Kawishiwi Watershed Protection Project Implementation Plan

June 2013

Prepared for:

WHITE IRON CHAIN OF LAKES ASSOCIATION (WICOLA)
LAKE COUNTY AND LAKE COUNTY SWCD, MINNESOTA
MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

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This report was prepared for the White Iron Chain of Lakes Association (WICOLA), Lake County, the Lake County Soil and Water Conservation District (SWCD), and the Minnesota Pollution Control Agency (MPCA), with the assistance of the following stakeholders:

1854 Treaty Authority

Minnesota Board of Water and Soil Resources

Community GIS

Minnesota DNR- Aquatic Invasive Species

Minnesota DNR- Ecological and Water Resources

Minnesota DNR - Fisheries, Tower

Twin Metals

Ely Field Naturalists

Friends of the Boundary Waters

Kawishiwi Watershed Protection Project

Lake County Planning and Zoning

Lake County SWCD

Minnesota Lakes and Rivers Advocates

Minnesota Pollution Control Agency

Minnesota Power

Minnesota Sea Grant

Natural Resources Research Institute- Ely Field Station

Northeast Minnesotans for Wilderness

North St. Louis County SWCD

Pelican Lake Owners Association

St. Cloud State University, Biology Department

Superior National Forest, Kawishiwi Ranger District

US Forest Service, Superior National Forest

Vermillion Community College

White Iron Chain of Lakes Association (WICOLA)

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Acronyms and Abbreviations

Ac	Acres
AIS	Aquatic Invasive Species
BMP	Best Management Practice
BWCAW	Boundary Waters Canoe Area Wilderness
BWSR	Board of Water and Soil Resources
cfs	cubic feet per second
Chl-*a*	Chlorophyll-*a*
CWA	Clean Water Act
CWP	Clean Water Partnership
CWLA	Clean Water Legacy Act
DNR	Minnesota Department of Natural Resources
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
ft	feet
GIS	Geographic Information Systems
GPS	Global Positioning System
KWPP	Kawishiwi Watershed Protection Project
m	meter
MDH	Minnesota Department of Health
MDNR	Minnesota Department of Natural Resources
MEPA	Minnesota Environmental Policy Act
MINNLEAP	Minnesota Lake Eutrophication Analysis Procedure
mg/L	milligrams per liter
MN DNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
NASS	National Agricultural Statistics Service
NEPA	National Environmental Policy Act
NLCD	National Land Cover Database
NLF	Northern Lakes and Forests
NRCS	Natural Resource Conservation Service
ppb	parts per billion
SNF	Superior National Forest
SSTS	Subsurface Sewage Treatment Systems
SWCD	Soil and Water Conservation District
TKN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
µg/L	microgram per liter
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
Wenck	Wenck Associates, Inc.
WCA	Wetland Conservation Act
WICOL	White Iron Chain of Lakes
WICOLA	White Iron Chain of Lakes Association
WRAP	Watershed Restoration and Protection

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Executive Summary

A partnership of the White Iron Chain of Lakes Association, Ely Minnesota (WICOLA) and Lake County, Minnesota received a Clean Water Land and Legacy Grant in 2011 assess the condition of water resources in the Kawishiwi Watershed. The Kawishiwi Watershed Protection Project (KWPP or the Project) was a multi-year joint effort of WICOLA, Lake County Soil and Water Conservation District (SWCD), and the Minnesota Pollution Control Agency (MPCA) to collect data which helped these partners create a comprehensive management plan to restore and maintain a healthy watershed. This project included the following elements:

- Performed water quality sampling on selected lakes and streams for nutrient and chemical analysis;
- Compiled existing data into a common format and consolidation into a public source;
- Assessed the condition of previously untested lakes and streams;
- Investigated the paleolimnology of selected lakes through core sediment samples to understand the historical impact of human development;
- Inventoried and assessed the existing condition of the Subsurface Sewage Treatment Systems (SSTS) within the watershed and provide an evaluation of the susceptibility of shallow groundwater and surface water from the existing SSTS in the area;
- Identified options for aggressively combating Aquatic Invasive Species (AIS);
- Performed Geographic Information Systems (GIS) analysis to identify environmentally sensitive areas; and
- Developed a comprehensive and integrated approach to watershed planning and management.

This report provides background information about the Kawishiwi River watershed; summarizes the findings of individual reports prepared for each of the project elements noted above; and sets forth an Implementation Plan of actions to be undertaken by a partnership of federal, state, county, local, and private stakeholders to protect and improve the beneficial uses of the water resources within the watershed. These actions are both short and long term, and include both structural (capital and maintenance projects) and nonstructural (education, regulation, incentives) actions.

A Technical Advisory Team developed and prioritized implementation objectives and management actions for six Kawishiwi Watershed Priority Management Areas:

1. Enforce shoreland management regulations as property develops and redevelops, and encourage voluntary actions to mitigate the impacts of past development.
2. Proactively protect beneficial uses by taking positive actions to halt or minimize the spread of Aquatic Invasive Species (AIS).

3. Protect and improve water quality by reducing the number of noncompliant Subsurface Treatment Systems (SSTS) and increase the number of SSTS that are properly operated and maintained.
4. Protect and improve water quality and aquatic and terrestrial habitat by implementing shoreland Best Management Practices (BMPs) to stabilize and restore eroding shoreline and establish native shoreline and emergent vegetation.
5. Continue to monitor water quality and evaluate water quality trends.
6. Coordinate education and outreach messages and delivery methods with and between federal and state agencies, county and local governments, lake associations and other groups.

Stakeholder roles and responsibilities are detailed for each of these management areas, identifying the many partners who will work together to achieve the project's objectives. This Implementation Plan also includes a Priority Information and Education Program that sets forth important messages to convey to various stakeholders, including lakeshore and watershed property owners; lake users; campers; County, Soil and Water Conservation District, and local staff and elected officials; the media; and business owners.

