Watershed Planning for the Ridgeway Drain
Background Document

Prepared for: Bluewater Shoreline Resident's Association (BSRA)

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Introduction

Recently in Ontario there has been a recognition of the importance of an ecosystem approach to land use planning. An ecosystem approach requires that ecological goals be treated equally with economic and social goals. The boundaries for land use planning, under the ecosystem approach are based on biophysical boundaries; **the primary boundary for an ecosystem approach of land use planning should be the watershed** (Ministry of the Environment and Energy and the Ministry of Natural Resources 1993).

Everyone lives in a watershed – the area that drains to a common waterway, such as a stream, lake, estuary, wetland, or ultimately, the ocean (US EPA 2006). Technically, this area is referred to as a drainage basin or catchment area, though the use of catchment generally is reserved for small basins. The term 'watershed' describes the boundary separating two drainages (in British usage) and is a synonym for catchment (in American usage) (Allan 1995).

A watershed management plan is a proactive document created cooperatively by the community and government agencies to manage the water, land/water interactions and aquatic resources within a particular watershed to protect (and enhance) the health of the ecosystem as land uses change (Ministry of the Environment and Energy and the Ministry of Natural Resources 1993). A recent, local example of the watershed planning process is the watershed plan developed for the Fifteen, Sixteen and Eighteen Mile Creeks by the Niagara Peninsula Conservation Authority (2007).

In the Ausable Bayfield Conservation Authority area, watershed report cards were completed for 16 sub-watersheds. The South Gullies Watershed reaches from Grand Bend to just south of Bayfield and spans three municipalities: Bluewater, Lambton Shores and South Huron. The area is comprised of many relatively small gullies that drain directly into Lake Huron. All of these watersheds are managed by the Ausable Bayfield Conservation Authority (ABCA). The Ridgeway Drain (a sub watershed within the South Gullies, also referred to as the Kading Drain) extends through both South Huron and Bluewater.

The Ridgeway Drain has been identified by the Bluewater Shoreline Residents' Association (BSRA) as a priority area in which to conduct further investigation, with the ultimate goal of creating a watershed planning process to improve water quality. Over the past several years, water quality testing has taken place in the Ridgeway Drain, along with several other drains in the South Gullies area. Results have shown that the Ridgeway Drain generally has poor water quality; this watershed could benefit from a watershed planning exercise that focuses on opportunities for enhancement. Spanning an area of 9.4 km^2, the Ridgeway Drain is located just north of Grand Bend and includes the Village of Dashwood (Map 1).

Watershed Features

Topography

The Ridgeway Drain watershed is generally level, with gently sloping headwaters off the Wyoming Moraine. At the lakeshore, however, land drops off into fairly steep bluffs. Steep banks were also created along the drain as the gully has carved down to lake level (Luinstra *et al.*, 2007) (Map 2).

Physiography

The headwaters of the Ridgeway Drain originate on the west slopes of the Wyoming Moraine and the ravine extends westward towards Lake Huron across the glacial Lake Warren beach and across Lake Warren's beveled till plain, which includes a strip of sand plain (Chapman and Putnam, 1984 *in* Luinstra *et al.*, 2007). The shoreline in this area is highly erodible. This active erosion has created fairly steep bluffs along the shore, including drops of 20 m or more. Active erosion along the drain has also contributed to steep banks near the lake (Luinstra *et al.*, 2007) (Map 3).

Soils

East of Dashwood, the Ridgeway Drain is composed of mainly clay loam soils that range from moderate to poor drainage. West of Dashwood, the soils tend to be poorly-drained and range from clay loam to sandy loam. A narrow band of well-drained soil runs from north to south through Dashwood. The easternmost part of the watershed also has well-drained clay loam (Map 4).

Land Use

The Ridgeway Drain watershed is predominantly an agricultural area, which accounts for 85% of the land. Forested area is particularly low, accounting for 7 % of the land cover in the watershed. It includes several small woodlots at the back of crop fields, a small section of regenerating field, and the HAY-9-C Environmentally Significant Area (ESA). Due to the soil conditions and geology, potential for wetland areas can be seen in 29 % of the land. However, most of this land is used in agriculture at the present time. Urban area makes up 7% of the watershed and is centered on the Village of Dashwood, which has about 225 properties and approximately 400 residents living within its borders. There is also a small lakeshore community at the mouth of the Ridgeway Drain, accounting for 1% of the land use (Map 5).

Natural Heritage Features

The Ridgeway Drain is not a large area, and therefore does not contain an abundance of natural heritage features. One ESA, HAY-9-C, falls within its watershed boundary, and has a total area of 94.5 ha. Part of this area is a relatively undisturbed woodlot that consists of sugar maple, beech, hemlock, and yellow birch. This particular area is also know for a large bird population and houses red fox (ABCA, 1995).

Additionally, the Ridgeway watershed includes a small portion of the Dashwood Area Moraine Earth Science Area of Natural and Scientific Interest (ANSI). The entire ANSI covers 2400 ha, and is representative of the Wyoming Moraine in the Grand Bend-Parkhill area (Earth Sciences Database, 1998 *in* Natural Heritage Information Centre, 2008) (Map 6).

Locally Significant Wetlands

The Ridgeway Drain watershed is fairly devoid of wetland areas; however, the HAY-9-C ESA has significant wetlands within it. Almost 72 ha of the ESA are classified as wetland area. It mainly consists of swamp land throughout a series of wet depressions. There are also open areas of thicket. Ridgeway Drain runs directly through the northern portion of the ESA, but for the most part, the area is poorly drained (ABCA, 1995) (Map 7).

Aquatic Habitat

Due to the sandy and clay till soils in the Ridgeway Drain, it may have a relatively low base flow. This would limit the number and type of fish communities found there (Veliz, 2001). At the present time, however, no fish studies have been completed in the Ridgeway Drain.

Most of the Ridgeway Drain is classified as a warm water stream and therefore would not likely support cold-water sensitive fish species. Further upstream, Ridgeway is classified as a cool water stream, but this portion of the drain does not contain sensitive species either. The headwaters of the drain are tiled (Map 8).

Water Quality

Water quality can be monitored using many different kinds of indicators. Nutrient and pathogen indicators have previously been used to monitor water quality in the Ridgeway Drain. As part of the Clean Up Rural Beaches (CURB) program, nutrient and *Escherichia coli* (*E. coli*) concentrations were monitored in the drain throughout 1987 and 1988. Water samples were collected by the Ausable Bayfield Conservation Authority (ABCA) near the drain's junction with Highway 21 (Map 9). Between 2003 and 2008, the outlet of the Ridgeway Drain to Lake Huron was monitored for *E. coli* by either the Huron County Health Unit or the ABCA. Water samples were collected near the drain's outlet to Lake Huron (site GULRW2) during the summer swimming season (June to September). The data from these two monitoring programs are presented in this report.

Total Phosphorus

Total phosphorus (TP) includes phosphorus that is dissolved in water and phosphorus that binds to organic and inorganic material in water. In many aquatic systems, phosphorus is the nutrient that limits plant growth and, when phosphorus is added, the first response may be increased growth. While this may create an aesthetic concern, increased plant growth is beneficial to aquatic life. Beyond a certain point, however, detrimental effects become apparent as nutrient over-enrichment results in excess plant growth. The Government of Ontario established a

Provincial Water Quality Objective (PWQO) for TP of 0.03 mg/L to prevent eutrophication (excessive algae and aquatic plant growth, shortened food chains, changes in the aquatic plant and animal communities; MOEE, 1994). Average TP concentrations in the Ridgeway Drain during 1987 and 1988 were approximately three times the PWQO (Table 1, Figure 1) and more than 85 % of the samples collected exceeded the PWQO (Table 2). These high TP concentrations may have resulted in eutrophic conditions in the Ridgeway Drain.

