guidelines (CEQG) are provided for the protection of aquatic life.

The indicator parameters that will be reported on in this section are arsenic, fluoride, hardness, iron, sodium, total phosphorus, nitrate, copper, lead, suspended solids and chloride. Typical sources of the parameters are provided, but are not meant to be exhaustive. The indicator parameters are identified as being applied to surface water (SW) or groundwater (GW).

TABLE 2.8.1 – Summary of objectives, standards, and guidelines for chosen indicators

	Canadian DWQG		**ODWS**		**PWQO**
Parameter	***MAC (mg/L)***	***AO (mg/L)***	***MAC (mg/L)***	***AO (mg/L)***	***(mg/L)***
Arsenic			(Interim) ≤0.025		≤0.1
Chloride		≤250		≤250	
Copper				≤1.0	≤0.005
Fluoride	≤1.5		≤1.5		
Hardness				≤500	
Iron				0.3	≤0.3

	Canadian DWQG		ODWS		PWQO
Parameter	***MAC (mg/L)***	***AO (mg/L)***	***MAC (mg/L)***	***AO (mg/L)***	***(mg/L)***
Lead	≤0.01		≤0.01		Hardness as CaCO3 (mg/L) / Interim PWQO: <30 / 0.001; 30-80 / 0.003; > 80 / 0.005
Nitrate-N	≤10.0		≤10.0		
Sodium		≤200		≤200	
Total Phosphorus					≤0.03*
Total Suspended Solids		≤500		≤500	
Zinc		≤5.0		≤5.0	Interim PWQO ≤ 0.02

*Concentration provided to prevent aesthetic deterioration in lakes

Arsenic (GW)

The interim maximum acceptable concentration (IMAC) for arsenic in drinking water is 0.025mg/L (ODWS). The source of arsenic in groundwater is largely the result of minerals dissolving from weathered rocks and soils. Anthropogenic sources include industrial waste, phosphates, fertilizers and coal.

Chloride (SW and GW)

The aesthetic objective for chloride is 250 mg/L (ODWS) and will be used to assess any exceedences. The sources of the chloride ion include sodium chloride (salting of highways), potassium chloride (potash fertilizers), and calcium chloride (wastewater treatment). Other anthropogenic sources of chloride include oil well operations and sewage and irrigation drainage.

Copper (SW)

The aesthetic objective for copper is 1.0 mg/L (ODWS) and will be used to assess any exceedences. Typical sources of copper are from soil erosion, commercial activities (marine paints), agricultural and domestic activities (fungi pesticides, wood preservatives) and wastewaters.

Fluoride (GW)

The maximum acceptable concentration (MAC) for fluoride is 1.5mg/L (ODWS) and will be used to assess any exceedences. Where fluoride is added to drinking water it is recommended that the concentration be adjusted to 1.0 (+/- 0.2) mg/L, which is the optimum level to control

tooth decay (ODWS). The sources of fluoride in groundwater include industrial processes, and phosphorus fertilizers.

Hardness ($CaCO_3$) (GW)

The chemical/physical objective for total hardness operational guideline is 80-100 mg/L (ODWS). This objective is not health related. Any value over 500 mg/L will be treated as an exceedence, as it is considered unacceptable for most domestic purposes. Hardness is caused by dissolved calcium and magnesium, and is expressed as the equivalent quantity of calcium carbonate.

Iron (GW)

The aesthetic objective for iron is 0.30 mg/L (ODWS) and will be used to assess any exceedences. Iron may be present in groundwater as a result of chemically reducing underground conditions which cause mineral deposits. Iron can also leach into groundwater through industrial practices.

Lead (SW)

The maximum acceptable concentration for lead in drinking water is 0.01 mg/L (ODWS) and will be used to assess any exceedences. Typically, the sources of lead are from soil erosion or from industrial processes where lead is emitted into the air and is later deposited into water courses, from stormwater runoff, or directly discharged into a stream.

2.8.1.8 Nitrate (SW and GW)

Elevated nitrates in drinking water can cause serious health issues with infants. Typically, high nitrate levels can be attributed to lawn fertilizers, leaking septic tanks, animal wastes and landfills. The ODWS maximum acceptable concentration for nitrates in drinking water is 10 mg/L as NO_3-N and will be used to assess any exceedences. The Canadian Environmental Quality Guidelines have a limit of 2.9 mg/L NO_3-N and are used as a benchmark for aquatic health.

