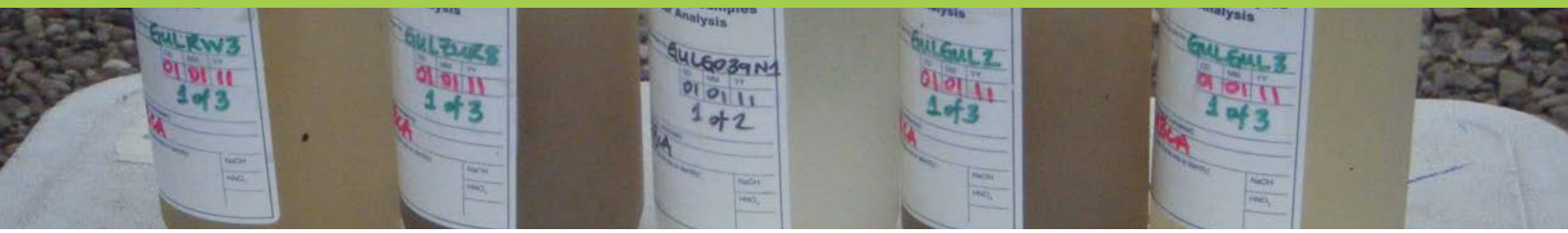


Chapter 2: Methods and Results

Since the release of the first Ausable Bayfield watershed report card in 2007, a review of the methods by Conservation Ontario revealed the need for a more standardized set of indicators and evaluation system. These new guidelines (Conservation Ontario 2011) allow for improved consistency and use of information across all conservation authorities.

Please note that there have been some changes in the land use information from the previous report card. These changes have resulted in what appears to be a decrease in agricultural land and an increase in natural area. In reality, these changes are a result of the mapping methodology, which has allowed for features that had previously been classified as agriculture, to now be classified as natural (*e.g.*, ditch, fencerow, windbreak). Furthermore, the first watershed report card simply looked at what was classified as 'woodlot', not the more comprehensive 'natural' category of this watershed report card.

2.0 The Process

The Ausable Bayfield area has been divided into 16 watersheds for reporting purposes. These watersheds represent areas to which people from the watershed community can relate, and that are of an appropriate size for the Ausable Bayfield Conservation Authority (ABCA) to monitor.

Watershed boundaries (Map 2) were determined such that each of the 16 watersheds is:

- A section of the main branch of the Ausable or Bayfield River;
- A major tributary to the Ausable or Bayfield Rivers; or
- A group of watercourses that drain directly into Lake Huron (Lakeshore Watersheds).

There are four main resource categories that contribute to our understanding of the general watershed condition: forest conditions, wetland cover, and surface and groundwater quality. The indicators we evaluated for each category are as follows:

- **Forest conditions** – percentage of forest cover, forest interior, streamside cover;
- **Wetland cover** – percentage of wetland cover;
- **Surface water quality** – concentrations of total phosphorus and *Escherichia coli* (E. coli), and an index of benthic invertebrates (small animals that live in the bottom of streams and indicate stream health); and
- **Groundwater quality** – concentrations of nitrate and chloride.

These indicators provide a measure of ecosystem health and are explained further in section 2.1. Conservation Ontario (2011) also provided a grading system to interpret these indicators. Except for the indicators of groundwater quality, the indicators were summarized and assigned a grade for each of the 16 watersheds of the ABCA area.

Another important part of the watershed report card process was to involve key stakeholders in the review of both the concept and a draft of the report card. Before embarking on the second edition of the report card, copies of the first edition were sent to stakeholders within the watershed for their comments on what format and content was useful and what was not helpful. ABCA directors, on behalf of member municipalities, also provided feedback regarding an earlier 2013 version. These comments and suggestions were incorporated into this document.

2.1 Measurements of Ecosystem Quality

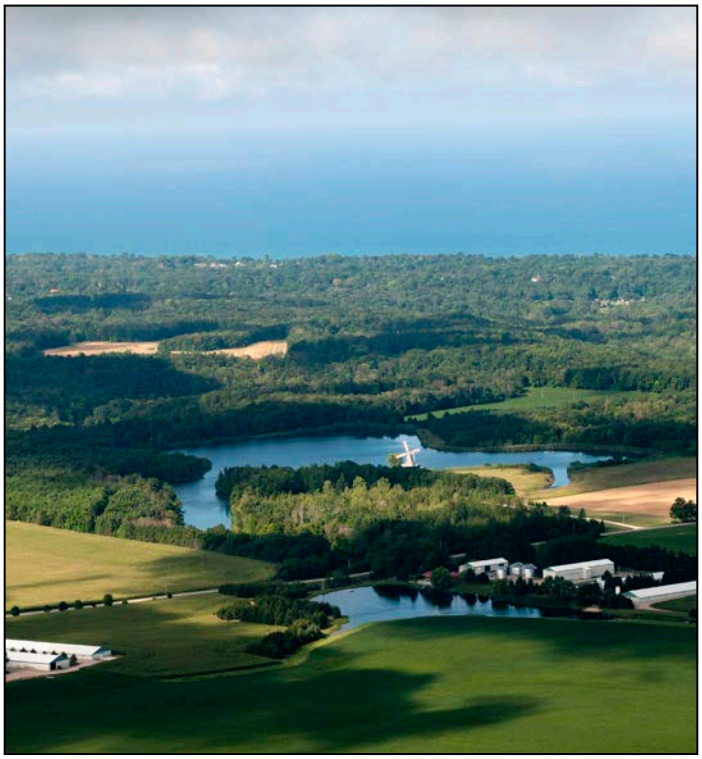
2.1.1 Forest Conditions

Methods

Forest cover, forest interior, and streamside forest cover were three indicators used to evaluate forest conditions with Geographic Information Systems (GIS). These indicators were expressed as percentages. Forest cover was calculated as the total amount of forested area within a watershed. Forest interior refers to the inner portion of a woodlot after removing a 100-metre buffer around the perimeter of that woodlot. Streamside forest cover refers to the amount of forest cover that fell within a 30-metre zone on both sides of an open watercourse.

Woodlot information was extracted from the Ausable Bayfield Natural Heritage Layer, which was updated with colour aerial photography from 2006. Each forest indicator was given a point score based on the percentage of cover in a watershed (Table 1). The point scores for the three forest indicators were then averaged in order to assign a final grade for overall forest conditions in each watershed (Table 1).

Wooded areas that were mapped included deciduous and coniferous forests, treed swamps, and both young and mature plantations. An important consideration is that a minimum mapping unit of 0.5 hectares was used when updating natural heritage features in the Ausable Bayfield watershed. Any heritage feature that was less than 0.5 hectares was not likely picked up during this mapping exercise. For this reason, street trees and small woodland patches were not included in any of the forest cover calculations.



This view looks south over Bayfield River Road (foreground) and the Bayfield River valley and Lake Huron (background).

Note that these indicators of forest conditions are reflective of the amount of forest, not forest health.

Table 1: Forest condition indicator scoring and grading for the Ausable Bayfield watersheds (adapted from Conservation Ontario 2011).

Forest Cover (%)	Forest interior (%)	Streamside Cover (%)	Point Score	Grade	Average Point Score	Final Grade
>35.0	>11.5	>57.5	5	A	>4.4	A
25.1-35.0	8.6-11.5	42.6-57.5	4	B	3.5-4.4	B
15.1-25.0	5.6-8.5	27.6-42.5	3	C	2.5-3.4	C
5.0-15.0	2.5-5.5	12.5-27.5	2	D	1.5-2.4	D
<5.0	<2.5	<12.5	1	F	<1.5	F