Nitrate

Nitrate is the most stable form of inorganic nitrogen in streams and drains, and the primary source of nitrogen for algae and aquatic plants. Other forms of inorganic nitrogen (nitrite and ammonia) are less commonly found in streams and drains because they are quickly converted to nitrate by bacteria. When dissolved oxygen is plentiful in aquatic systems, rising concentrations of inorganic nitrogen increase the risk of algae blooms and eutrophication. Laboratory analyses often determine the concentration of nitrogen (N) in a water sample that is incorporated into nitrate molecules (NO_3^-). There are three standards for nitrate-N to consider when assessing nitrate-N concentrations. The Canadian Council of Ministers of the Environment (CCME, 2003) suggested that nitrate-N concentrations greater than 0.9 mg/L are generally associated with eutrophic conditions. The CCME (2007) also recommended a nitrate-N concentration of 3 mg/L as a draft Canadian Water Quality Guideline for protecting aquatic life from direct toxic effects. The Ontario Drinking Water Guideline for nitrate-N is 10 mg/L (MOE, 2006).

Nitrate-N concentrations may have contributed to eutrophic conditions in the Ridgeway Drain. Average nitrate-N concentrations exceeded 0.9 mg/L in 1987 and were near this value in 1988 (Table 1, Figure 1). More than approximately half of the samples collected had nitrate-N concentrations greater than 0.9 mg/L (Table 2). While average nitrate-N concentrations were not greater than the 3 mg/L guideline for protecting aquatic life, more than 40 % of the samples exceeded this guideline. Aquatic life in the Ridgeway Drain may therefore have been at risk of direct toxic effects due to nitrate. Average nitrate-N concentrations were not higher than the 10 mg/L drinking water guideline; however, at least 20 % of the samples exceeded the guideline.

Un-ionized Ammonia

Un-ionized ammonia may be toxic and lethal to aquatic animals, such as fish, if concentrations (measured as the concentration of N in a water sample that is incorporated into un-ionized ammonia molecules) exceed the Canadian Water Quality Guideline of 0.019 mg/L (CCME, 2000). The concentration of un-ionized ammonia depends on the concentration of total ammonia (the sum of un-ionized ammonia gas (NH_3) and ionized ammonia (NH_4^+)), water pH, and water temperature. During the summer months, daily increases in water pH and temperature can shift ammonia into the toxic, un-ionized form. Un-ionized ammonia-N concentrations in the Ridgeway Drain rarely reached a level at which they could be toxic to aquatic animals. Average concentrations were less than the 0.019 mg/L guideline and only 7 % of the samples collected exceeded the guideline (Tables 1, 2, Figure 1).

Table 1. Geometric mean of nutrient concentrations (total phosphorus, nitrate as nitrogen, and un-ionized ammonia as nitrogen), turbidity, suspended solids concentration, conductivity, and biochemical oxygen demand (BOD) in the Ridgeway Drain near Highway 21 during 1987 and 1988.

Year	Total Phosphorus (mg/L)	Nitrate –N (mg/L)	Un-ionized Ammonia-N (mg/L)	Turbidity (FTU)	Suspended Solids (mg/L)	Conductivity (µS/cm)	BOD (mg/L)	Number of Samples
1987	0.090	1.6	no data	13.4	12.3	602	1.33	31[a]
1988	0.105	1.0	0.0009	12.4	no data	560	1.56	30[b]

[a] Number of samples was 27 for suspended solids.
[b] Number of samples was 28 for turbidity and 26 for BOD.

Table 2. Percentages of samples exceeding freshwater objectives or guidelines for total phosphorus, nitrate-N, and un-ionized ammonia-N in the Ridgeway Drain near Highway 21 during 1987 and 1988. For details on the objectives and guidelines, please refer to the text of this report.

Year	Total Phosphorus (mg/L)	Nitrate-N (mg/L)			Un-ionized Ammonia-N (mg/L)	Number of Samples
	Percentage of Samples > 0.03 mg/L	Percentage of Samples > 0.9 mg/L	> 3 mg/L	> 10 mg/L	Percentage of Samples > 0.019 mg/L	
1987	87	58	48	26	no data	31
1988	90	47	43	20	7	30

Table 3. Geometric mean and 90th percentile of *Escherichia coli* concentrations, in colony forming units (cfu) per 100 mL, and percentage of samples exceeding 100 cfu/100 mL and 1000 cfu/100 mL in the Ridgeway Drain during 1987 to 1988 and 2003 to 2008.

Site	Year	*Escherichia coli* (cfu/100 mL)		Percentage of Samples		Number of Samples
		Geometric Mean	90th Percentile	> 100 cfu/100 mL	> 1000 cfu/100 mL	
Highway 21	1987	324	3800	77	19	31
	1988	514	2850	86	27	44
Outlet	2003	605	868	100	0	7
	2004	1611	6900	91	73	11
	2005	1153	2290	91	64	11
	2006	1509	9722	100	54	13
	2007	482	1520	77	38	13
	2008	354	748	100	0	13

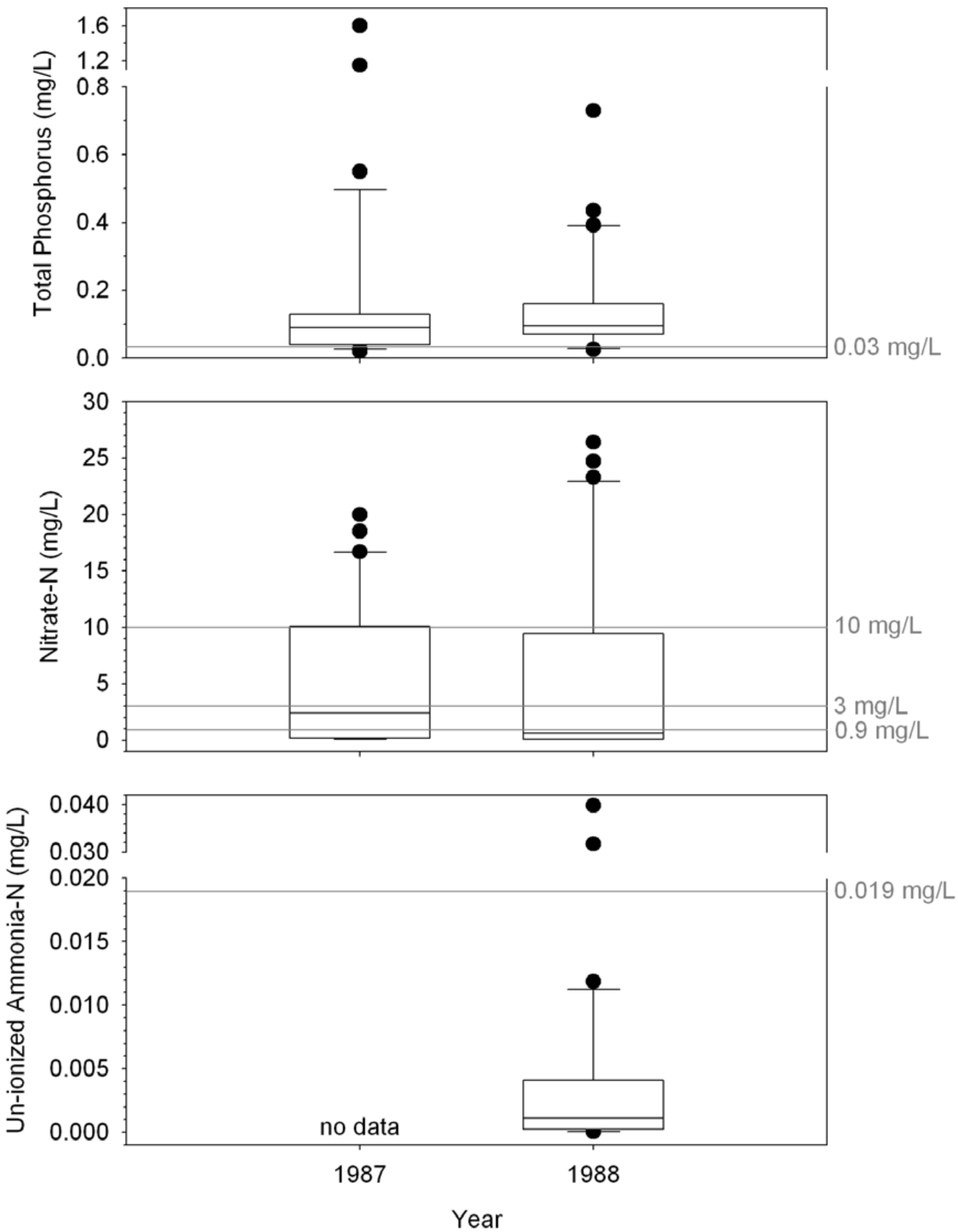


Figure 1. Median nutrient concentrations (total phosphorus, nitrate as nitrogen, and un-ionized ammonia as nitrogen) in the Ridgeway Drain near Highway 21 during 1987 and 1988. Box represents 50 % of the concentrations and whiskers represent 80 %. All outliers (*i.e.*, observations that are far outside the range of the rest of the data) are presented as circles. Light grey lines mark standards for each nutrient (see text for details). Note breaks in the scales for total phosphorus and un-ionized ammonia-N.