Based on the information gathered as part of the Kawishiwi Watershed Protection Project, the work of the Kawishiwi Project Coordinator, Technical Advisory Team, and other parties will focus on the following elements:

- Further assessment of SSTS conditions and implementation of structural improvement projects identified in Community Assessment Reports;
- Identification of Shoreland BMP projects, acquisition of funding, and completion of shoreline restoration and stabilization projects;
- Coordination of ongoing research, monitoring, analysis of conditions in the lakes and streams in the watershed, and dissemination of findings;
- Participation in education and awareness programs about Aquatic Invasive Species (AIS), future research projects, and monitoring; and
- Furthering ongoing partnerships and information sharing by regular TAT meetings and teleconferences.

1.0 Introduction

1.1 INTRODUCTION

The Kawishiwi River Watershed is located in the Rainy River Basin of northern Minnesota. The watershed is 1,230 square miles in area and drains portions of Cook, Lake, and St. Louis Counties (Figure 1.1). About 1,168 square miles, or 95 percent, of the watershed is located within the Superior National Forest, and 404 square miles, or one-third of the watershed, is within the Boundary Waters Canoe Area Wilderness (BWCAW). The Kawishiwi River originates in the BWCAW and generally flows west to its confluence with Fall Lake near the town of Winton. There are over 430 lakes in the watershed. The White Iron Chain of Lakes on the west edge of the watershed, a popular recreational chain, includes White Iron, Garden, and Farm Lakes (Figure 1.2). Water levels in the White Iron Chain have historically been controlled by Winton Hydro and Birch Lake dams.

The White Iron Chain of Lakes Association (WICOLA) was formed in 1993 to promote good management of the lake system and to protect and preserve the interests of the property owners. The association was formed in response to a perceived decline in water quality, and the association immediately became involved in monitoring water quality on a voluntary basis. The association applied for inclusion in the Minnesota Pollution Control Agency's (MPCA) Lake Assessment Program to collect and interpret baseline water quality data. The MPCA completed an initial assessment of White Iron, Farm, and Garden Lakes in 1995 and made management recommendations to protect and improve water quality.

In 2011 the MPCA completed an assessment of the water resources in the watershed as part of that agency's 10 year assessment cycle. Assessed lakes were found to meet state water quality standards, with most exhibiting stable water quality as measured by lake clarity. Additional water chemistry and profile data is available for the White Iron chain and a few other lakes, and those lakes currently meet the state water quality standards.

1.2 THE KAWISHIWI WATERSHED PROTECTION PROJECT

A partnership of WICOLA, and Lake County received a Clean Water Land and Legacy Grant in 2011 to assess the condition of water resources in the Kawishiwi watershed. The Kawishiwi Watershed Protection Project ("the Project") was a multi-year joint effort of WICOLA, Lake County SWCD, and the MPCA to collect data which helped these partners create a comprehensive management plan to restore and maintain a healthy watershed. This project included the following elements:

- Performed water quality sampling on selected lakes and streams for nutrient and chemical analysis;
- Compiled existing data into a common format and consolidation into a public source;
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- Identified options for aggressively combating Aquatic Invasive Species (AIS);
- Performed GIS analysis to identify environmentally sensitive areas; and
- Developed a comprehensive and integrated approach to watershed planning and management.