Forest Conditions Results

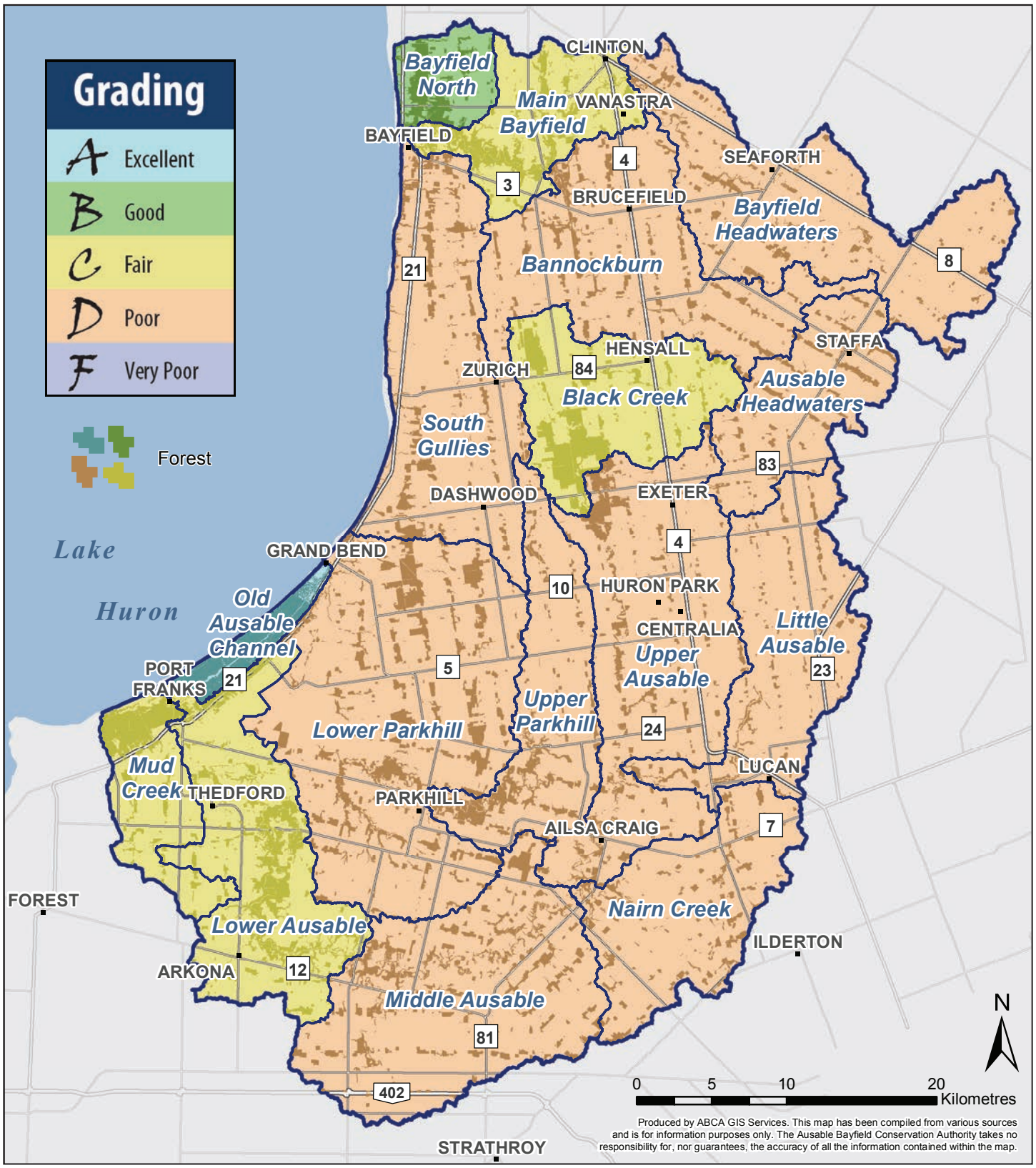
In the Ausable Bayfield area, forest cover and forest interior are limited (Table 2, Map 6, Figure 1). Most of the watersheds received a D for forest cover and an F for forest interior. Streamside cover throughout the watersheds had more C and D grades, suggesting that streamsides typically have 30 per cent cover. Interestingly, headwater watersheds (Ausable Headwaters and Bayfield Headwaters) fared poorly in the streamside cover indicator. The combination of the three indicators to measure forest conditions showed that most watersheds received a D grade.

The limited forest conditions can be attributed to the clearing of much of the land for agriculture, or urbanization. An A grade was given to the Old Ausable Channel watershed, most of which is contained within Pinery Provincial Park. The Bayfield North watershed also scored quite high due to several large upland forest habitats that have been left intact. These forest habitats have been designated as a provincially significant Area of Natural and Scientific Interest (ANSI).

The F grades received by the majority of watersheds for forest interior reflect the fragmented nature of the remaining woodlots. For the most part, forests that remain in the Ausable Bayfield area are small patches, which lack the protected core of larger woodlots.

Table 2: Percentage of forest cover, forest interior, and streamside cover, their associated grades, and the overall forest conditions grade for each Ausable Bayfield watershed.

	Forest Cover		Forest Interior		Streamside Cover		Overall
Watershed	**Percentage**	**Grade**	**Percentage**	**Grade**	**Percentage**	**Grade**	**Grade**
Ausable Headwaters	10.2	D	1.2	F	18.9	D	D
Bannockburn	10.8	D	1.4	F	26.2	D	D
Bayfield Headwaters	7.2	D	0.7	F	17.6	D	D
Bayfield North	30.0	B	9.0	B	63.4	A	B
Black Creek	20.5	C	9.2	B	30.8	C	C
Little Ausable	6.4	D	0.3	F	18.4	D	D
Lower Ausable	20.5	C	3.8	D	47.5	B	C
Lower Parkhill	14.7	D	3.5	D	26.3	D	D
Main Bayfield	22.6	C	4.4	D	57.1	B	C
Middle Ausable	13.6	D	1.9	F	43.2	B	D
Mud Creek	24.4	C	10.7	B	33.8	C	C
Nairn Creek	9.6	D	1.0	F	27.6	C	D
Old Ausable Channel	80.5	A	40.2	A	68.3	A	A
South Gullies	11.7	D	2.0	F	24.0	D	D
Upper Ausable	10.6	D	2.0	F	31.8	C	D
Upper Parkhill	13.9	D	2.3	F	39.4	C	D
Ausable Bayfield Conservation Authority Area	**14.1**		**3.2**		**32.7**		



Map 6: Grade distribution of forest conditions throughout the Ausable Bayfield watersheds

Some watersheds, particularly those that could be considered the main channel watersheds (Lower Ausable and Main Bayfield), received higher grades for streamside cover. The steep slopes that exist along the larger rivers would be considered marginal land for agriculture, so forest cover persists. However, watershed residents also recognize the importance of establishing buffers and they have increased efforts to maintain buffers. An analysis of streamside cover over time was not possible because the methodology differed between the 2007 report card and the methodology used to prepare the 2013 report card.

Small reported increases in percentages of forest cover and forest interior since the 2007 watershed report card were likely a result of using a higher level of detailed mapping with the 2013 version. Colour photography, along with a higher photo resolution, allowed air photo interpretation to be more accurate when deciphering natural heritage features.

Note that scores from the 2007 report card were reconfigured for comparison with the new grades because changes have been made to the grading system for the indicators.

A document published by Environment Canada (2004), entitled *How Much Habitat is Enough?*, provides science-based information and guidelines for habitat protection in southern Ontario. Conservation Ontario has now incorporated these guidelines into their guidance document for developing watershed report cards (Conservation Ontario 2011).

Due to the slow-growing nature of forests, we may not be able to recognize the full impact of reforestation efforts taking place in the last five years. Nevertheless, environmental benefits from planting trees begins immediately.

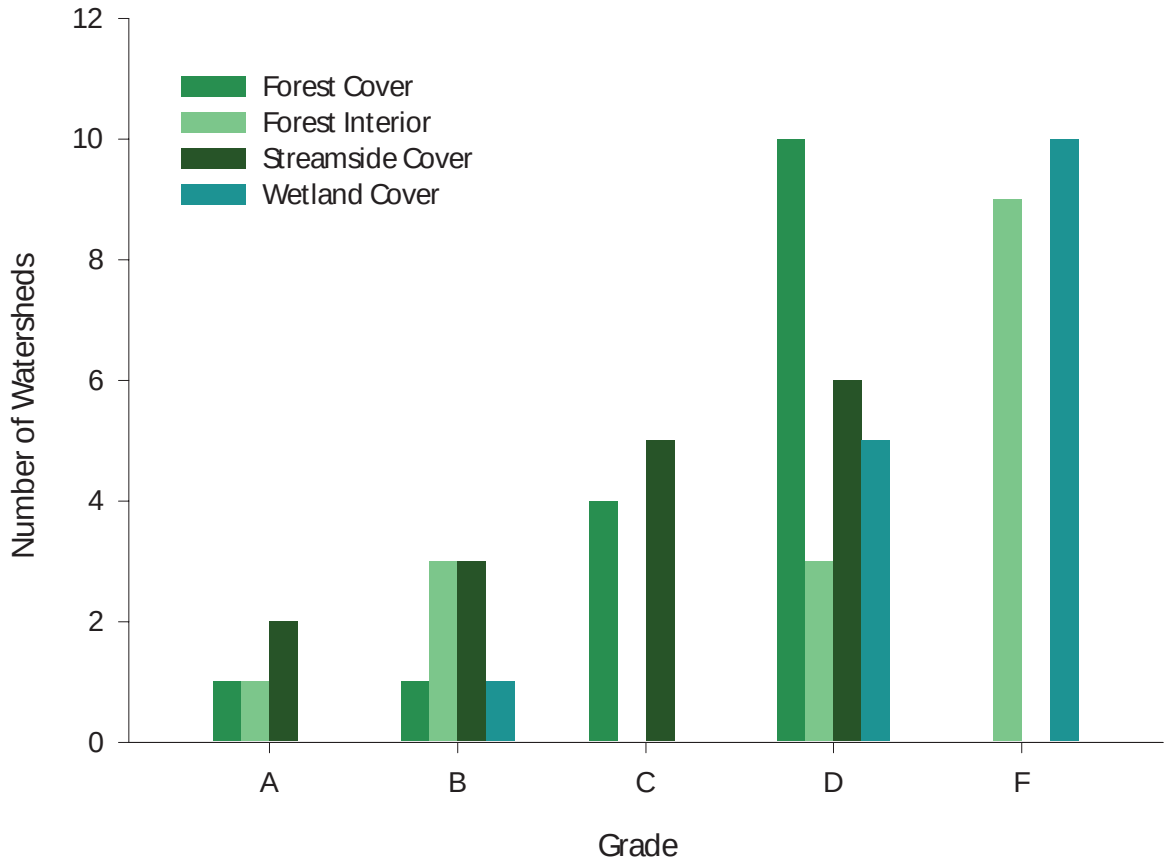


Figure 1: Distribution of grades for forest cover, forest interior, streamside cover, and wetland cover for the Ausable Bayfield watersheds.

2.1.2 Wetland Cover

Methods

Wetland cover was also determined with Geographic Information Systems (GIS) and the Ausable Bayfield Natural Heritage Layer. Unlike forest conditions, however, wetland conditions were only based on one indicator: percentage of wetland cover. The percentage of wetland cover directly determined the grade that was achieved in each watershed (Table 3).