Turbidity and Suspended Solids

Turbidity and suspended solids provide complementary information about water quality. Turbidity is a measure of the amount of light in an aquatic system that is scattered or absorbed by solids suspended in the water. Suspended solids are a main component of turbidity and a measure of the amount of material (*e.g.*, sediment and algae) that is suspended in the water of an aquatic system. High turbidity values indicate that the amount of light being transmitted through the water is limited, which may restrict aquatic plant photosynthesis. High suspended solids concentrations can negatively impact feeding and respiration by aquatic animals, such as fish.

Standards for turbidity and suspended solids are difficult to develop because there are many site-specific conditions that affect the response of aquatic organisms to suspended material. As a result, a variety of standards have been set by different environmental agencies. The CCME (2002) recommends turbidity and suspended solids guidelines for the protection of aquatic life based upon flow condition (clear versus high or turbid), length of exposure, and background levels. For example, under clear flow conditions and short-term exposure (*e.g.*, 24 hours), suspended solids concentrations should increase by no more than 25 mg/L above background levels (CCME, 2002). Data currently available for the Ridgeway Drain are insufficient to evaluate the drain in relation to the CCME guidelines. According to the European Inland Fisheries Advisory Committee (EIFAC, 1965, *in* Kerr, 1995), good fisheries can be maintained with suspended solids concentrations up to 80 mg/L, and poor fisheries are likely to be associated with suspended solids concentrations greater than 400 mg/L. Average turbidity values for the Ridgeway Drain were not statistically different between 1987 and 1988 (Table 1, Figure 2). The average and range of values were also within the range of historical values reported for the nearby Ausable River watershed (Nelson *et al.*, 2003). More than half of the samples collected from the Ridgeway Drain in 1987 had suspended solids concentrations less than 25 mg/L and nearly 90 % of the samples were under 80 mg/L (Figure 2). Therefore, suspended solids would rarely have impacted fisheries in the drain, but could have affected some sensitive species.

Conductivity

Conductivity is a measure of the electrical conductance of water and can be used to estimate the concentration of total dissolved ions, including bicarbonate (HCO_3^-) and sodium (Na^+). It reflects the rock composition and soil type of the landscape surrounding a watercourse, but can also be influenced by pollutants such as road salts and sewage. Higher conductivity values can result from higher inputs of dissolved ions or from lower water levels, which concentrate the ions present in the water. No guidelines have been set for conductivity. Average conductivity values for the Ridgeway Drain in 1987 were not statistically different from those in 1988 (Table 1, Figure 3).

Biochemical Oxygen Demand

Biochemical oxygen demand (BOD) is the amount of oxygen needed by bacteria to combine organic material with oxygen over a specific period of time (*e.g.*, five days). It is used as an indicator of the amount of organic waste that is present in water. No guidelines have been set for

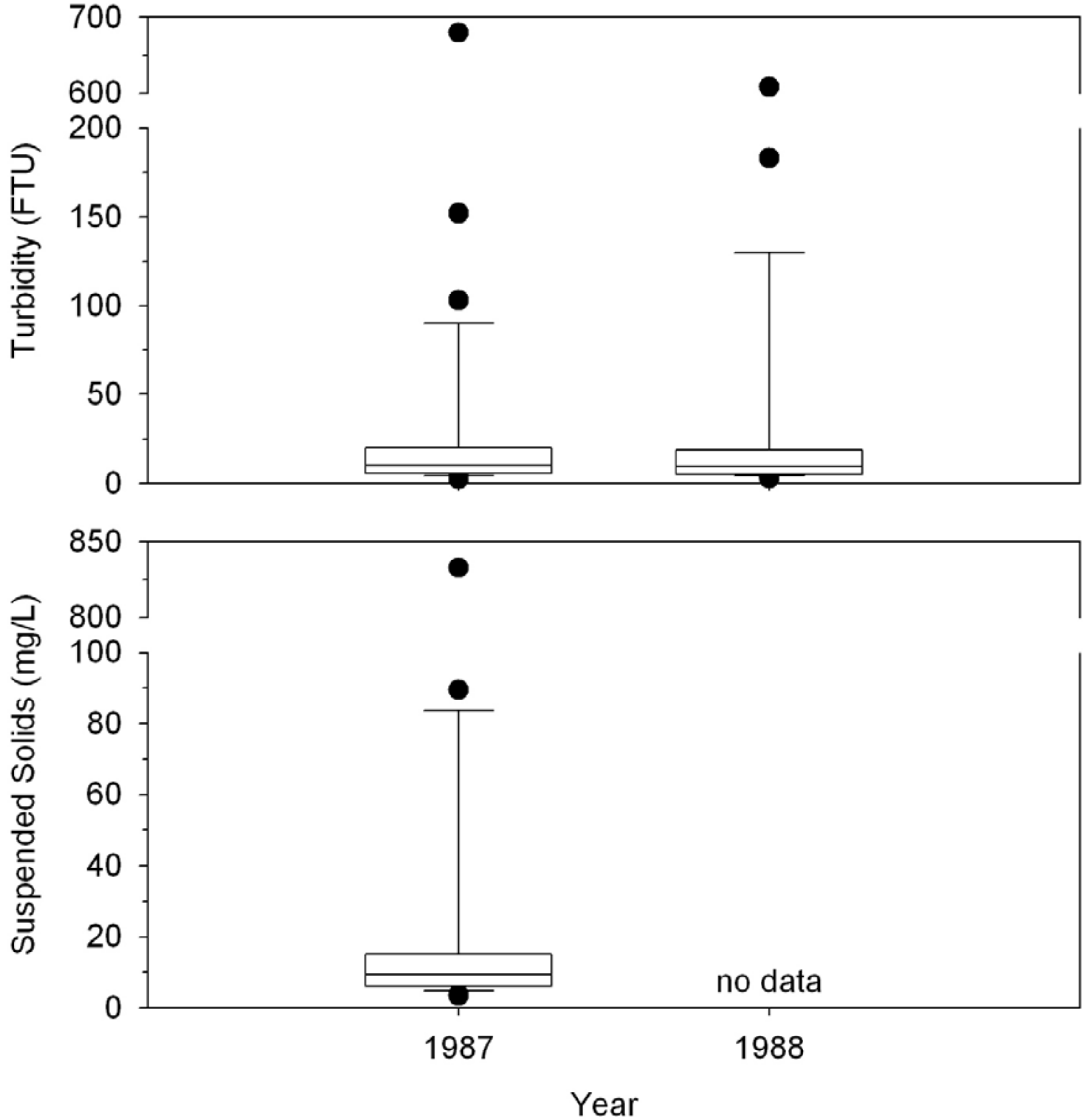


Figure 2. Median turbidity and suspended solids concentration in the Ridgeway Drain near Highway 21 during 1987 and 1988. Box represents 50 % of the concentrations and whiskers represent 80 %. All outliers (*i.e.*, observations that are far outside the range of the rest of the data) are presented as circles. Note the breaks in the scales for turbidity and suspended solids.