Sodium (GW)

The aesthetic objective for sodium in drinking water is 200 mg/L (ODWS). Sodium occurs naturally, and is slowly released from rocks and soils. When levels exceed 20 mg/L, the local Medical Officer of Health is required to be notified. Anthropogenic sources of sodium include road salt, runoff from fertilizers, and domestic water softeners.

Total Phosphorus (SW)

Total phosphorus represents all forms of phosphorus present in a water sample. Phosphorus is a required nutrient for all organisms and is naturally occurring in rocks, soils, and organic matter. Elevated total phosphorus relative to ambient levels can be indicative of excessive inputs of fertilizers, detergents, or animal wastes. High levels of phosphorus can be associated with algal blooms and subsequent decreases in dissolved oxygen and a degradation of suitable aquatic conditions.

The Ontario Provincial Surface Water Quality Objectives do not have a firm objective for total phosphorus because of insufficient scientific evidence, but general guidelines are provided. To prevent nuisance algae in lakes and excessive plant growth in streams, total phosphorus levels should remain below 0.02 mg/L, and 0.03 mg/L, respectively. To prevent aesthetic deterioration, levels should remain below 0.01 mg/L (PWQO). Any concentration greater than 0.03 mg/L will be treated as an exceedence.

Total Suspended Solids (SW)

There is no standard or guideline for total suspended solids (TSS), but there is an aesthetic objective for total dissolved solids being less than 500 mg/ L (ODWS). High values of TSS can make drinking water undesirable, affect other domestic uses, and be harmful to aquatic organisms. Suspended solids (silt, clay, organic/inorganic matter, plankton, and other microscopic particles) also allow for the transport of phosphorus, metals and other contaminants.

Zinc (SW)

To maintain the aesthetic objective for zinc, concentrations in drinking water should not exceed 5 mg/L (ODWS; Interim PWQO is 0.02 mg/L for aquatic life). Sources of zinc include corrosion of galvanized materials, electroplaters, domestic and industrial sewage, combustion of solid waste and fossil fuels, stormwater runoff, and soil erosion.

2.8.2 Surface Water Quality Data Analysis

The Provincial Water Quality Monitoring Network (PWQMN) was established in 1964 to collect water chemistry data in streams of Ontario. Water quality parameters were examined for the Grey Sauble SPA on a subwatershed basis where water chemistry data exists from the PWQMN (Map 2.18). The data analyses within the SPA spans from the early 1970s to 2005 depending on the number of years data was collected at each monitoring station on a particular stream.

The Grey Sauble SPA was parsed into 19 subwatersheds based on sampling locations and drainage boundaries. Data exists for eight of the 19 subwatersheds within the Grey Sauble SPA. Data is absent from the Stoney Creek, Gleason Brook, Indian Creek, Johnson Creek, Sucker Creek (S. Bruce Peninsula), Sucker Creek (Meaford), Centreville/Orchard Creek, Little Beaver Creek, and Indian Brook watersheds. For each subwatershed that has existing data, the station that is active and is closest to the mouth will be used to assess the overall water quality of the area and reflect current conditions.

Sampling Uncertainties

The reported values of copper, lead, and zinc in the 1970s and 1980s are often given as higher than the actual values, as concentrations were below detection limits of the laboratory equipment. In these instances, metal concentrations were reported at detection limits, when actual concentrations were less than the reported value. The reported values, therefore, may skew how the results are interpreted or used in identifying trends. For this report the concentrations provided were not modified and were used as provided.

This is also the case for more recent reporting of metals, but better laboratory methods/ equipment and the resulting lower detection limit have greatly reduced the margin of error. Even with these improvements, caution must be exercised when assessing trends or identifying exceedences, as there is a +/-0.011 mg/L for lead concentrations, which can greatly influence the results. Any exceedences will be identified as such, but the reader must be cognizant that the discrepancy between reported and actual concentrations is unknown and analytical limitations must be understood.