Wetlands consist of land that is seasonally or permanently flooded by shallow water, as well as land where the water table is close to the surface.

Table 3: Grading system for wetland cover for the Ausable Bayfield watersheds (adapted from Conservation Ontario 2011).

Wetland Cover (%)	Grade
>11.5	A
8.6-11.5	B
5.6-8.5	C
2.5-5.5	D
<2.5	F

Results

Wetlands are limited in the Ausable Bayfield watershed (2.4 per cent), with ten watersheds receiving an F grade (Table 4, Map 7, Figure 1). Five of the six remaining watersheds received a D, and Black Creek received the highest grade in the entire watershed with a B grade. This can be attributed to the presence of the provincially significant Hay Swamp.

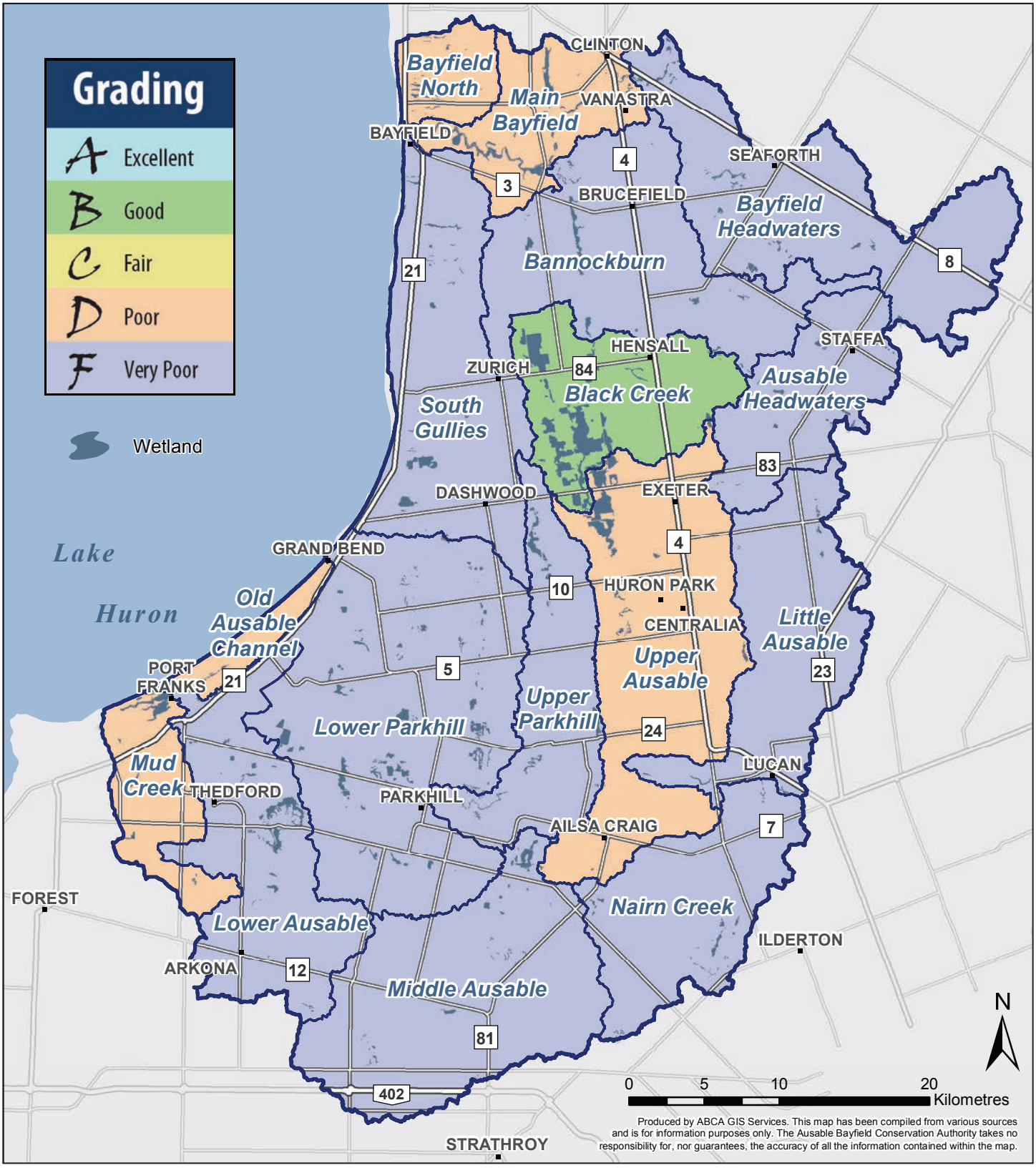
In order to have a healthy functioning watershed, Environment Canada (2004) recommends restoring wetland cover to six per cent of a subwatershed (*e.g.*, Middle Ausable) and to ten per cent of a major watershed (*e.g.*, Ausable River). Restoring wetlands may not be practical everywhere in light of the highly productive agricultural lands within the Ausable Bayfield watershed, but wetlands need to be enhanced in strategic locations to maintain resilient watersheds now, and in the future.

It is important to enhance wetland cover in strategic areas.

Wetland cover was not compared between 2007 and 2013 as the methodology for calculating this indicator has changed.

Table 4: Percentage of wetland cover and grades throughout the Ausable Bayfield watersheds.

	Wetland Cover	
Watershed	**Per cent**	**Grade**
Ausable Headwaters	0.9	F
Bannockburn	1.4	F
Bayfield Headwaters	1.3	F
Bayfield North	2.9	D
Black Creek	11.5	B
Little Ausable	0.4	F
Lower Ausable	2.4	F
Lower Parkhill	2.4	F
Main Bayfield	5.5	D
Middle Ausable	0.9	F
Mud Creek	3.1	D
Nairn Creek	0.8	F
Old Ausable Channel	4.7	D
South Gullies	1.4	F
Upper Ausable	2.6	D
Upper Parkhill	2.2	F
ABCA Area	**2.4**	



Map 7: Grade distribution of wetland cover throughout the Ausable Bayfield watersheds

2.1.3 Surface Water Quality

Methods

Since the early 1960s, the Ausable Bayfield Conservation Authority (ABCA) has partnered with the Ontario Ministry of the Environment (MOE) to take surface water quality samples at locations within the Ausable Bayfield watersheds through the Provincial Water Quality Monitoring Network (PWQMN). There are nine PWQMN sites within the Ausable Bayfield jurisdiction at present.

In order to more effectively monitor water quality in the Ausable Bayfield watersheds, the ABCA has since added nine additional water quality stations to these routine monitoring sites (stations). This enhancement of the water quality monitoring program provides the community with information about more watersheds.

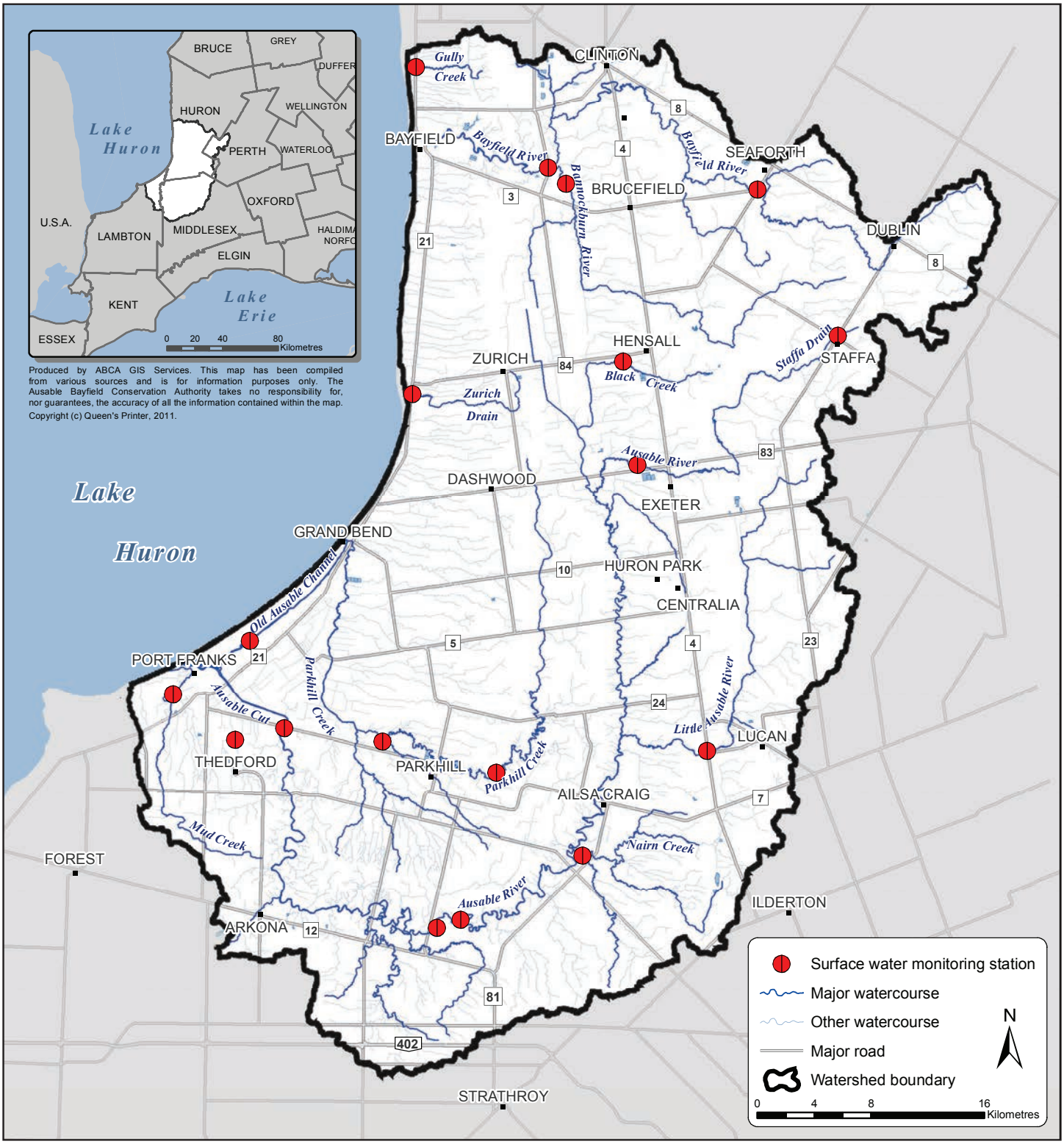
Monthly grab samples were collected at a monitoring site in each watershed between the months of March and November (Map 8, Table 5). The samples were analyzed for a variety of water quality indicators, including total phosphorus and *Escherichia coli* (E. coli).