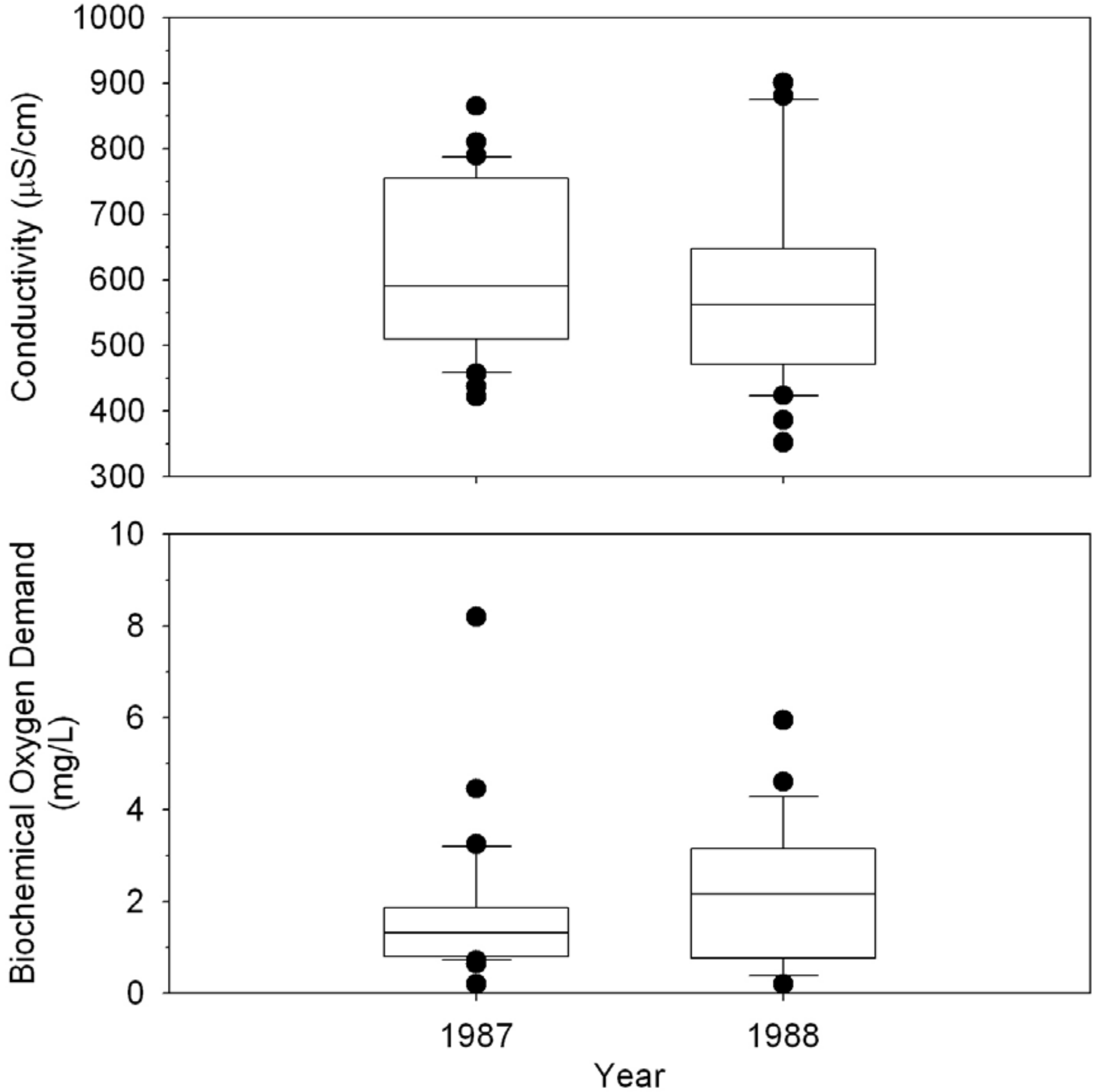


Figure 3. Median conductivity and biochemical oxygen demand in the Ridgeway Drain near Highway 21 during 1987 and 1988. Box represents 50 % of the concentrations and whiskers represent 80 %. All outliers (*i.e.*, observations that are far outside the range of the rest of the data) are presented as circles.

BOD in streams or drains. There was no statistical difference in the average BOD for the Ridgeway Drain in 1987 versus 1988 (Table 1, Figure 3).

Escherichia coli

E. coli is a bacterium that is found in the intestinal tract of warm-blooded animals. While *E. coli* itself is not a threat to the environment, its presence in water collected from drains may indicate contamination by other harmful bacteria, viruses, or parasites that are associated with animal wastes (*i.e.*, sewage or manure). The Ontario Ministry of Health and Long-term Care established a recreational guideline for *E. coli* of 100 colony forming units (cfu) per 100 mL (MOEE, 1994). Average (geometric mean and median) *E. coli* concentrations from the Ridgeway Drain exceeded the guideline during all years when sampling took place (Table 3, Figure 4). At least three quarters of the samples collected in each year exceeded the 100 cfu/100 mL guideline. *E. coli* was particularly abundant between 2004 and 2006, when average concentrations also exceeded 1000 cfu/100 mL. Other years sampled during the 2000 decade had average concentrations that were consistent with those from the 1980s. The 90th percentile of *E. coli* concentrations (Table 3) is the concentration below which 90 % of the samples for a given year occur. For all years except 2003 and 2008, the 90th percentile exceeded 1000 cfu/100 mL in the Ridgeway Drain. The magnitude of fluctuations in *E. coli* concentrations was lower during the 2000s than in the 1980s (Figure 4).

Recommendations

1. Continue monitoring water quality at both the mouth of the Ridgeway Drain and in the lake.
2. Expand the sampling regime to include sites further upstream in the drain.
3. Secure funding for a long-term sampling regime.
4. Begin a dialogue with and inform the community about the watershed planning process.
5. Create an advisory committee to guide the watershed planning process.
6. Begin initiating water quality improvement activities in the Ridgeway Drain watershed.

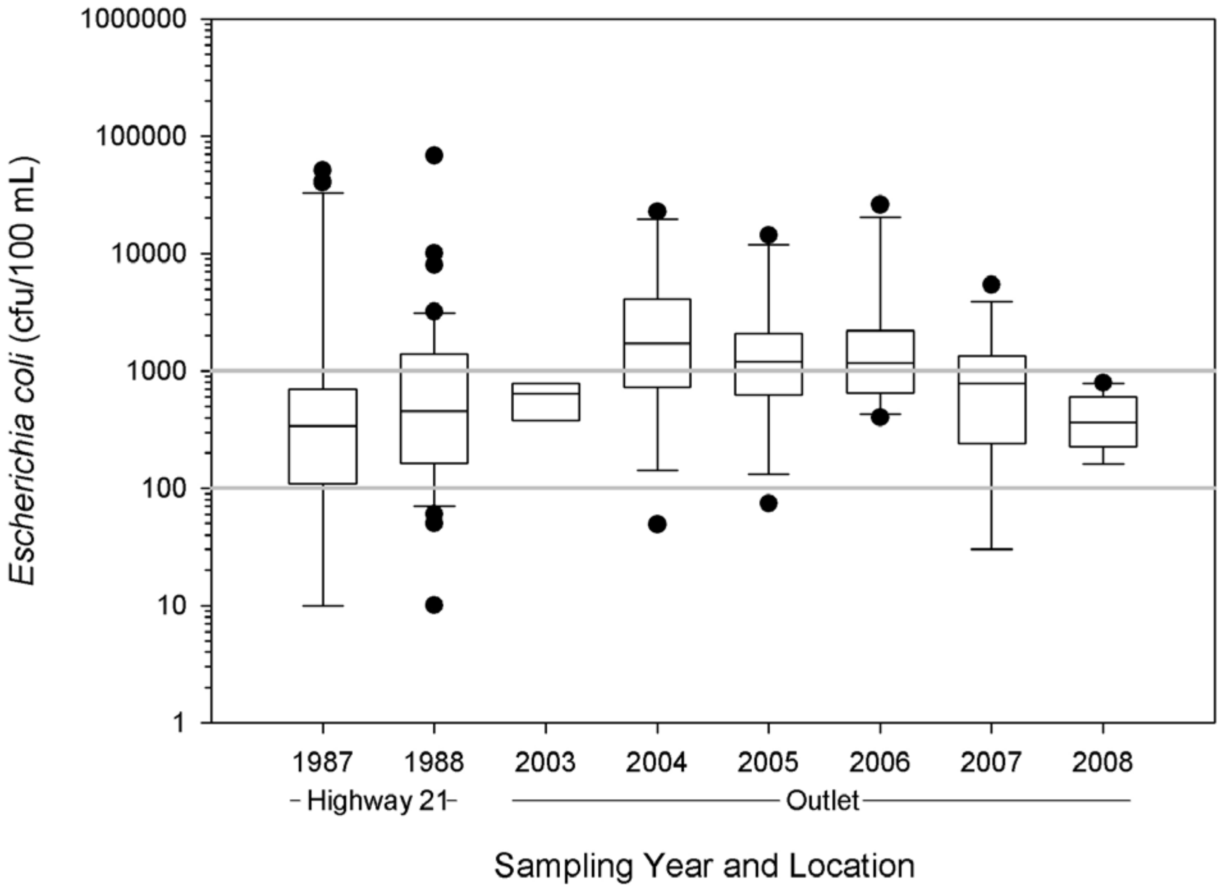


Figure 4. Median *Escherichia coli* concentrations in the Ridgeway Drain during 1987 to 1988 and 2003 to 2008. Box represents 50 % of the concentrations and whiskers represent 80 %. All outliers (*i.e.*, observations that are far outside the range of the rest of the data) are presented as circles. Light grey lines mark the 100 cfu/100 mL Ontario recreational guideline and 1000 cfu/100 mL.