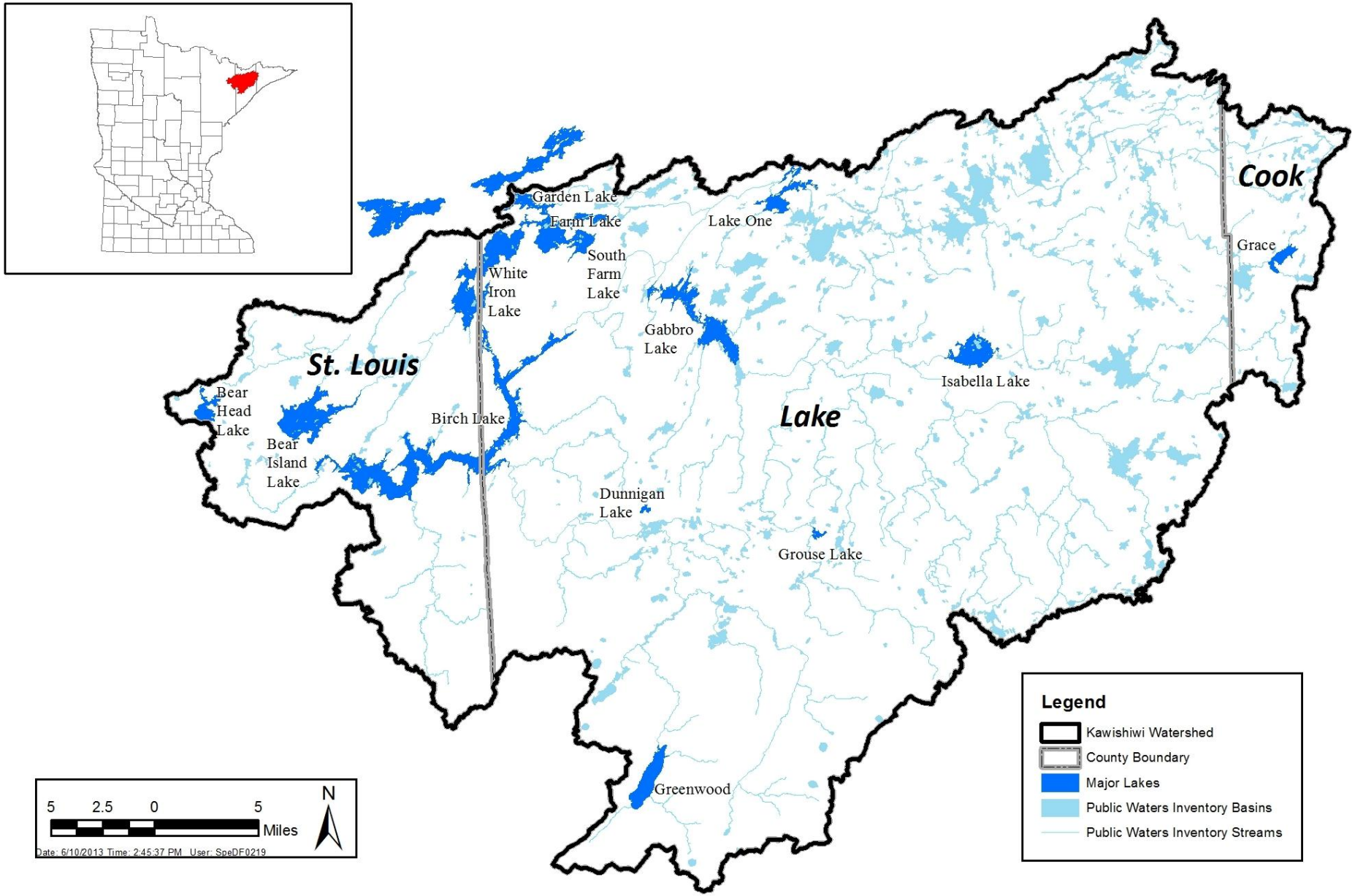


Figure 1.1. The Kawishiwi watershed.

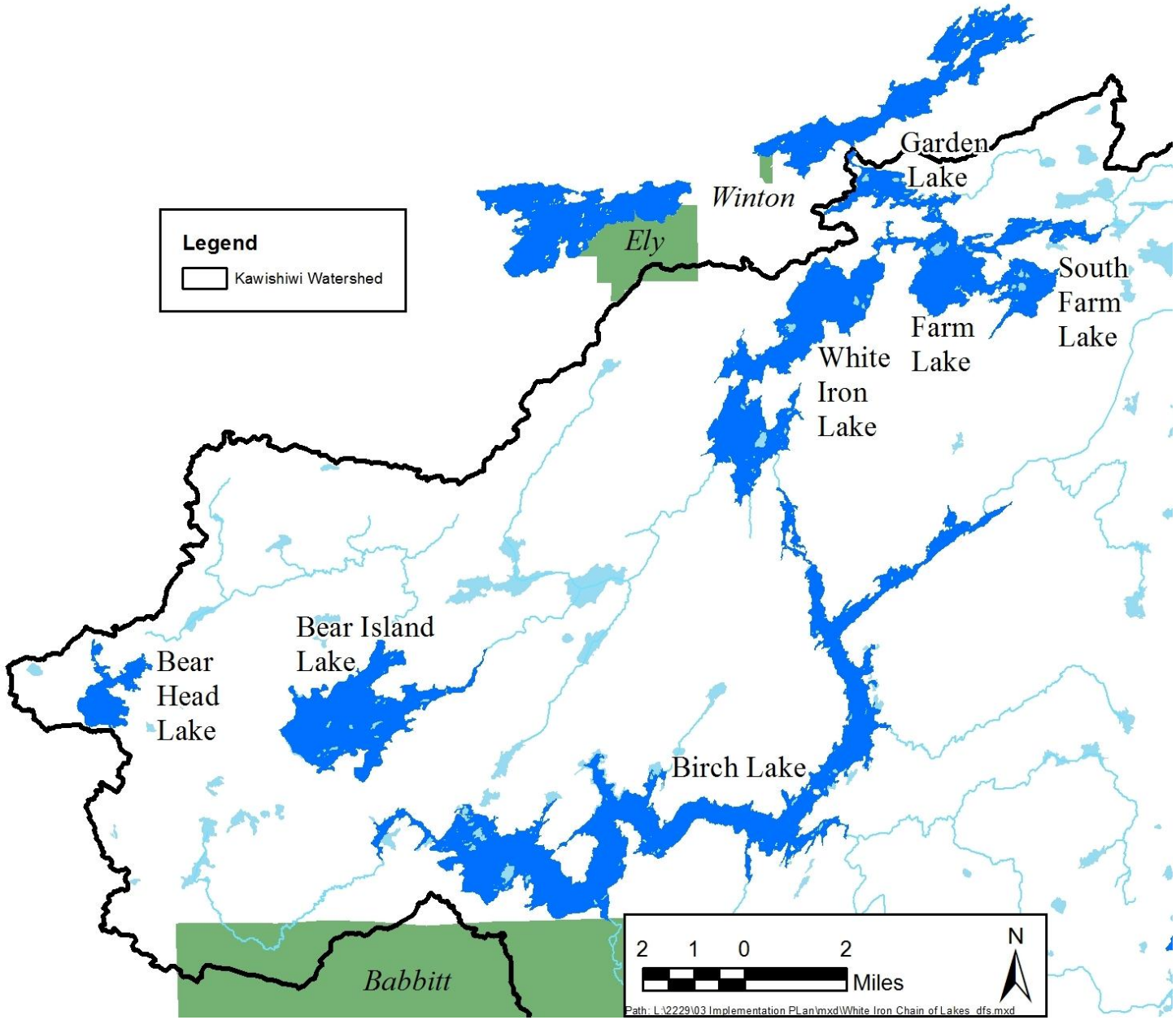


Figure 1.2. The White Iron Chain of Lakes in the Kawishiwi watershed.

2.0 Diagnostic Study

2.1 PROJECT AREA

The project area encompasses 1,230 square miles in Cook, Lake, and St. Louis Counties in northern Minnesota (Figure 2.1). The northeastern third of the watershed is located within the Boundary Waters Canoe Area Wilderness. Nearly all the watershed falls within the Superior National Forest.