Yearly in October, benthic invertebrate samples were also collected at a monitoring station in each watershed, except the Old Ausable Channel (OAC) (Map 8, Table 5). The habitat for benthic invertebrates in the OAC is too different from the other sites to make a meaningful comparison.

The grading systems for total phosphorus, E. coli, and benthic invertebrates have changed slightly since the 2007 report card. For total phosphorus, the grading system was changed to better reflect ecosystem impairment from this nutrient. With respect to E. coli, a change was introduced to improve the comparison of E. coli concentrations across the province. The updated grading system for benthic invertebrates better reflects local watershed conditions across the region. It is also important to note that grades from the first report card have been reassessed with the new grading systems in order to accurately compare those grades with the grades in this report card. Further details on why and how these grading systems were changed can be found in the *Guide to Developing Conservation Authority Watershed Report Cards* (Conservation Ontario 2011).

Surface water sampling

Benthic invertebrate sampling



Map 8: Surface water quality monitoring stations throughout the Ausable Bayfield watershed

Table 5: Data used to determine watershed report card grades for surface water quality conditions throughout the Ausable Bayfield watersheds.*

		Total Phosphorus		*Escherichia coli*		Benthic Invertebrates	
Watershed	**Site**	**Years of Data**	**Number of Samples**	**Years of Data**	**Number of Samples**	**Years of Data**	**Number of Samples**
Ausable Headwaters	HASTAF1	2007-2011	45	2007-2011	45	2008, 2010, 2011	3
Bannockburn	MBBAN1	2007-2011	45	2007-2011	45	2007, 2009-2011	4
Bayfield Headwaters	MBSEA1	2007-2011	43	2007-2011	43	2008, 2010, 2011	3
Bayfield North	GULGUL2	2007-2011	42	2007-2011	43	2007, 2009-2011	4
Black Creek	MABLA2	2007-2011	43	2007-2011	45	2007, 2009-2011	4
Little Ausable	MALIT2	2007-2011	43	2007-2011	45	2007, 2009-2011	4
Lower Ausable	MADECK2	---	---	---	---	2008, 2010, 2011	3
	MABOG1	2007-2011	43	2007-2011	45	---	---
Lower Parkhill	MPMCIN1	2007-2011	43	2007-2011	45	2007, 2009-2011	4
Main Bayfield	MBVAR1	2007-2011	41	2007-2011	44	2007, 2009-2011	4
Middle Ausable	MASPR	2007-2011	43	2007-2011	45	---	---
	MAGLAS1	---	---	---	---	2007, 2009-2011	4
Mud Creek	MMOUTER1	2007-2011	45	2007-2011	45	2008-2011	4
Nairn Creek	MANAIRN1	2007-2011	45	2007-2011	45	2007, 2009-2011	4
Old Ausable Channel	OACDAM1	2007-2011	39	2007-2011	35	---	---
South Gullies	GULZUR8	2007-2011	43	2007-2011	42	2007-2011	5
Upper Ausable	MAEXE1	2007-2011	42	2007-2011	44	2010, 2011	2
Upper Parkhill	MPMCGUF1	2007-2011	45	2007-2011	45	2007-2011	5

* Please note that data were collected in 2006. However, to remain consistent with other conservation authorities, we used the 2007 to 2011 data set for reporting and comparison.

Methods – Total Phosphorus

Total phosphorus is a nutrient that limits the growth of algae and aquatic plants. When phosphorus is added to an aquatic system, the first response is increased algae and plant growth, which can be beneficial to aquatic life. Beyond a certain point, however, phosphorus becomes over-abundant and produces excessive growth of algae and aquatic plants (eutrophication), which is detrimental to streams and rivers. The Provincial Water Quality Objective (PWQO) for total phosphorus is 0.03 mg/L, to prevent eutrophication. Sources of phosphorus include human and animal waste, fertilizers, detergents, and soil erosion.

The 75th percentile total phosphorus concentration was calculated for data collected from each site between 2007 and 2011 (Table 5). The 75th percentile represents the value below which 75 per cent of the values occur. This value was used as opposed to a median value (50th percentile) to account for the tendency of PWQMN samples to be collected during dry weather periods.

The 75th percentile concentration of total phosphorus was converted to a point score and a grade for each watershed according to the Conservation Ontario guidelines (Conservation Ontario 2011) (Table 6).

Results – Total Phosphorus

As in the 2007 report card, most watersheds exceeded the objective set by the MOE of 0.03 mg/L (Figure 2). Grades ranged from a B to an F, with the majority of watersheds receiving a D grade (Figure 3). The Old Ausable Channel and the Main Bayfield watersheds had the lowest total phosphorus concentrations, which were approximately 0.02 mg/L.

Most watersheds had only slight increases or decreases from the phosphorus concentrations in the 2007 report card; however, the Upper Ausable watershed appeared noticeably higher than the previous report card. Further analysis showed that this watershed does not have an overall increasing trend in phosphorus concentrations, and it is likely that several extremely high values caused this increase in the 75th percentile value. It is important for all stakeholders to investigate and act upon ways of reducing phosphorus concentrations in not only the Upper Ausable watershed, but all Ausable Bayfield watersheds.

In addition to sources of human and animal waste, fertilizers, detergents, and soil erosion can contribute to phosphorus concentrations because phosphorus binds to soil particles. High phosphorus concentrations may therefore be related to increased erosional processes. Across the Ausable Bayfield landscape, clay soils and land use dominated by agriculture may contribute to erosion.

Table 6: Surface water quality indicator scoring and grading for the Ausable Bayfield watersheds (adapted from Conservation Ontario 2011).

Total Phosphorus (mg/L) – 75th Percentile	*Escherichia coli* (cfu*/100 mL) – Geometric Mean	Benthic Invertebrates (Modified Family Biotic Index†)	Point Score	Grade
<0.020	0-30	0.00-4.25	5	A
0.020-0.030	31-100	4.26-5.00	4	B
0.031-0.060	101-300	5.01-5.75	3	C
0.061-0.180	301-1000	5.76-6.50	2	D
>0.180	>1000	6.51-10.00	1	F