Beaver River

Total phosphorus concentrations were near or above the target objective of 0.03 mg/L for the majority of the samples taken at the mouth. There were 26 exceedences observed for the data collected midstream and 23 for exceedences closer to the mouth (Table 2.8.2). Comparing the two monitoring stations for the years 2002-2005, there were 4 values that exceeded the target objective closer to the mouth of the river compared to 2 values midstream. Metals data for the midstream monitoring location was not available. Other indicator parameters were below established drinking water standards/guidelines. Overall, water chemistry concentrations appear to be stable and the available data does not show severe impacts from land use activities.

TABLE 2.8.2 – Summary of water chemistry exceedences for the Beaver River

Beaver River Midstream			
Year	***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences
1978-1982	64	10	15.6
1983-1987	53	8	15.1
1988-1992	54	4	7.4
1993-1996	34	2	5.9
2002-2005	28	2	7.1
TOTAL	233	26	11.2

Beaver River near mouth			
Year	**Total Phosphorus**		
	Total # Samples	# of Exceedences	% Exceedences
2002-2005	28	4	14.3
TOTAL	28	4	14.3

Note: Limit for parameter - - Total Phosphorus: guideline of 0.03 mg/L (PWQO)

Bighead River

Data has been collected from the Bighead River from 1975 to 1996 and from 2002 to 2005. No data exists between 1997 and 2001. No metals data was collected prior to 1980. Also, no nitrate data exists prior to the samples that were collected in 2002. Table 2.8.3 summarizes water chemistry exceedences for the time period monitored. Copper and lead exceedences have decreased for the period monitored, while total phosphorus exceedences have remained constant.

TABLE 2.8.3 – Summary of water chemistry exceedences for the Bighead River

Bighead River									
Year	*Copper*			*Lead*			*Total Phosphorus*		
	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences
1975-1979	0	0	N/A	0	0	N/A	52	9	17.3
1980-1984	40	1	2.5	39	2	5.1	73	20	27.4
1985-1989	111	0	0.0	111	4	3.6	113	32	28.3
1990-1996	126	1	0.8	128	3	2.3	128	21	16.4
2002-2005	27	0	0.0	10	0	0.0	28	5	17.9
TOTAL	304	2	0.7	288	9	3.1	394	87	22.1

Note: Limits for parameters - - Copper: AO of 1.0 mg/L (ODWS); Lead: MAC of 0.01 mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO)

Bothwell's Creek

Data for chloride, total suspended solids and total phosphorus have been collected from 1972 to present. Copper, lead and zinc data are sparse until the early 1980s. Water samples were not tested for nitrates until 2002. Lead and total phosphorus were the only two parameters to exceed established limits (Table 2.8.4), but the occurrences have decreased for the period monitored. Chloride concentrations typically increased for the entire time period. Lead (reported) and total phosphorus levels are above drinking water standards/operational guidelines for all of the five-year groupings. The water chemistry data suggests that urban activities are influencing stream conditions.

TABLE 2.8.4 – Summary of water chemistry exceedences for Bothwell's Creek

Bothwell's Creek						
Year	*Lead*			*Total Phosphorus*		
	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences
1972-1974	2	1	50.0	40	15	37.5
1975-1979	1	1	100.0	62	14	22.6
1980-1984	46	9	19.6	59	7	11.9
1985-1989	50	3	6.0	52	10	19.2
1990-1996	66	0	0.0	67	5	7.5
2002-2005	14	0	0.0	28	2	7.1
TOTAL	179	14	7.8	308	53	17.2

Note: Limits for parameters - - Copper: AO of 1.0 mg/L (ODWS); Lead: MAC of 0.01 mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO)

Centreville Creek

Samples were collected from Centreville Creek from 1973 to 1978. Data for total suspended solids were absent from late 1975 to late 1977. Total phosphorus concentrations were routinely above 0.03 mg/L (Table 2.8.5), while total suspended solids and chloride concentrations were

within acceptable limits. The lack of data prevents any meaningful assessment of present day stream quality conditions.