2.1.1 Land Cover

Land cover in the watershed is dominated by forest and woody wetlands, with less than two percent of the watershed developed. Figure 2.2 displays data from the National Agricultural Statistics Service (NASS) CropScape Cropland Data Layer, and is derived from satellite imagery collected by the Indian Space Research Organization's RESOURCESAT-1 and processed by the US Department of Agriculture NASS.

Figure 2.3 displays data from the National Land Cover Database, which is derived from the National Aeronautic and Space Agency's Landsat 7 Thematic Mapper satellite imagery and processed by the Multi-Resolution Land Characterization (MRLC) consortium of ten federal agencies. The Cropland Data Layer is updated annually while the National Land Cover Database is updated less frequently. Data is presented for 2006 for both because that is the most recent National Land Cover Database geodata available.

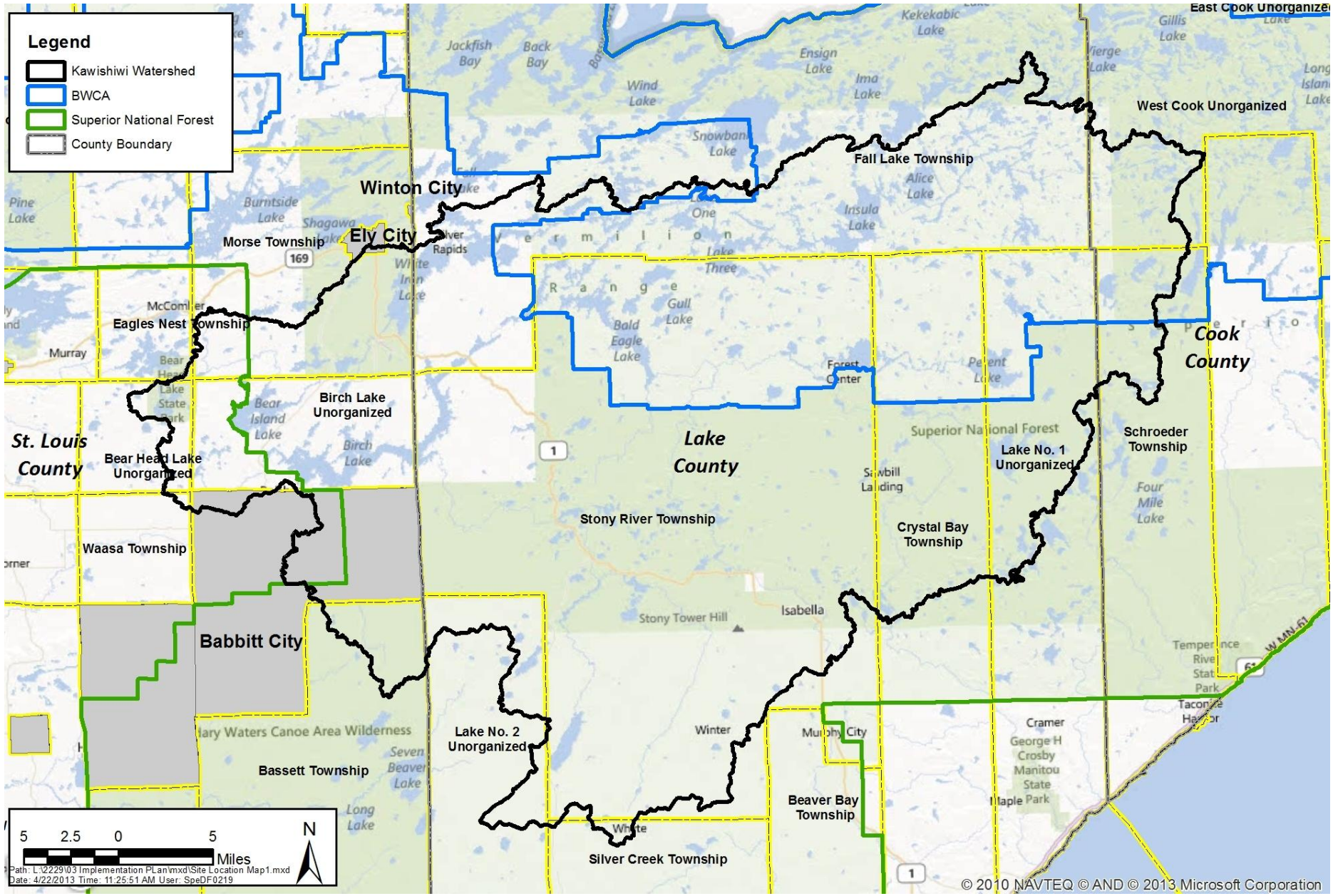
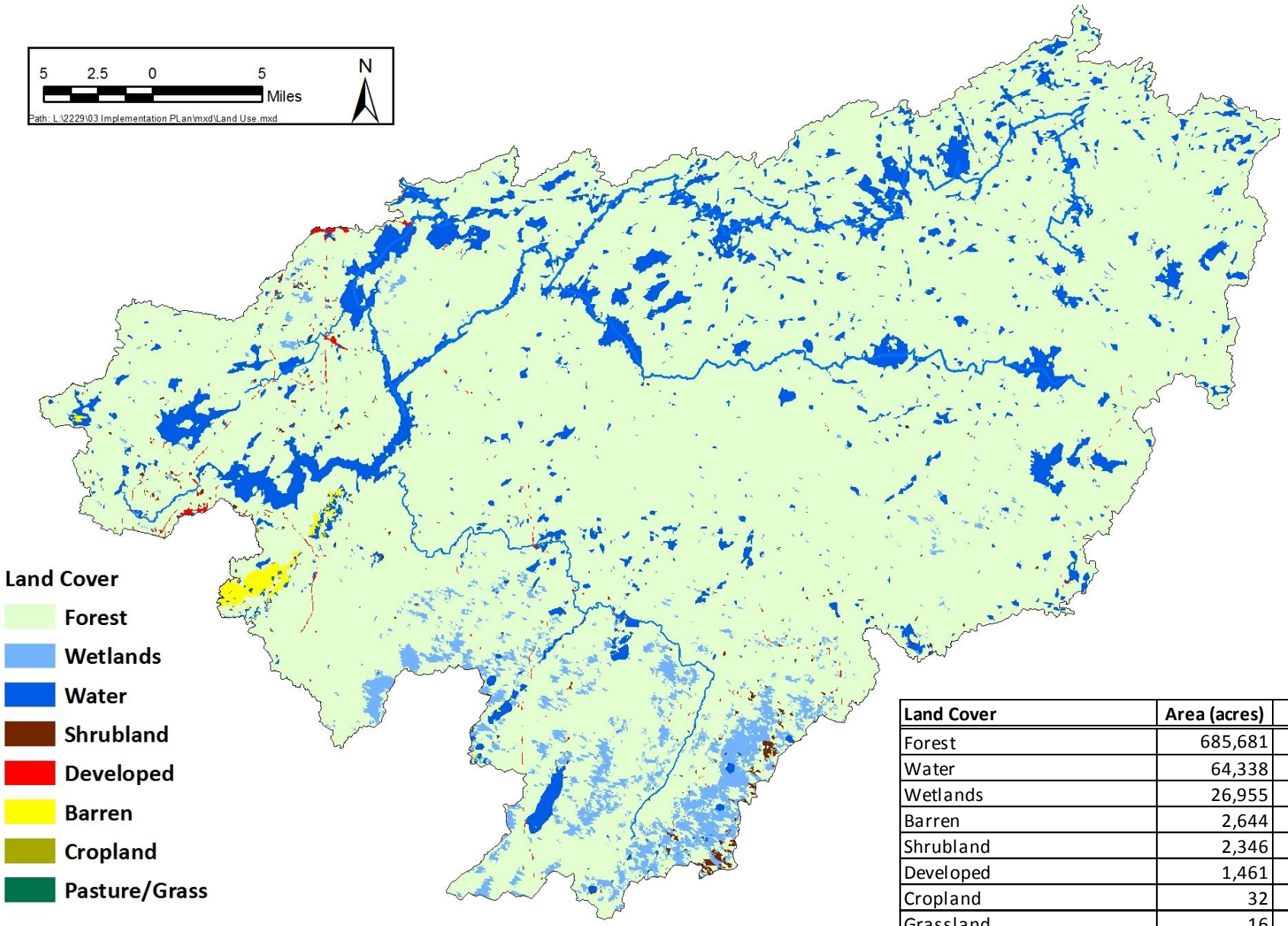