References

ABCA (Ausable Bayfield Conservation Authority). 1995. Environmentally Significant Areas, Appendix to: Environmentally Significant Areas Watershed Plan Report #2 (1984). ABCA. Exeter, Ontario. 111 p.

Allan, J.D. 1995. Stream Ecology: Structure and function of running waters. Chapman and Hall, London.

CCME (Canadian Council of Ministers of the Environment). 2000. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Ammonia. In CCME, 2000, Canadian Environmental Quality Guidelines.

CCME (Canadian Council of Ministers of the Environment). 2002. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Total Particulate Matter. In CCME, 1999 (updated 2002), Canadian Environmental Quality Guidelines.

CCME (Canadian Council of Ministers of the Environment). 2003. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Nitrate Ion. In CCME, 1999 (updated 2003), Canadian Environmental Quality Guidelines.

CCME (Canadian Council of Ministers of the Environment). 2007. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Summary Table. In CCME, 1999 (updated 2007), Canadian Environmental Quality Guidelines.

Kerr, S. J. 1995. Silt, turbidity and suspended sediments in the aquatic environment: an annotated bibliography and literature review. Ontario Ministry of Natural Resources, Southern Region Science and Technology Transfer Unit Technical Report TR-008.

Luinstra, B., Snell, L., Steele, R., Walker, M. and M. Veliz. 2007. Ausable Bayfield & Maitland Valley Source Protection Region – Watershed Characterization. Ontario Ministry of the Environment. 97 p.

MOE (Ministry of the Environment). 2006. Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines. Government of Ontario Publication No. 4449e01.

MOEE (Ministry of Environment and Energy). 1994. Water Management Policies, Guidelines, and Provincial Water Quality Objectives of the Ministry of Environment and Energy. Government of Ontario Publication No. 3303E.

Ministry of the Environment and Energy and the Ministry of Natural Resources. 1993. Water Management on a Watershed Basis: Implementing an Ecosystem Approach. Toronto, Ontario

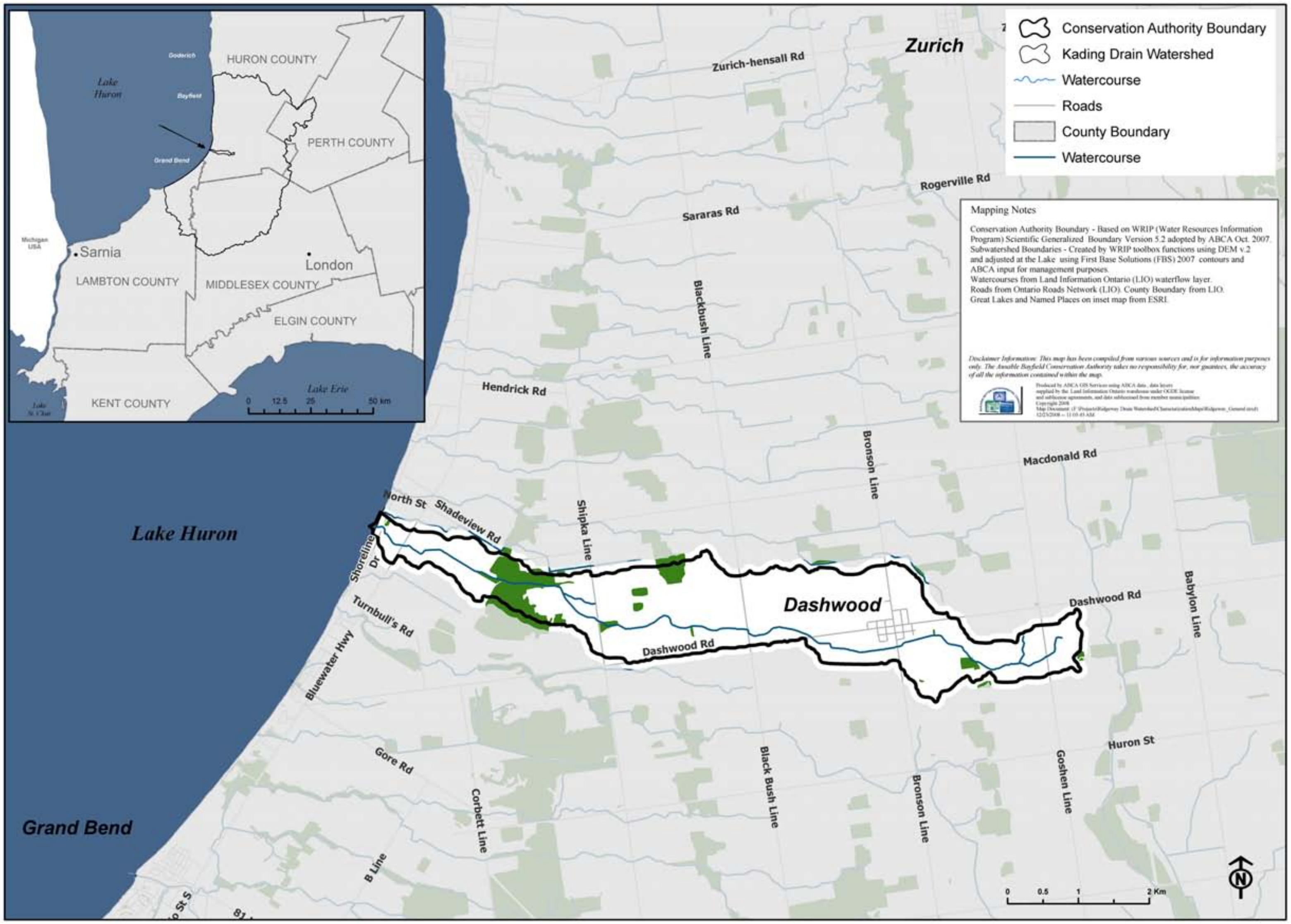
Natural Heritage Information Centre. 2008. Natural Areas General Report. Data provided by the Natural Heritage Information Centre, Ontario Ministry of Natural Resources. 12 December 2008. http://nhic.mnr.gov.on.ca/MNR/nhic/areas.cfm.

Nelson, M., M. Veliz, S. Staton, and E. Dolmage. 2003. Towards a Recovery Strategy for Species at Risk in the Ausable River: Synthesis of Background Information. Ausable Bayfield Conservation Authority and Fisheries and Oceans Canada. Ontario.