TABLE 2.8.5 – Summary of water chemistry exceedences for Centreville Creek

Centreville Creek			
Year	***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences
1973-1978	75	13	17.3
TOTAL	75	13	17.3

Note: Limit for parameter - - Total Phosphorus: guideline of 0.03 mg/L (PWQO)

Keefer Creek

Data collection from Keefer Creek was limited to 1995 and 1996 and exists for chloride, total suspended solids and total phosphorus (Table 2.8.6). Chloride and total suspended solids were within acceptable limits while approximately 5% of total phosphorus values were above the operational objective of 0.03 mg/L. The lack of data prevents any meaningful assessment of stream quality conditions.

TABLE 2.8.6 – Summary of water chemistry exceedences for Keefer Creek

Keefer Creek			
Year	***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences
1995-1996	21	1	4.8
TOTAL	21	0	4.8

Note: Limit for parameter - - Total Phosphorus: guideline of 0.03 mg/L (PWQO)

Pottawatomi River

Samples for chloride, suspended solids, and total phosphorus were collected from 1970 until the end of 1996, and from 2002 to 2005. Copper, lead, and zinc data are not available prior to 1983. Nitrate was sampled from 2002 to 2005. No samples were collected between 1996 and 2002.

Lead and total phosphorus were above established limits within most year groupings (Table 2.8.7), but, comparatively, the number of exceedences has decreased in recent years. High values were noted in the 1970s and 1980s, but either limited data was collected or are based on single samples, which make it difficult to assess stream conditions. Chloride values appear to be gradually rising and are comparatively higher than levels in other subwatersheds of the Grey Sauble SPA, which is most likely from urban activities. Stream conditions appear to be more impacted on the Pottawatomi River relative to other watersheds, but the concentration of water chemistry parameters are below established limits.

TABLE 2.8.7 – Summary of water chemistry exceedences for the Pottawatomi River

Pottawatomi River						
Year	*Lead*			*Total Phosphorus*		
	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences
1970-1974	1	1	100.0	64	44	68.8
1975-1979	1	1	100.0	61	18	29.5
1980-1984	15	8	53.3	51	20	39.2
1985-1989	27	1	3.7	29	5	17.2
1990-1996	37	0	0.0	35	4	11.4
2002-2005	11	0	0.0	28	2	7.1
TOTAL	92	11	12.0	268	93	34.7

Note: Limits for parameters - - Lead: MAC of 0.01 mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO)

Sauble River

Chloride, total suspended solids and total phosphorus data has been collected from 1970 to 2005. Copper, lead and zinc data was sparsely collected until around 1985, at which time samples were tested regularly for metals. Nitrate data is only available from 2002 to present.

Exceedences were recorded for lead and total phosphorus (Table 2.8.2.9) and the frequency has decreased in recent years. There appears to be an upward trend in chloride concentrations beginning in the mid-1980s, while the concentrations of the other parameters appear to remain constant when comparing the different temporal groupings. Although most samples were below established limits, it appears that increased chloride concentrations may indicate the watershed is experiencing increased impacts from land use activities.

TABLE 2.8.8 – Summary of water chemistry exceedences for the Sauble River

Sauble River						
Year	*Lead*			*Total Phosphorus*		
	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences
1970-1974	3	2	66.7	63	10	15.9
1975-1979	12	9	75.0	65	9	13.8
1980-1984	20	7	35.0	54	4	7.4
1985-1989	53	1	1.9	54	6	11.1
1990-1996	67	0	0.0	66	6	9.1
2002-2005	8	0	0.0	29	1	3.4
TOTAL	163	19	11.7	331	36	10.9

Note: Limits for parameters - - Lead: MAC of 0.01 mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO)

Sydenham River

Data for chloride, total suspended solids and total phosphorus have been collected from 1975 to present. Metals data for lead are sparser until the mid-1980s, while copper and zinc data are more readily available from the late 1970s. Water samples were not tested for nitrates until 2002.

Chloride concentrations are below the aesthetic objective but increase for the entire time period, and more substantially from the mid-1980s to present. Total phosphorus levels were above drinking water standards/operational guidelines for all of the five year groupings, while observed exceedences for lead occurred in two of the five-year groupings. Table 2.8.9 summarizes observed exceedences of lead and total phosphorus, which have decreased over recent years.