* cfu – colony forming units

† based on New York State tolerance values

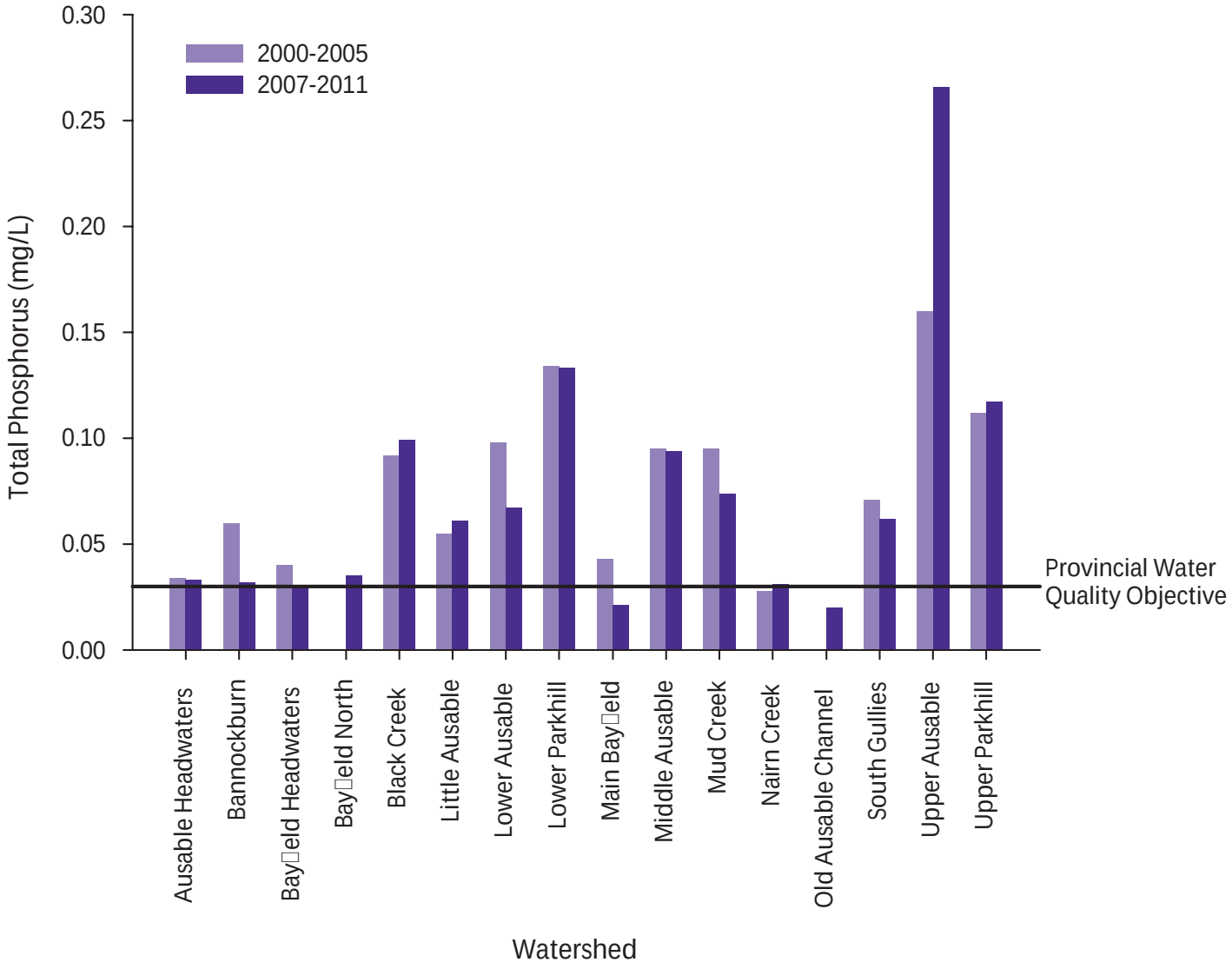


Figure 2: Concentrations of total phosphorus across all Ausable Bayfield watersheds. Black line represents the Provincial Water Quality Objective (0.03 mg/L).

Grassed waterways can reduce phosphorus and suspended sediment concentrations in downstream watercourses.

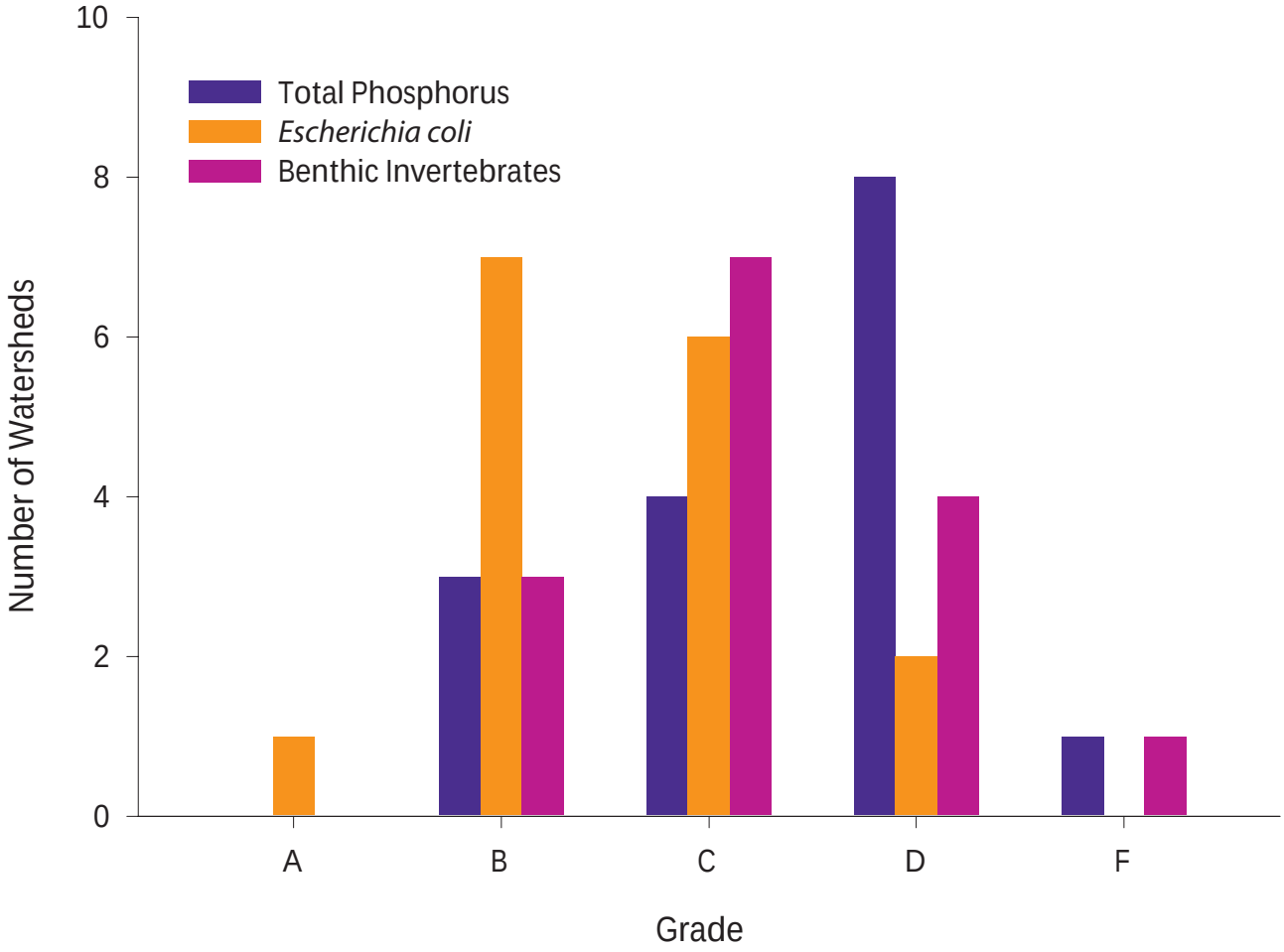


Figure 3: Distribution of grades for total phosphorus, *Escherichia coli* (E. coli), and benthic invertebrates for the Ausable Bayfield watersheds.

Methods – Escherichia coli

Escherichia coli (E. coli) are fecal coliform bacteria commonly found in the intestines of animals and humans. Their presence in water is a strong indication of recent sewage or animal waste contamination, and that there is potential for other disease-causing organisms to exist. Conservation Ontario (2011) therefore recommended that concentrations of E. coli also be used as an indicator for the watershed report card.

Concentrations of E. coli in surface water can be relatively low (<10 colonies per 100 mL) and very high (>10,000 colonies per 100 mL). The average concentration would inflate the typical conditions, so the geometric mean is calculated instead. It is calculated as the *n*th root of the product of *n* numbers. The geometric mean of E. coli concentrations was converted to a point score and grade for each watershed according to Conservation Ontario guidelines (2011) (Table 6). The Recreational Water Quality Guideline for E. coli, for people to swim or bathe in water, is 100 cfu/100 mL.

Escherichia coli data were also summarized for a five-year period (Table 5). It is hoped that a five-year reporting period will help to avoid making conclusions about concentrations that are limited to a wet or dry year.

Results – Escherichia coli

Concentrations of E. coli in the different watersheds continued to exceed the Recreational Water Quality Guideline of 100 cfu/100 mL (Figure 4). Although there were still some higher concentrations (which may suggest a local point source), eight watersheds met, or were below the Recreational Water Quality Guideline, compared with only one watershed in the previous report card. Grades ranged from A to D, with most watersheds receiving a B or a C grade (Figure 3). The Old Ausable Channel received the only A grade, which can be attributed to the surrounding natural land use.