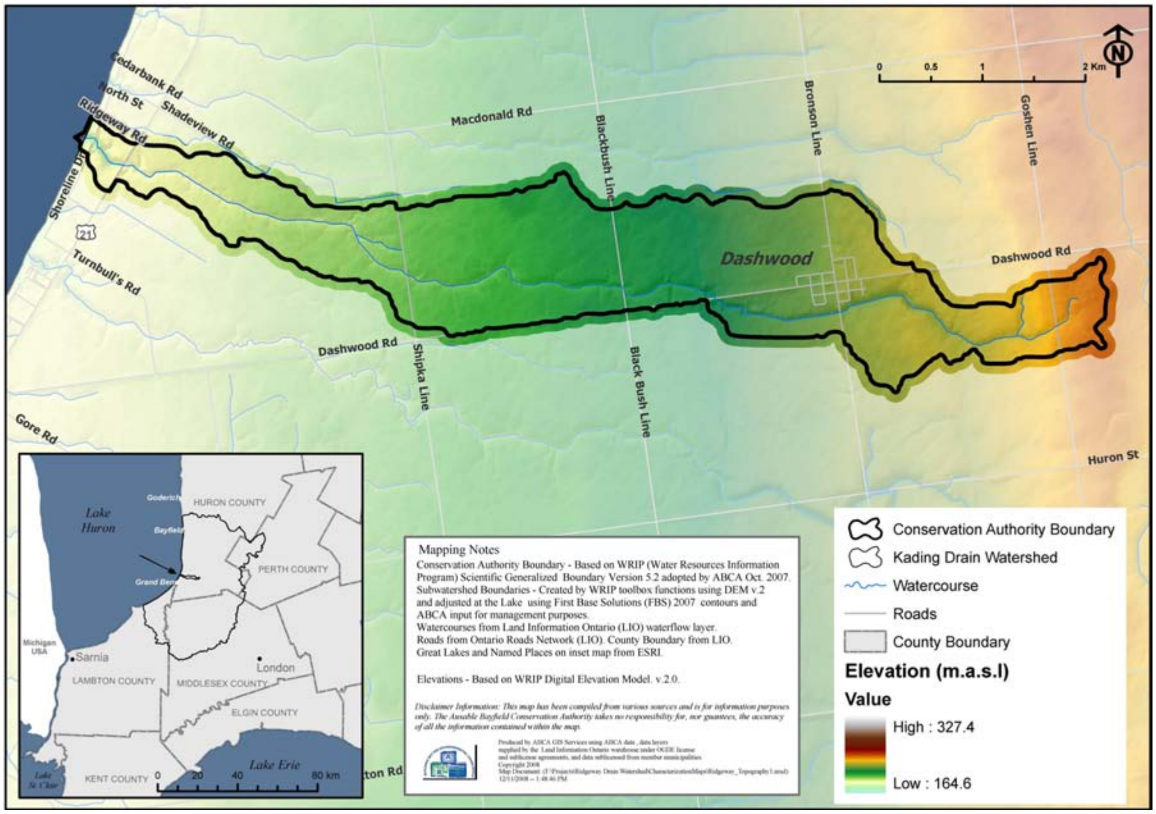
Niagara Peninsula Conservation Authority. 2007. Fifteen, Sixteeen and Eighteen Mile Creeks Watershed Plan: DRAFT Watershed Characterization and Issues Identification. Niagara Peninsula Conservation Authority. 25 Thorold Road West, 3rd Floor, Welland, Ontario L3C 2W3

United States Environmental Protection Agency. 2006. A handbook for developing watershed plans to restore and protect our waters. Chapter 4: http://www.epa.gov/owow/nps/watershed_handbook/pdf/ch04.pdf

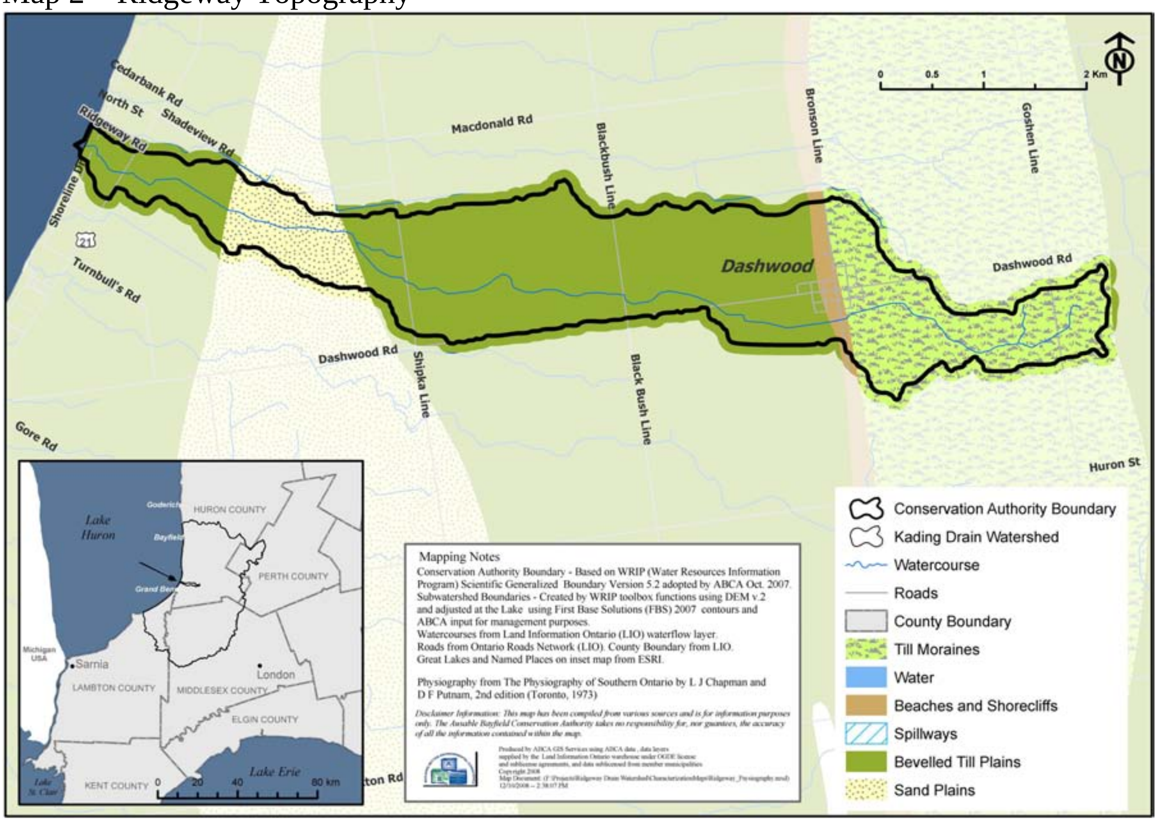
Veliz, M. 2001. Fish Management Habitat Plan. Ausable Bayfield Conservation Authority. Exeter, Ontario. 86 p.