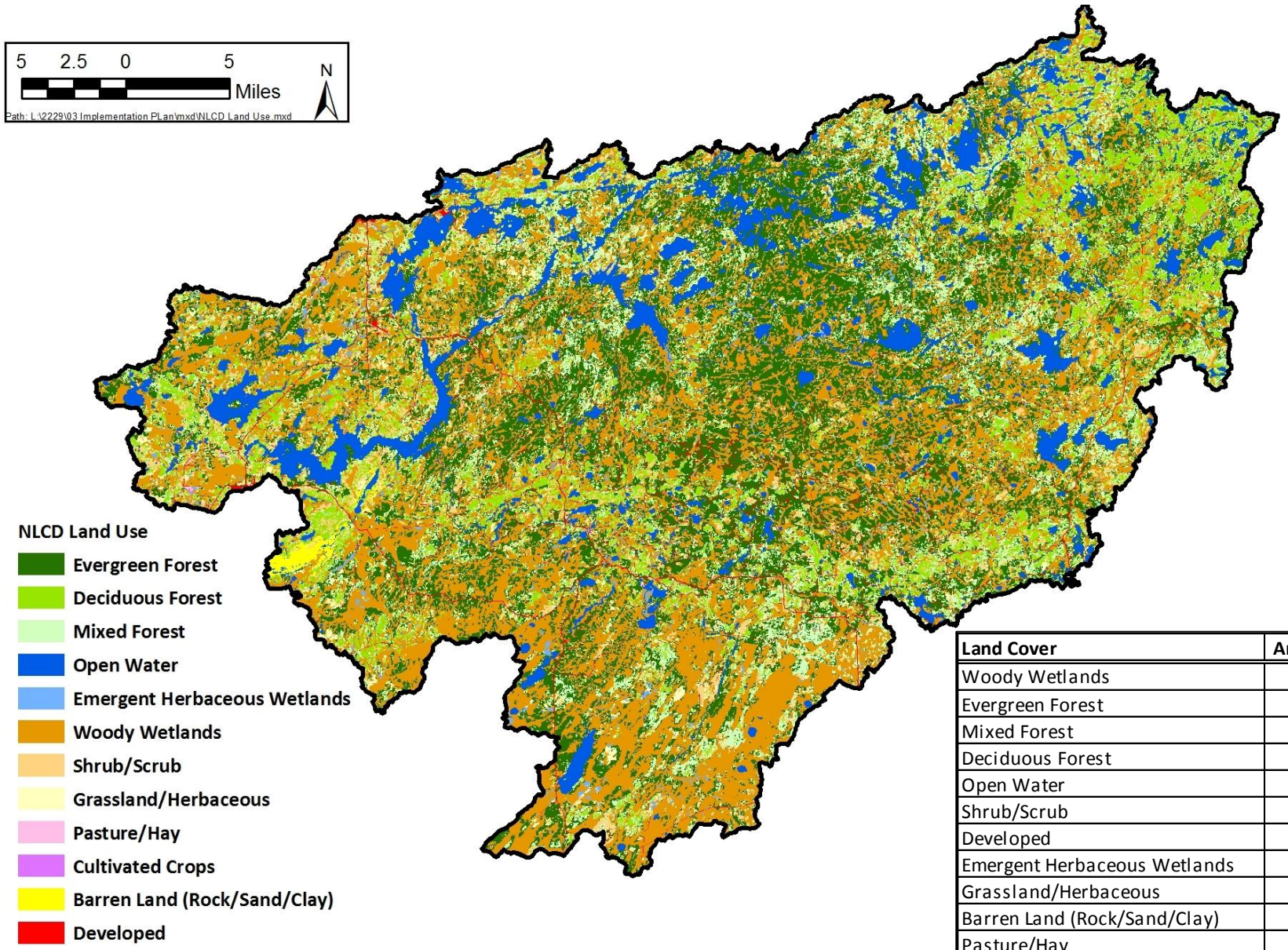
Figure 2.1. Political jurisdictions in the Kawishiwi watershed