TABLE 2.8.9 – Summary of water chemistry exceedences for the Sydenham River

Sydenham River						
Year	***Lead***			***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences
1975-1979	1	0	0.0	55	10	18.2
1980-1984	46	12	26.1	49	7	14.3
1985-1989	28	0	0.0	32	3	9.4
1990-1996	37	0	0.0	41	1	2.4
2002-2005	13	0	0.0	27	3	11.1
TOTAL	125	12	9.6	204	24	11.8

Note: Limits for parameters - - Lead: MAC of 0.01 mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO)

Waterton Creek

Data for Waterton Creek was collected from 1973 to early 1975. Chloride and total suspended solids were below objectives, while exceedences were noted for total phosphorus (Table 2.8.10). The lack of data prevents any meaningful assessment of present day stream quality conditions.

TABLE 2.8.10 – Summary of water chemistry exceedences for Waterton Creek

Waterton Creek			
Year	***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences
1973-1975	30	9	30.0
TOTAL	30	9	30.0

Note: Limits for parameters - - Total Phosphorus: guideline of 0.03 mg/L (PWQO)

2.8.3 Groundwater Quality Data Analysis and Reporting

The Provincial Groundwater Monitoring Network (PGMN) was joined in 2000 by Grey Sauble Conservation, in partnership with the Ontario Ministry of the Environment and Climate Change. Areas of interest were selected based on the groundwater issues relevant to the times. Within these areas, where possible, existing wells were evaluated for long term monitoring. Where suitable existing wells were not available, new wells were drilled in these areas. Monitoring wells were then equipped with data loggers that record water levels and temperature on an hourly basis.

Under the Provincial Groundwater Monitoring Network, there are 10 groundwater wells being tested once per year within the Grey Sauble SPA (Map 2.18). Table 2.8.11 identifies the various geological materials that the respective monitoring wells represent.

Initial sampling of wells for water quality was undertaken in 2003. All wells were sampled according to protocols established by the MOECC, and samples were analyzed at a common certified laboratory. The PGMN wells are a reliable source of water quality data for the SPA. These samples were all collected using a standard, rigorous protocol designed to minimize or eliminate any contamination of samples. In addition, the samples from these wells were all analyzed for a comprehensive suite of parameters at a single lab, using identical analytical methods, which make them ideal for comparing results between wells.

The major limitation of the PGMN data is the length of record for these analyses. The typical length of record for these samples is limited to the three years of the program's existence, and for the majority of these wells only four samples have been taken at the time of writing.

TABLE 2.8.11 – Attributing wells to formations

Formation/Aquifer	***Wells***
Amabel	GSCA66-1; GSCA77-1; GSCA98-1; GSCA69-1; GSCA190-1
Guelph	GSCA70-1; GSCA78-1; GSCA79-1
Thornbury OB	GSCA68-1

Amabel Formation/Aquifer

Monitoring well 066-1 is located east of Kolapore on the edge of the Niagara Escarpment. A water quality sample was taken in 2003, and there was an exceedence in hardness.

Monitoring well 069-1 is located east of Wiarton near Lake Charles. The well is surrounded by the Niagara Escarpment. A water quality sample was taken in 2003, and there were exceedences in chloride, hardness and iron.

Monitoring well 077-1 is located in the hamlet community of Rocklyn, which is surrounded by agricultural land. A water quality sample was taken in 2003, and there was an exceedence in hardness.

Monitoring well 098-1 is located in the hamlet community of Bognor. The area surrounding the well is largely marsh. A water quality sample was taken in 2003, and there was an exceedence in hardness.

Monitoring well 190-1 is located southwest of Hope Bay on the Bruce Peninsula. A water quality sample was taken in 2003, and there was an exceedence in hardness.

TABLE 2.8.12 – Monitoring Wells in the Amabel Formation/Aquifer

Amabel Formation/Aquifer	ODWS *MAC (mg/L)*	ODWS OA *(mg/L)*	066-1	077-1	098-1	069-1	190-1
			2003	2003	2003	2003	2003
Arsenic (µg/L)	0.025		0.2	0.2	0.3	3	0.5
Chloride (mg/L)		250	2.5	3.5	1.3	266	4.8
Fluoride (mg/L)	1.5		0.04	0.05	0.09	0.75	1.21
Hardness (mg/L)		500	295	310	282	599	2243
Iron (µg/L)		0.3	5	4	20	614	16
Nitrate (mg/L)	10.0		2.285	3.25	0.045	0.045	0.045
Sodium (mg/L)		200	4.6	1.6	1	102	2.2

Guelph Formation/Aquifer

Monitoring station 070-1 is located in the hamlet community of Keady, which is a farming community. A water quality sample was taken in 2003, and there was an exceedence in hardness.