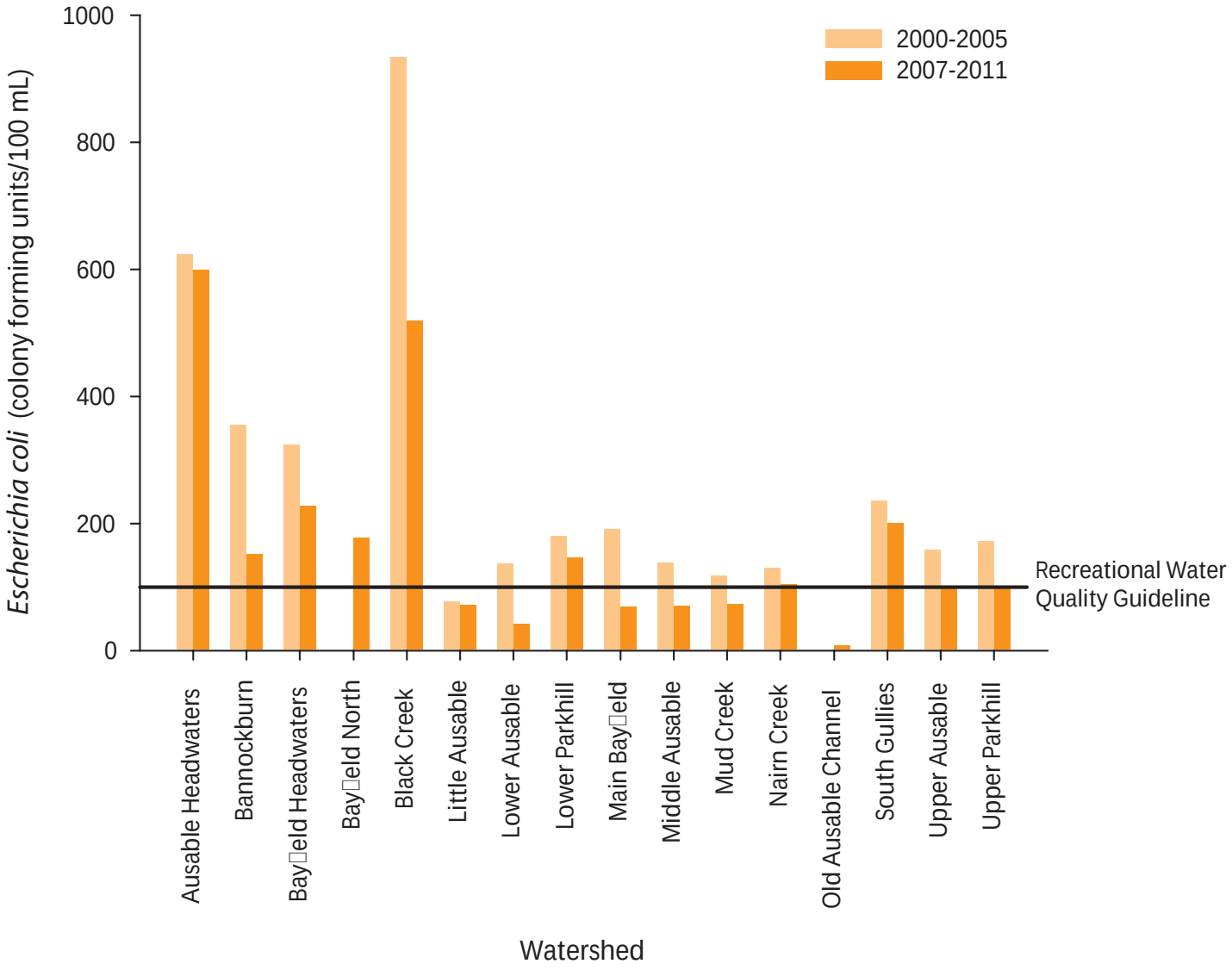


Figure 4: Concentrations of *Escherichia coli* (E. coli) across all Ausable Bayfield watersheds. Black line represents the Recreational Water Quality Guideline (100 cfu/100 mL).

Methods – Benthic Invertebrates

Benthic macroinvertebrates are commonly used as indicators of aquatic environmental quality. Invertebrates are animals without backbones, such as insects, crustaceans, molluscs, and worms. 'Benthic' refers to the bottom of lakes and rivers, where these invertebrates are found. 'Macro' refers to the subset of larger or visible invertebrates: generally ¼ to ½ millimetre in length.

Each species that makes up this assortment will have a different tolerance to the variety of stressors and pollutants that may be present in the local environment. Tolerance values between one and ten can be assigned to these animals, with one meaning intolerant to pollution and ten meaning tolerant. The tolerance values for invertebrates present at a particular site were used to calculate the Hilsenhoff 1988 Family Biotic Index (FBI), as modified by New York State (Smith *et al*. 2009). The FBI provided a score for each watershed (Table 6) that reflected the environmental quality within the area that these organisms were surveyed. More simply put, the presence of pollution-intolerant species generally indicates a healthy aquatic environment.

Benthic invertebrate communities reflect not only water chemistry, but also substrate (*i.e.*, stream bottom) conditions (Lammert and Allan 1999; Richards *et al*. 1993; de March 1976). Substrate conditions vary across watersheds, and so efforts were made to be as consistent as possible when sampling benthic sites. Sampling sites for the watershed report card process were of the highest quality substrate that supports the best possible invertebrate communities.

Although the benthic monitoring sites are now sampled on an annual basis, they had been sampled on an alternating year schedule in the past. Therefore, some sites have fewer than five years of data (Table 5). In addition, there is no benthic invertebrate monitoring site for the Old Ausable Channel watershed as the OAC is a very different aquatic system and comparisons to this site would be inappropriate.

Mayflies are an example of a benthic invertebrate. You may recognize the adult life-stage (shown here).

Photo by Shawn Staton/Courtesy Fisheries and Oceans Canada.

Results – Benthic Invertebrates

The benthic invertebrate scores for most watersheds increased slightly over the scores from the 2007 report card, which means a minor shift towards poorer conditions (Figure 5). The FBI values were generally between four and six, indicating that there were a variety of animals (both tolerant and intolerant to organic pollution) at each monitoring site. Grades ranged from B to F, with most watersheds receiving a C grade (Figure 3).

The Middle Ausable (4.47), Main Bayfield (4.55) and Nairn Creek (4.96) watersheds received a B grade (*i.e.*, benthic invertebrates found there are less tolerant to pollution). The Mud Creek site had the highest FBI (6.65), suggesting that this site was more degraded than others in this area. The Black Creek and South Gullies watersheds also had higher FBI values, indicative of degraded water quality.

Note that there are no comparisons to the previous report card for the Bayfield North and Upper Ausable watersheds, as the sites for these watersheds have been moved since the last report card.

Methods – Overall Surface Water Quality

As with forest conditions, the point scores for each water quality indicator (total phosphorus, E. coli, and benthic invertebrates) were averaged to determine an overall point score for a watershed. This point score was then given a final grade for each watershed (Table 7).