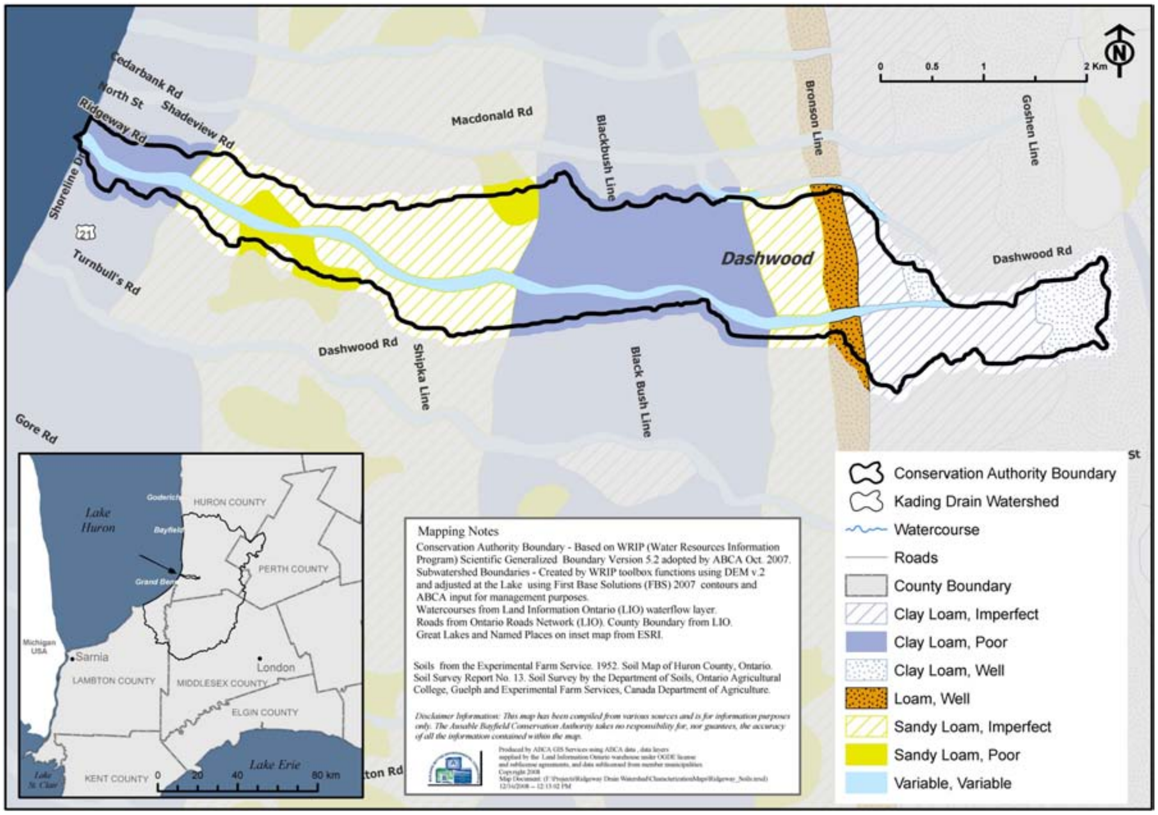
Map 1 – Ridgeway Drain



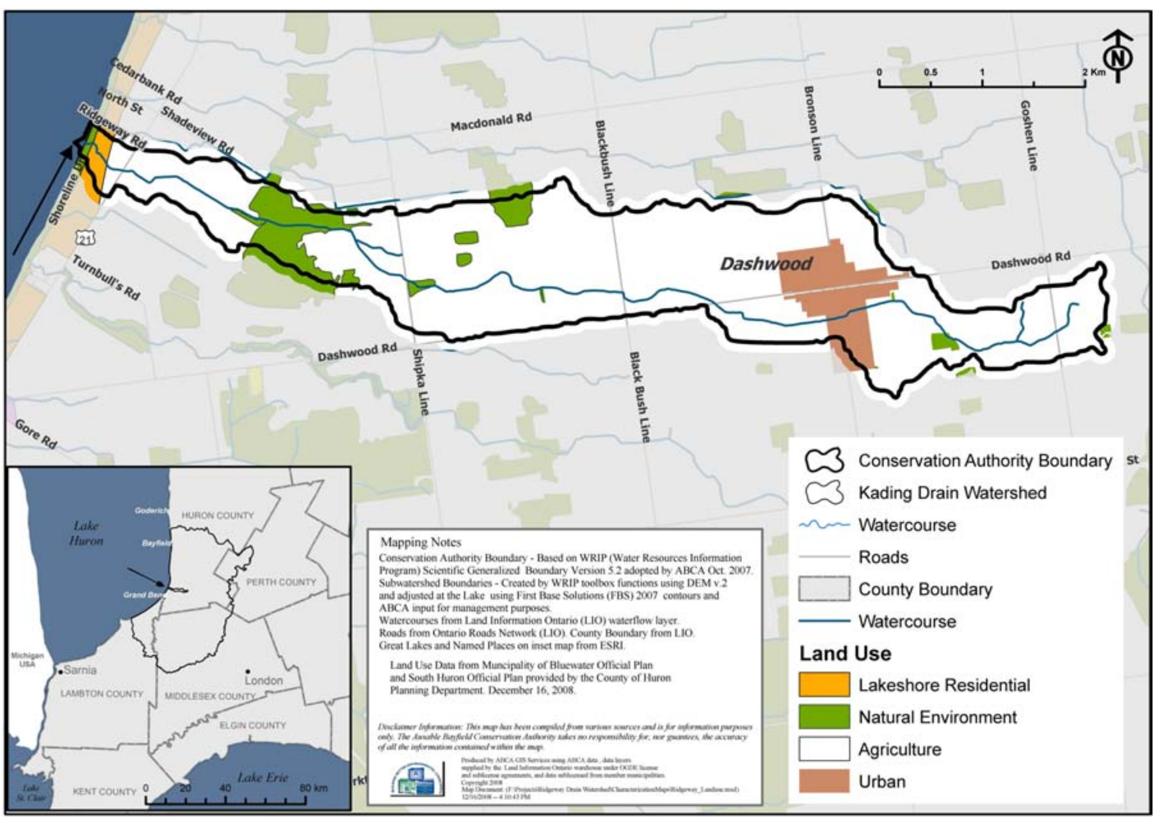
Map 2 – Ridgeway Topography



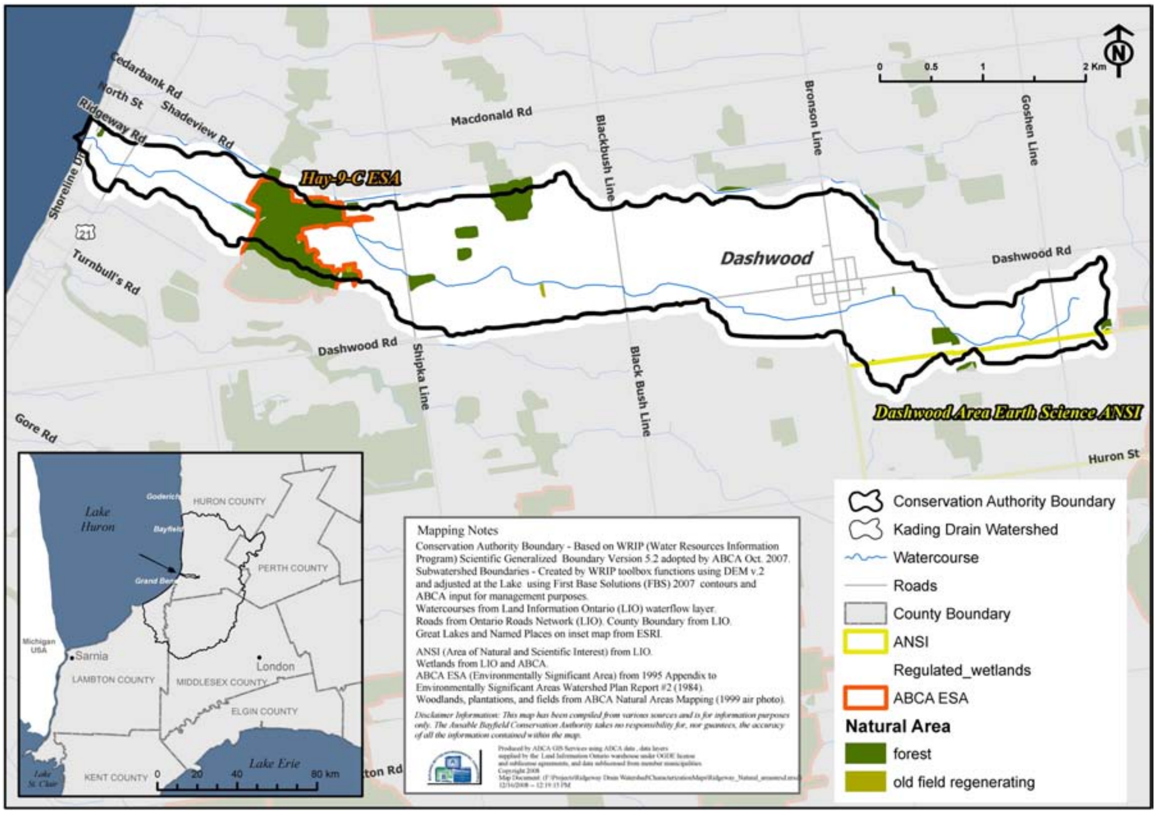
Map 3 – Ridgeway Physiography



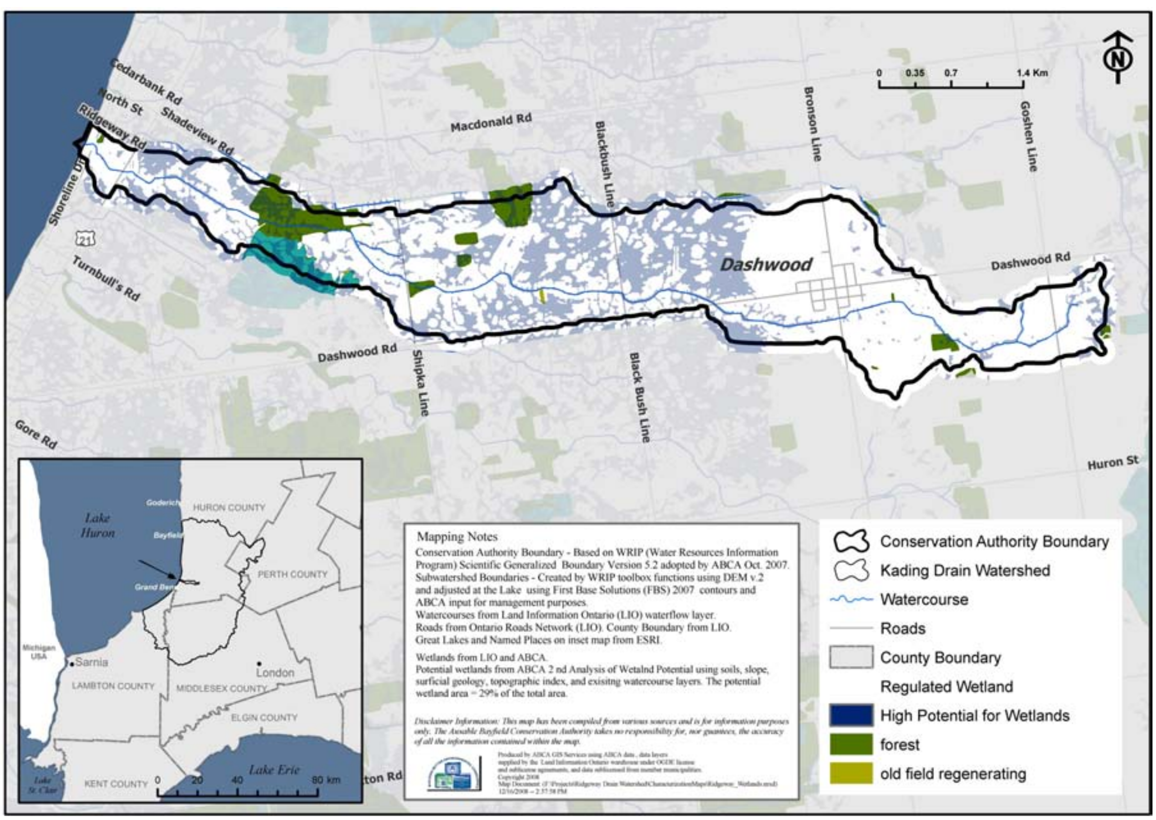
Map 4 – Ridgeway Soils