Monitoring station 078-1 is located north of Allenford. The well is located in a rural area. In 2003, there were exceedences in fluoride, hardness and iron.

Monitoring station 079-1 is located west of Clavering, and is surrounded by forested land. A water quality sample was taken in 2003, and there was an exceedence in hardness.

TABLE 2.8.13 – Monitoring Wells in the Guelph Formation/Aquifer

Guelph Formation/Aquifer	ODWS *MAC (mg/L)*	ODWS OA *(mg/L)*	070-1	078-1	079-1
			2003	2003	2005
Arsenic (µg/L)	0.025		0.4	0.1	0.6
Chloride (mg/L)		250	113	47.9	7.3
Fluoride (mg/L)	1.5		0.16	1.74	0.09
Hardness (mg/L)		500	316	269	310
Iron (µg/L)		0.3	1	2460	26
Nitrate (mg/L)	10.0		4.25	0.045	0.045
Sodium (mg/L)		200	54.8	27.8	0.8

Thornbury OB Formation/Aquifer

Monitoring station 068-1 is located in the urban community of Thornbury. A water quality sample was taken in 2003, and there were exceedences in hardness and in iron.

TABLE 2.8.14 – Monitoring Wells in the Thornbury OB Formation/Aquifer

Thornbury OB Formation/Aquifer	ODWS *MAC (mg/L)*	ODWS OA *(mg/L)*	068-1
			2003
Arsenic (µg/L)	0.025		2.7
Chloride (mg/L)		250	12.8
Fluoride (mg/L)	1.5		0.09
Hardness (mg/L)		500	324
Iron (µg/L)		0.3	17900
Nitrate (mg/L)	10.0		0.032
Sodium (mg/L)		200	5.8

2.8.4 Great Lakes Index Stations (GLIS) Monitoring

The Great Lakes Index Stations (GLIS) monitor water quality in the Great Lakes. It is one of several programs by the Ontario Ministry of the Environment and Climate Change to monitor near shore water quality within the Great Lakes. There are 57 sites located in the Great Lakes and two of those are located in proximity to the Grey Sauble SPA, specifically the stations at Colpoy's Bay and Owen Sound (Map 2.18).

Samples are taken in the spring, summer and fall months. There were five samples taken between 2002 and 2003. This was the first sampling session for the Lake Huron/Georgian Bay basin. The chemical/physical parameters being discussed at each site and their respective upper limits, given in parentheses, are: chloride (250 mg/L, ODWS); total phosphorus (0.03 mg/L, PWQO); copper (1 mg/L, ODWS); nitrate (10 mg/L, ODWS); total suspended solids (500 mg/L, ODWS); and zinc (5 mg/L, ODWS).

Figures 2.8.1 and 2.8.2 summarize the water chemistry/physical parameters for the relevant monitoring stations in Georgian Bay. No exceedences were observed.