Land Cover	Area (acres)	Percent
Forest	685,681	87.5%
Water	64,338	8.2%
Wetlands	26,955	3.4%
Barren	2,644	0.3%
Shrubland	2,346	0.3%
Developed	1,461	0.2%
Cropland	32	0.0%
Grassland	16	0.0%
Total	783,472	100.0%

Source: USDA CropScape Cropland Data.

Figure 2.2. 2006 National Agricultural Statistics Service land cover in the Kawishiwi watershed.



Land Cover	Area (acres)	Percent
Woody Wetlands	258,999	33.1%
Evergreen Forest	207,137	26.4%
Mixed Forest	109,708	14.0%
Deciduous Forest	70,774	9.0%
Open Water	70,087	9.0%
Shrub/Scrub	40,591	5.2%
Developed	11,866	1.5%
Emergent Herbaceous Wetlands	7,128	0.9%
Grassland/Herbaceous	4,562	0.6%
Barren Land (Rock/Sand/Clay)	2,363	0.3%
Pasture/Hay	198	0.0%
Cultivated Crops	59	0.0%
Total	783,472	100.0%

Source: 2006 National Land Cover database. (Fry, et al. 2011.)

Figure 2.3. 2006 National Land Cover Database land cover in the Kawishiwi watershed.

2.1.2 Water Resources

There are over 430 lakes in the watershed, most of them less than 100 acres in area. Table 2.1 shows lake morphometry for some of the major lakes within the watershed (Figure 2.4), while Table 2.2 shows the lengths of the major streams.

Table 2.1. Characteristics of select lakes in the Kawishiwi watershed.

Lake	ID	County	Lake Area (ac)	Max Depth (ft)	Trophic Status[1]
Bear Head	69-0254	St. Louis	649	46	M
Birch	69-0003	St. Louis	7,315	25	M
Bear Island	69-0115	St. Louis	2,320	70	M
White Iron	69-0004	St. Louis	3,151	47	M
Farm	38-0779	Lake	1,283	56	M
Garden	38-0782	Lake	636	55	M
Dunnigan	38-0664	Lake	83	15	O
Grouse	38-0557	Lake	121	10	E
Isabella	38-0396	Lake	1,078	18	M
Gabbro	38-0701	Lake	1,044	50	--
Little Gabbro	38-0703	Lake	189	26	E

[1]E=eutrophic, O=oligotrophic, M=mesotrophic
Source: Minnesota DNR Lake Finder.

Numerous streams drain the watershed. Some of the longest streams are shown on Figure 2.4 and detailed in Table 2.2.

Table 2.2. Characteristics of select streams in the Kawishiwi watershed.

Stream	Length (mi)
Stony	127.0
Isabella	115.7
Kawishiwi	78.2
South Kawishiwi	50.4
Birch Lake Outlet	26.2
Bear Island	24.0

Source: Minnesota DNR 24K stream shapefile.