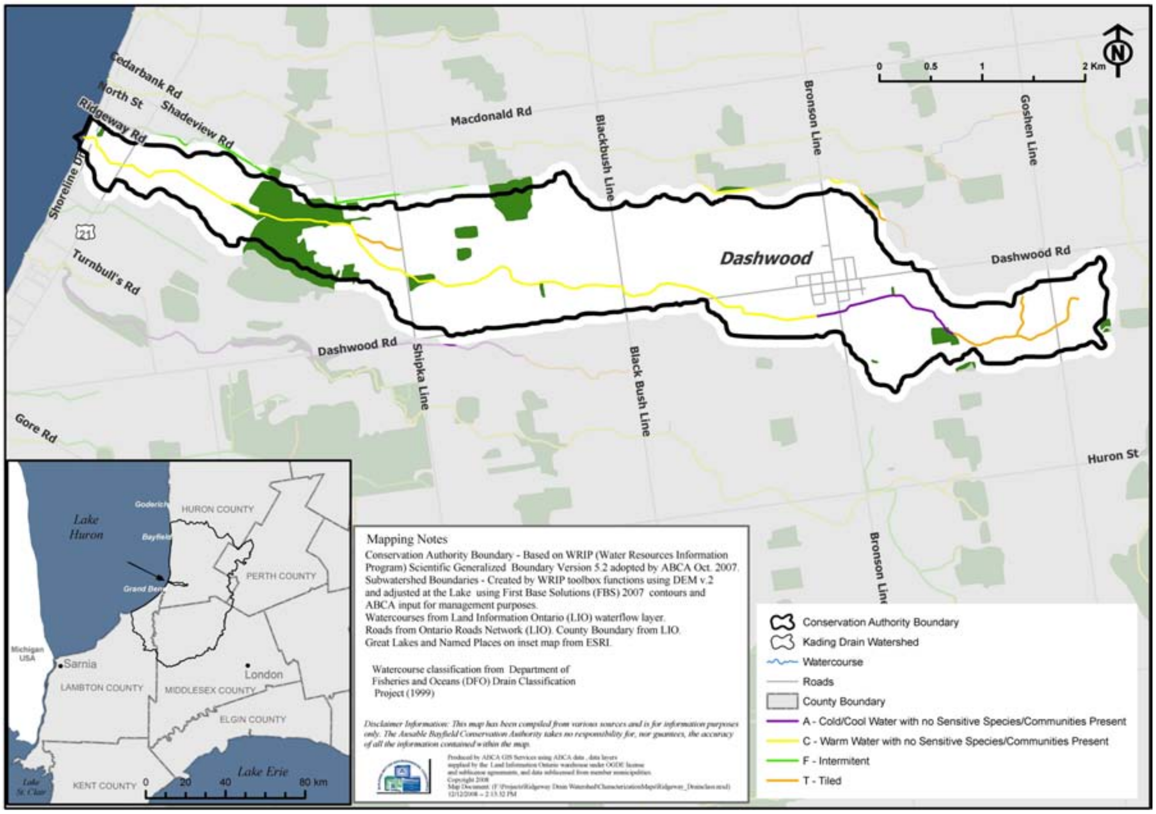
Map 5 – Ridgeway Land Use



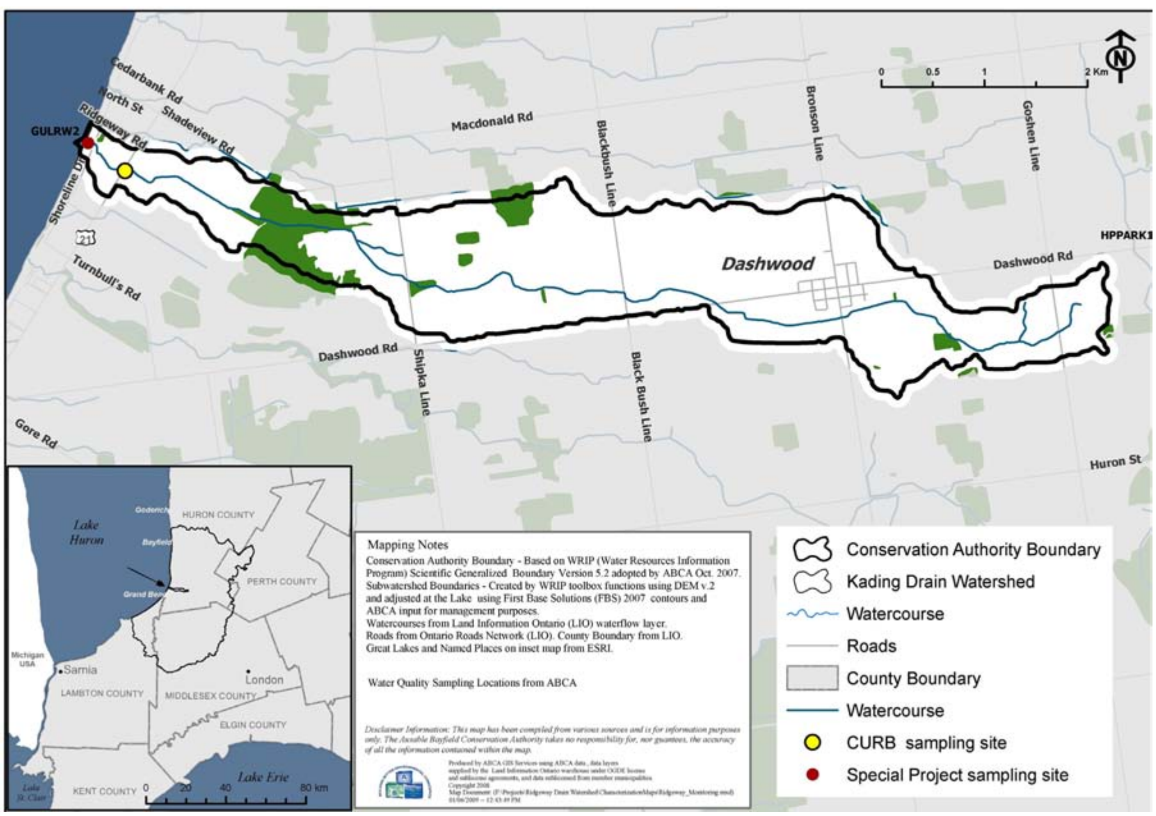
Map 6 – Ridgeway Natural Heritage Features



Map 7 – Ridgeway Significant Wetlands



Map 8 – Ridgeway Drain Classification



Map 9 – Ridgeway Water Quality Monitoring Locations