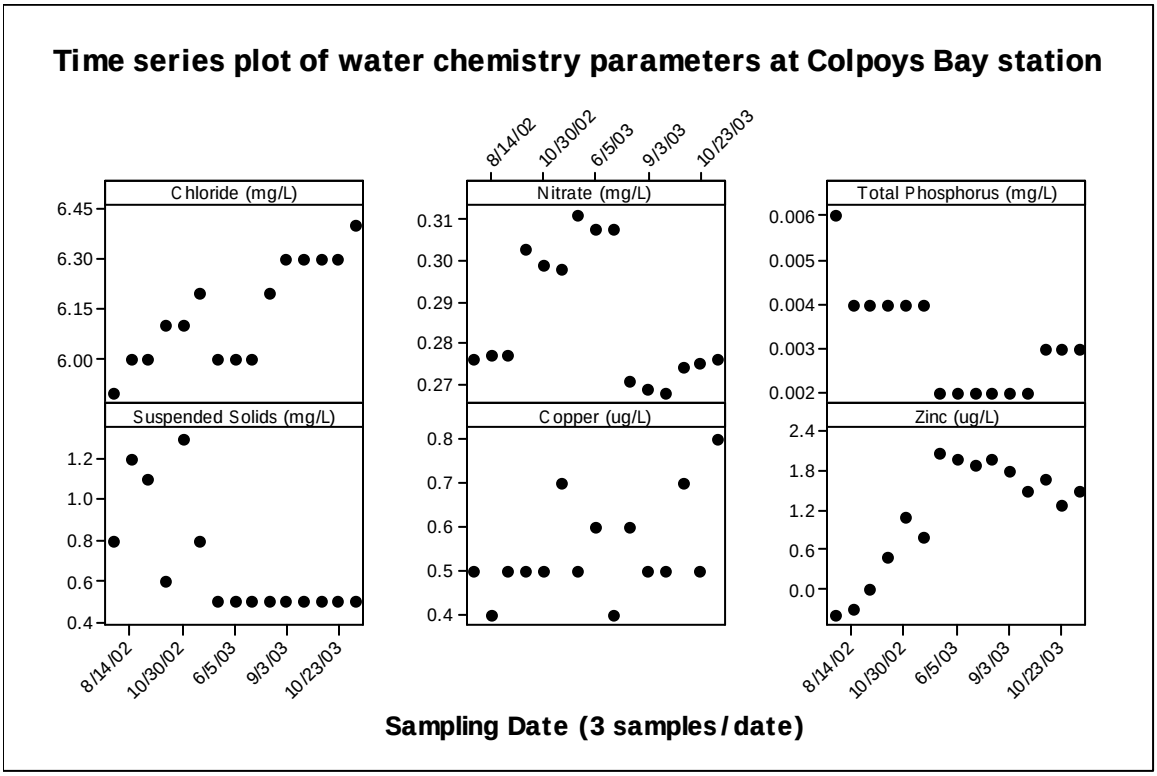

Figure 2.8.1 *Summary of selected water quality parameters from the Great Lakes Index Station monitoring program at the Colpoys Bay (Georgian Bay) location.*

Note: Limits for parameters - - Chloride: AO of 250 mg/L (ODWS); Copper: AO of 1.0 mg/L (ODWS); Nitrate: MAC of 10mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO); Total Suspended Solids: AO of 500 mg/L (ODWS); Zinc: AO of 5.0 mg/L (ODWS)