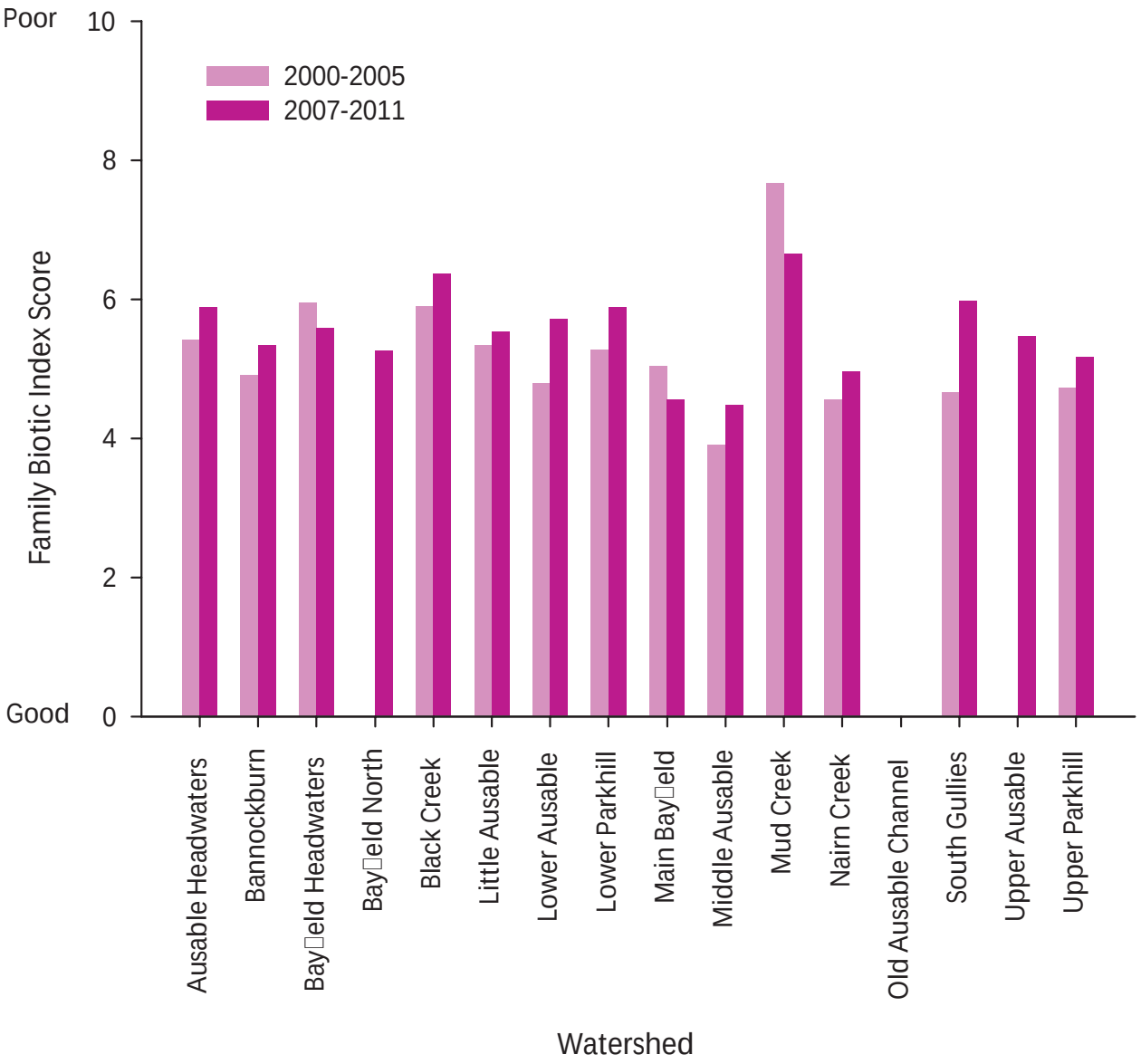


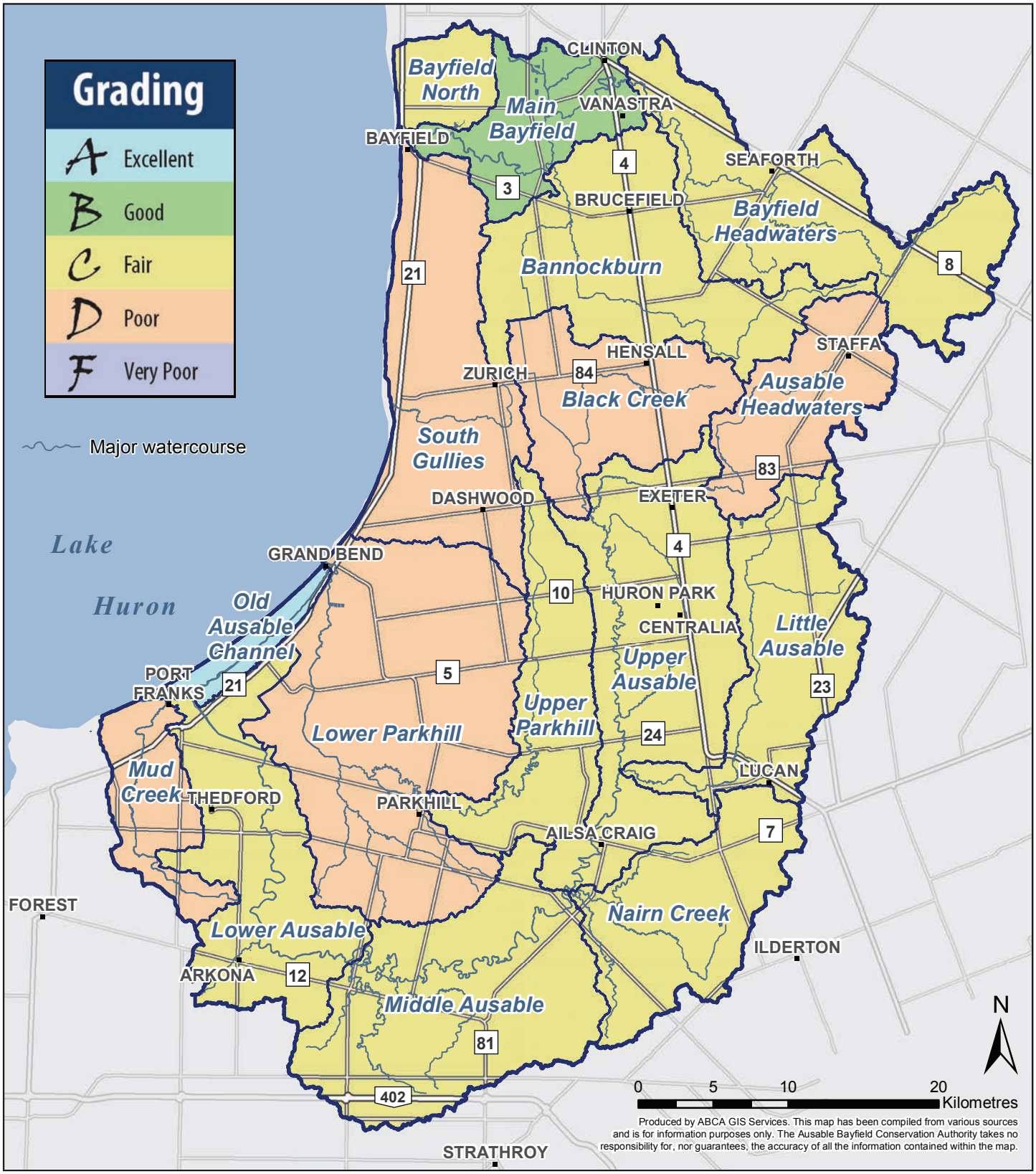
Figure 5: Benthic invertebrate Family Biotic Index (FBI) scores across all Ausable Bayfield watersheds. A score of 1 represents a healthy watershed and a score of 10 represents a degraded watershed.

Table 7: Overall surface water quality scoring and grading for the Ausable Bayfield watersheds (adapted from Conservation Ontario 2011).

Average Point Score	Overall Surface Water Quality Grade
>4.4	A
3.5-4.4	B
2.5-3.4	C
1.5-2.4	D
<1.5	F

Results – Overall Surface Water Quality

Indicators for surface water quality conditions within the Ausable Bayfield area indicate fair to poor conditions, as most watersheds received a C or D grade (Map 9, Figure 3). Only the Old Ausable Channel watershed received an A grade. Water quality was excellent within the channel, most of which is within Pinery Provincial Park. The Main Bayfield watershed received a B grade. Further evaluation of the conditions in the Main Bayfield watershed is being undertaken in 2013, as this is a priority watershed for the *Healthy Lake Huron – Clean Water, Clean Beaches* initiative **(healthylakehuron.ca)**.



Map 9: Grade distribution of overall surface water quality conditions throughout the Ausable Bayfield watersheds

2.1.4 Groundwater Quality

Methods

Similar to the surface water monitoring program, the Provincial Groundwater Monitoring Network (PGMN) is a partnership between the Ontario Ministry of the Environment (MOE) and local conservation authorities. This program was started in 2003, and there are 14 monitoring wells within the Ausable Bayfield watershed at present (Map 10). Sampling at all monitoring wells occurred once a year and samples were analyzed for various indicators. Conservation Ontario recommends that nitrate and chloride be used as indicators of groundwater quality (Conservation Ontario 2011).

For each well, the 75th percentile was calculated for nitrate and chloride over the five-year time period from 2007 to 2011. The 75th percentile concentration for each indicator was then converted to a point score and given a grade (Table 8).

Conservation Ontario (2011) recommends averaging point scores for both indicators at each well to arrive at an overall grade. Ausable Bayfield Conservation decided not to average these indicators because the combined values give less significance to potential quality issues for the monitoring wells. When the indicators were not combined, the separate grades for nitrate and chloride more accurately reflected conditions where concentrations approached the drinking water standard or guideline. This information better informs people of issues that may impact their own wells in the vicinity of a monitoring well. Only two grading categories were used, with a monitoring well receiving either an 'A grade' or 'Less than an A grade.' Wells that received a point score of five received an A grade, whereas wells that received a point score of less than five received a 'Less than A grade.'

Results

Reporting on groundwater conditions is more difficult than reporting on surface water quality conditions for several reasons.

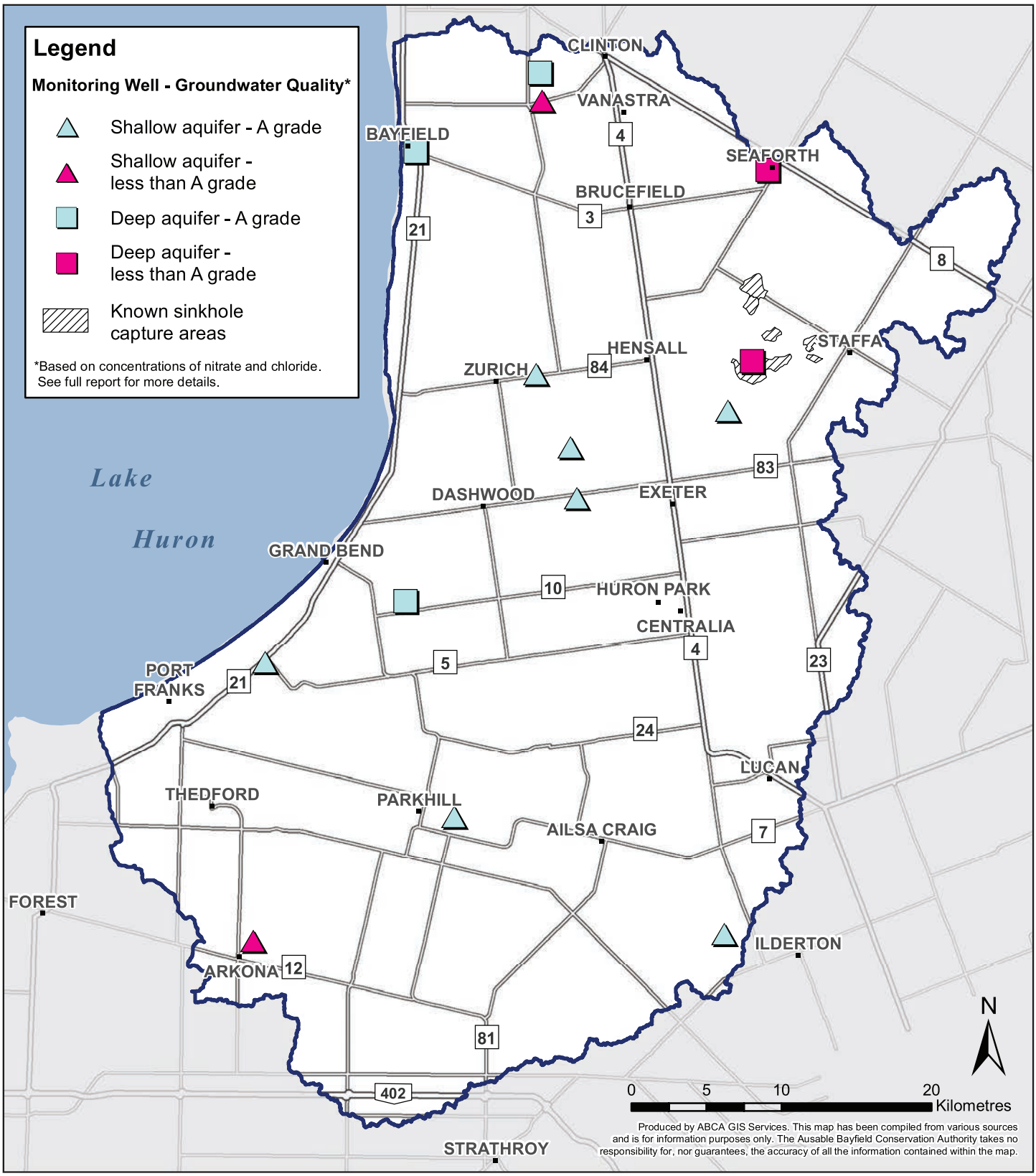
Surface water and groundwater move differently – one over the land surface, and the other through soil and bedrock into aquifers (underground rock formations/structures that carry water). Flowpaths are typically downward or horizontal through these aquifers, and since it is hard to see these interactions underground, we can only infer the source of water for individual monitoring wells. Most importantly, groundwater boundaries differ from surface water boundaries, which can make grading on a watershed scale irrelevant. Groundwater quality grades provided in this report card were therefore given to each monitoring well, not each watershed like the other indicators. Different aquifers exist throughout the region, and have the potential to be quite localized, so it is important to monitor water quality at private drinking water wells regularly, even if the water scores high on a watershed-wide basis.