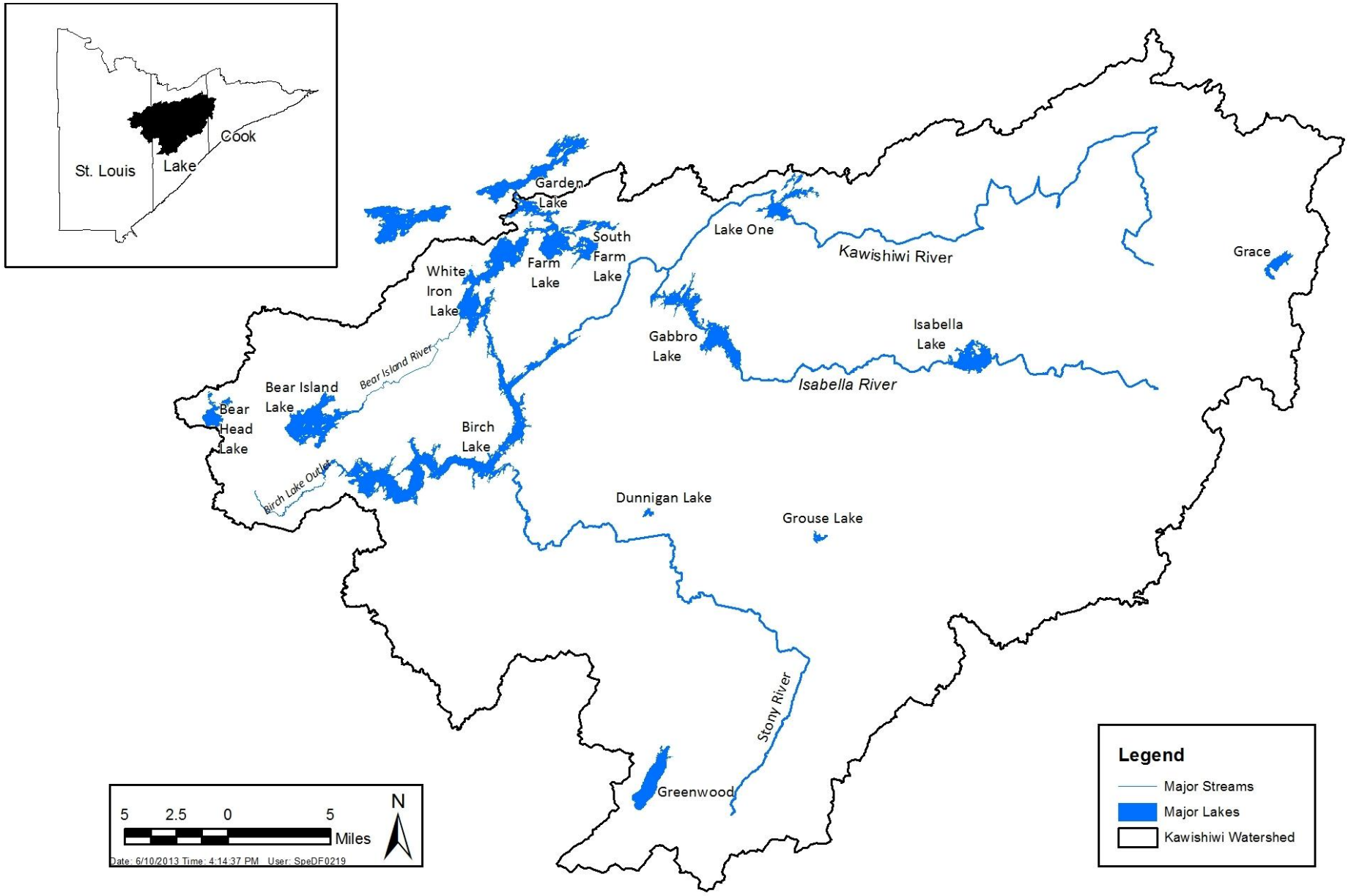


Figure 2.4. Major lakes and streams in the Kawishiwi watershed.

2.2 COLLECTED DATA

2.2.1 Beneficial Uses

Minnesota Statute Chapter 115.44 and Minnesota Rule Chapter 7050 designate the beneficial uses of the lakes and streams in Minnesota. These designated uses must be protected from degradation from pollution and alteration. Each water may have multiple classifications, which are shown in Table 2.3. In addition, waters in the BWCAW are further designated as Outstanding Resource Value Waters (ORVW) in Minnesota Rules 7050.0180.

Table 2.3. Beneficial use classifications in the Kawishiwi Watershed.

Class 1 waters: domestic consumption	Class 2 waters: aquatic life and recreation	Class 3 waters: industrial consumption
	Class 2A: cold water aquatic life, aquatic recreation, and drinking water source	
Class 1B: drinkable with approved disinfection	Class 2Bd: cool or warm water aquatic life, aquatic recreation, and drinking water source	Class 3B: general industrial purposes, needs only moderate treatment
Class 1C: drinkable with approved treatment	Class 2Bd: cool or warm water aquatic life, aquatic recreation	Class 2C: industrial cooling and materials transport

Source: Minnesota Rules Chapter 7050.0140 and 7050.0220.

The Beneficial Use Study prepared for the KWPP detailed the beneficial uses for the lakes and streams in the watershed. These are summarized in Table 2.4 and Table 2.5. Table 2.6 describes the statutory protections for each beneficial use classification grouping.

Table 2.4. Beneficial use classifications of lakes in the watershed.

Use Classification	Number	Percent	Use Classification	Number	Percent
2B, 3C	262	63.7%	1B, 2A, 3B – ORVW	5	1.2%
1B, 2Bd, 3B - ORVW	125	30.4%	1C, 2Bd, 3C	2	0.5%
1B, 2A, 3B	16	3.9%	1B, 2Bd, 3C	1	0.2%

Source: Kawishiwi Watershed Beneficial Use Study 2013.

Table 2.5. Beneficial use classifications of streams in the watershed.

Use Classification	Number	Percent	Use Classification	Number	Percent
1B, 2A, 3B	97	44.3%	1B, 2A, 3B – ORVW	6	2.7%
2B, 3C	86	39.3%	1B, 2Bd, 3C	3	1.3%
1B, 2Bd, 3B	25	11.4%	1B, 2Bd, 3C –ORVW	2	0.9%

Source: Kawishiwi Watershed Beneficial Use Study 2013.

Table 2.6. Description of beneficial use classification groupings.

Use Classification	Protected For
2B, 3C	Aquatic recreation including bathing, supporting cool or warm water fisheries and associated aquatic life and habitats. Industrial Use, agriculture and wildlife, aesthetic enjoyment, and navigation.
1B, 2Bd, 3C 1C, 2Bd, 3C 1B, 2Bd, 3B – ORVW	Drinking water, aquatic recreation including bathing, supporting warm and cool water fisheries and associated aquatic life and habitats, industrial use, agriculture and wildlife, and aesthetic enjoyment of scenery and navigation ORVW indicates Outstanding Resource Value Water and is also protected for exceptional quality. Discharges prohibited or greatly restricted. In the BWCA, all waters are ORVW and discharges are specifically prohibited.
1B, 2A, 3B 1B, 2A, 3B – ORVW	Drinking water, aquatic recreation including bathing, supporting cold-water fisheries (trout) and associated aquatic life and habitats, industrial use, agriculture and wildlife, aesthetic enjoyment, and navigation. ORVW indicates Outstanding Resource Value Water and is also protected for exceptional quality. Discharges prohibited or greatly restricted.