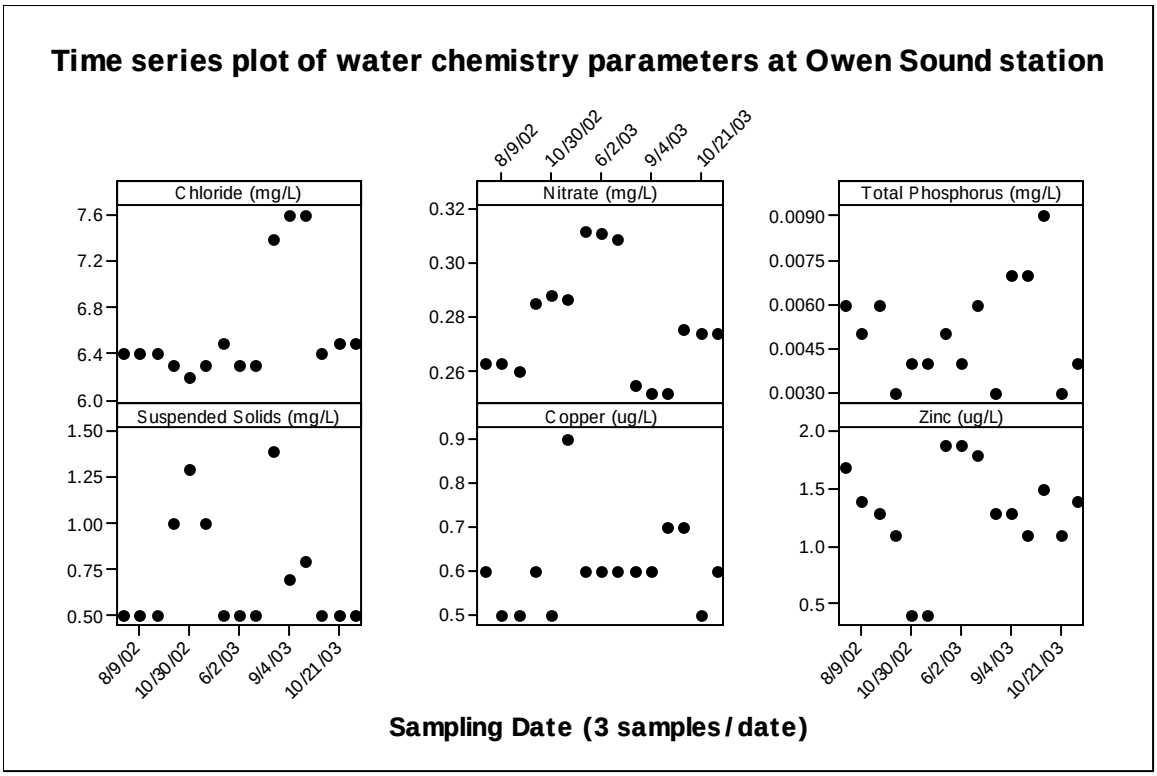

Figure 2.8.2 *Summary of selected water quality parameters from the Great Lakes Index Station monitoring program at the Owen Sound (Georgian Bay) location*

Note: Limits for parameters - - Chloride: AO of 250 mg/L (ODWS); Copper: AO of 1.0 mg/L (ODWS); Nitrate: MAC of 10mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO); Total Suspended Solids: AO of 500 mg/L (ODWS); Zinc: AO of 5.0 mg/L (ODWS)

2.9 Water Use

Water that enters the Grey Sauble SPA is put to many uses, including human consumption, agriculture, industrial, commercial, recreational and ecological. Water takings for municipal drinking water supplies include seven surface water intakes from Lake Huron and Georgian Bay and more than 15 groundwater wells. Agriculture, including livestock feeding operations, relies upon the bedrock aquifers as a water supply, with relatively few takings from surface water. Private consumption within the SPA almost exclusively exploits overburden and bedrock aquifers. The typical taking utilizes a drilled or, less commonly, bored well, which is then redirected into shallow overburden aquifers via a septic system.

Recreational water use is a large economic driver within the SPA. These uses include outdoor recreation, hobby fishing, canoeing/kayaking and tourism and are focused on Lake Huron, Georgian Bay, the larger rivers and the inland lakes. Recreational usage of water is generally non-consumptive and is not considered to impact the quantity of water in the system. However, adequate availability of water is required for the continued recreational use of these resources.

Further discussion on water usage can be found in Chapter 3 of this report. For a detailed analysis of water use, refer to the Saugeen, Grey Sauble, Northern Bruce Peninsula Planning Region Draft Conceptual Water Budget (2007).

2.10 Data and Knowledge Gaps for Watershed Characterization

There is sparse information on fish species and a lack of thermal and fish population studies. Benthic data collection is too sparse and there are gaps in the time series. Little information is available on the extent of invasive species within the Grey Sauble SPA. Much of the forestry information is older; however, new aerial photography is now available that could help to fill this gap. The MOECC wells data set is partially populated and contains spatial inaccuracies.

TABLE 2.10.1 – Data and Knowledge Gaps

WC Deliverable	*Data Set Name*	*Data Gap Problem*	*Comment*
Fish Species		Too sparse	Lack of thermal and fish population studies
Species at risk		Too sparse	Little to no info on spatial extent of species or habitats at risk
Invasive Species		Too sparse	Little to no info on spatial extent of invasive species or habitats at risk
Wells	MOECC Wells	Spatially inaccurate; partially populated	Well type not classified (municipal, communal, etc.) per Regulations 170/03 and 252/05 of SDWA
Forestry		Dated information on forest cover	Lack of recent information on extent of forest cover and composition
Water Quality	PWQMN	Spatial availability of monitoring locations	Watersheds too large to capture potential issues
Water Quality	PGMN	Spatial and temporal availability of data is limited	Not enough data to identify trends

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