This watershed report card refers to bedrock wells as deep wells, and overburden wells as shallow wells.

Table 8: Groundwater quality indicator scoring and grading for monitoring wells throughout the Ausable Bayfield watersheds (adapted from Conservation Ontario 2011).

Nitrate* (mg/L)	Chloride (mg/L)	Point Score	Grade
0-2.5	0-62.5	5	A
2.6-5.0	62.6-125.0	4	Less than A
5.1-7.5	125.1-187.5	3	Less than A
7.6-10.0	187.6-250.0	2	Less than A
>10.0	>250.0	1	Less than A

*Nitrate = Concentrations of nitrogen that are in the form of nitrate and nitrite.



Map 10: Groundwater quality conditions at the 14 provincial monitoring wells throughout the Ausable Bayfield watershed

Concentrations of nitrate and chloride at most of the provincial monitoring wells were better than the drinking water standard for nitrate and guideline for chloride (*i.e.*, received an A grade) (Map 10). A few locations received a grade less than an A because the concentration of nitrate or chloride approached, or exceeded, the drinking water standard or guideline. Wells that received less than an A grade were the TR9 well (near Clinton) and the Sinkhole well (near Staffa) due to nitrate, and the Seaforth well and the Rock Glen well (near Arkona) due to chloride (Table 9).

Monitor your well to ensure your water is safe to drink.

The Ontario (and Canadian) Drinking Water Quality Standard for nitrate (nitrate + nitrite as nitrogen) is 10 mg/L. Concentrations above 10 mg/L in drinking water can have adverse effects on infants less than six months old (Nova Scotia Environment 2008a). The Sinkhole well very closely approached this standard, and the TR9 well near Clinton exceeded it (Table 9). Although nitrogen can occur naturally in rocks and groundwater, applying excessive amounts of fertilizer and manure, as well as faulty septic systems, can result in high nitrate concentrations.

The Canadian Drinking Water Quality Guideline for chloride is 250 mg/L. Chloride in drinking water is generally not considered harmful for consumption, although most people find water with concentrations above 250 mg/L unpleasant to drink (Nova Scotia Environment 2008b). Although the Rock Glen well near Arkona had a chloride concentration of approximately 85 mg/L, this concentration is typically higher than what was observed at the other monitoring wells. This was also the case for the Seaforth well, which came much closer to the guideline (Table 9). Unlike nitrate, high chloride concentrations (*i.e.*, above the guideline) can occur naturally, which can be related to the type of rock coming into contact with the water. High chloride concentrations can also come from human sources (*e.g.*, road salt), so the cause of high concentrations needs to be evaluated.

Note that two out of the four wells that did not receive an A grade are deep wells (*i.e.*, bedrock wells) (Table 9). It is unknown whether the high chloride concentrations in the Seaforth well are naturally occurring, but it is likely that the high nitrate concentrations in the Sinkhole well are a result of surface water contamination through the known sinkholes in that area. Deep wells are not precluded from contamination.

Properly maintaining wellheads and reducing nutrient inputs into surface water limits the potential for contaminants to reach groundwater sources.

Visit **abca.on.ca** for more information on water well stewardship. Grants may be available to help upgrade or decommission existing wells.

Table 9: Ausable Bayfield groundwater monitoring wells that received a grade less than A for nitrate or chloride.

Watershed	Well Name (Nearest Urban Area)	Type of Well	Indicator with less than an A grade	75th Percentile Concentration	Drinking Water Standard or Guideline
Bannockburn	Sinkhole (Staffa)	Deep	Nitrate	9.1 mg/L	10 mg/L
Bayfield Headwaters	Seaforth (Seaforth)	Deep	Chloride	198.3 mg/L	250 mg/L
Main Bayfield	TR9 (Clinton)	Shallow	Nitrate	12 mg/L	10 mg/L
Lower Ausable	Rock Glen (Arkona)	Shallow	Chloride	84.6 mg/L	250 mg/L

2.2 Summary

Forest conditions remain limited in the Ausable Bayfield watersheds. Trees grow slowly and, consequently, any increases from recent reforestation efforts were not likely picked up by the most recent mapping. Forest patches had to be at least 0.5 hectares to be captured in the mapping. The slight reported increases in forest cover and forest interior that occurred since the 2007 report card result from more detailed mapping for the 2013 watershed report card. The switch from black and white to colour aerial photography was an important change between the 2007 and 2013 report cards. Mapping technologies should be more equivalent in the future, improving the comparison of forest conditions over time.

Wetland cover in the Ausable Bayfield watersheds is also limited. Although no comparison can be made to prior conditions, as the methods differed between 2007 and 2013, additional wetlands are needed in strategic locations across the watersheds.

Most watersheds have remained steady in terms of water quality. Compared with the previous report card, in which only one watershed met the recreational guideline for *Escherichia coli* (E. coli), eight watersheds now meet this guideline. Furthermore, two watersheds (Bannockburn and Main Bayfield) have had measurable improvements in concentrations of total phosphorus and E. coli.

Groundwater quality throughout the Ausable Bayfield watersheds is generally good. Several wells, however, approached the drinking water standard for nitrate or the guideline for chloride, and therefore received grades less than an A. All landowners drinking from private wells should test those wells and be aware of the quality of their drinking water.

Surface water and groundwater quality results reflect natural features (*e.g.*, soil characteristics, topography) and land use, which vary from watershed to watershed. Low forest and wetland cover, combined with predominantly clay soils, intensive agricultural activities, and, in some areas, urbanization, contribute to water quality conditions that need improvement.

We encourage individuals and agencies to continue to strive to achieve A grades. However, Ausable Bayfield Conservation Authority is also aware that A grades may not be practical due to natural factors, and the high agricultural productivity of the land. The goal of local individuals, community groups, agencies, and governments may therefore be to improve specific values. For example, E. coli in the South Gullies watershed was 236 cfu/100 mL in the 2007 report card, and is currently 200 cfu/100 mL. A reasonable goal would be to decrease this concentration to 150 cfu/100 mL. If we continue to take enough of these small steps forward, we will create healthier watersheds together.

2.3 Next Steps

Why is the Watershed Report Card Important?

Summarizing forest and water quality conditions on a watershed basis provides this information on an ecologically-relevant scale. We may be more accustomed to thinking of our properties in terms of municipal boundaries (towns, townships, and counties) rather than ecosystem boundaries. For water conditions in particular, ecosystem boundaries help to determine the quality (and quantity) of the resource. Grading the watersheds helps environmental managers and the public assess environmental health and identify areas with better or degraded conditions. This information highlights areas we need to protect and areas that we need to improve.

The watershed report card process helps to highlight principles of the Framework for Community Action for the Lake Huron-Georgian Bay Watershed (Figure 6). The watershed report card informs people about the current conditions of their watershed. It also helps support community involvement by providing residents with the knowledge they need to make changes and examples of actions taken throughout the watershed. It is hoped that once individuals or communities have these tools, they can move forward by initiating these actions on the landscape. It is also important to evaluate our collective actions. The watershed report card, which is produced every five years, provides an opportunity for this evaluation. With every new report card, we can measure our efforts, and determine the best ways to continue to protect and enhance the watershed.

Figure 6: Principles of the Lake Huron-Georgian Bay Watershed Framework for Community Action **(lakehuroncommunityaction.ca)**.

What Can I Do as an Individual or as Part of a Community?

Watershed health may not be something you think of very often, but it has a direct impact on the air you breathe, the water you use, and the community in which you live.

Can an individual make a difference? Yes. Landowners in many watersheds have planted trees and undertaken site-specific water quality improvement projects to improve forest conditions, local fisheries, and water quality.

A brief look at the 'Thumbs Up' section for each watershed will provide some insight into these various activities. Furthermore, individuals are working within their communities to develop relevant recommendations and actions through watershed planning processes. Examples of these watershed planning documents include:

Management Plan for the Bayfield North Watersheds **(abca.on.ca/page.php?page=bayfield-north)**

Management Plan for the Old Ausable Channel **(abca.on.ca/page.php?page=old-ausable-channel)**

Community-based Biodiversity Strategy for the Port Franks Area **(abca.on.ca/page.php?page=port-franks)**

It is important to remember that these individual and community efforts come together to have a positive effect. Just as individual behaviours contributed to degraded watershed health in the first place, positive individual and community efforts will help protect and improve our environment in the future.

Local, provincial, and federal incentive grants may currently be available to help make improvements to forest conditions and water quality on your property. Local agencies, such as the Ausable Bayfield Conservation Authority, have staff available to assist you with these types of projects.

Windbreaks help to prevent soil loss.