Source: Kawishiwi Watershed Beneficial Use Study 2013.

2.2.2 Water Quality

The watershed is located in the Northern Lakes and Forests ecoregion. Water quality standards by ecoregion and beneficial use are set forth in Minnesota Rules 7050.0220 through 7050.0227. Minnesota Rules 7050.0180 establishes the State's nondegradation policy for ORVWs that prohibits or strictly controls new or expended discharges of pollutants to ORVWs.

Bearhead and White Iron Lakes are DNR Sentinel Lakes. Lakes in this program are monitored long-term as a way to observe and record biological and chemical changes that occur in a sample of lakes that are representative of the state's most common aquatic environments. Other lakes in the watershed are monitored through the Citizens Lake Monitoring Program and through monitoring performed by WICOLA volunteer efforts and for the KWPP.

Impaired Waters. There are 73 waterbodies in the Kawishiwi River Watershed listed on the MPCA's 2012 303(d) Impaired Waters List. A waterbody is determined by the MPCA to be an Impaired Water if monitoring data shows that it does not meet water quality standards. Seventy-two lakes in the watershed and the Kawishiwi River are listed as impaired for mercury accumulation in fish tissue. A statewide Total Maximum Daily Load (TMDL) study completed for mercury estimated that 99.5 percent of mercury in fish in Minnesota comes from atmospheric sources, most of which originated from sources outside of Minnesota. No other chemical, physical, or biological impairments have been found for the waterbodies in this watershed.

Lake Nutrients and Clarity. In 1996 the MPCA, in cooperation with the DNR, North St. Louis and Lake County Soil and Water Conservation Districts, and WICOLA completed an assessment of conditions in White Iron, Farm, and Garden Lakes (MPCA 1997). Water quality data from that

assessment is shown in Table 2.7, and compared to State of Minnesota water quality standards and ecoregion averages.

Table 2.7. 1996 summer average water quality in White Iron, Farm, and Garden Lakes.

Lake	Total Phosphorus (µg/L)	Chlorophyll-a (µg/L)	Secchi Depth (m)
White Iron	29	4.1	1.4
Farm	23	4.0	1.9
Garden	22	5.9	1.6
State Standard	*≤30*	*≤9*	*>2*
Ecoregion Range	*14-27*	*<10*	*2.4-4.6*

Source: MPCA 1997.

Total phosphorus (TP), while still lower than the state standard for the Northern Lakes and Forests ecoregion, was at the high end of the ecoregion mean. Secchi depth, a measure of transparency, was lower than the standard and the ecoregion mean. Color measured in all three lakes was much higher than the ecoregion average, indicating that reduced transparency may be a result of both algal growth and bog staining. The MPCA conducted lake water quality modeling on the lakes using the model MINNLEAP (Minnesota Lake Eutrophication Analysis Procedure), which predicted lower TP and chlorophyll-a (chl-a) concentrations than observed, and a greater Secchi depth than observed. The 1997 report concluded that phosphorus loading from the watershed may be greater than estimated, and that potential sources may include leachate from septic systems; runoff from streets and yards; and pesticide and fertilizer use.

In 2010 the MPCA conducted a ten-year assessment of water quality of resources within the watershed (MPCA 2011). The report summarized data collected 2000-2009 by various agencies, citizen volunteers, and MPCA staff. Only a few lakes in the watershed have been monitored for parameters other than clarity as measured by Secchi depth. Data on those lakes is shown in Table 2.8. Lakes located within the BWCAW were assessed by remote sensing of water clarity.

Table 2.8. 2000-2009 summer average water quality in monitored lakes.

Lake	Total Phosphorus (µg/L)	Chlorophyll-a (µg/L)	Secchi Depth (m)
Dunnigan	16	4.4	3.0
Birch	24	6.6	1.2
Bearhead	14	7.5	2.9
Bear Island	17	6.3	1.9
White Iron	20	5.2	1.6
Farm	17	4.8	2.0
Garden	18	6.1	1.6
State Standard	*≤30*	*≤9*	*>2*
Ecoregion Range	*14-27*	*<10*	*2.4-4.6*

Source: MPCA 2011.

While Total Phosphorus concentration in the monitored lakes during 2000-2009 has improved slightly over the 1996 values, there appears to have been little change in chl-a and transparency since that time. Chl-a is a biochemical component found in algae and other photosynthesizing organisms. The chl-a concentrations are low and below the standard, indicating that algal blooms are not a significant factor impairing water quality and reducing clarity in these lakes. Clarity in most of the lakes in the watershed is influenced by bog staining, making it difficult to evaluate the relationship between chl-a and clarity.

Volunteers from WICOLA continued water quality monitoring in the White Iron chain in 2011 and 2012. Additional monitoring for the KWPP was conducted in other locations in the watershed by a network of volunteers and students. Sixty-five lakes and 12 streams were sampled between May 2011 to October 2012.

Trend Analysis. Water staining can limit the utility of Secchi depth as an indicator of water quality in a given year, but assuming staining does not vary significantly from year to year, clarity data can be useful for assessing trends over time. Water chemistry data are a better tool to evaluate current conditions and trends, but many of the lakes in the watershed are difficult to access to obtain samples and the lab analysis can be costly. With the limited chemistry data available for these lakes it is difficult to draw conclusions because year to year changes due to precipitation and weather effects can mask trends. A period of record of at least ten years is desirable to begin to separate trends from annual variation. Historic data and water quality trends for selected lakes are shown in the tables and figures in Appendix A.

Although data is limited, two lakes appear to be on a slight trend of reduced clarity: Farm Lake and Garden Lake. Farm Lake also appears to be on a slight trend of increased TP and chl-a concentration. Additional years of data and more analysis would be required to determine if this observed trend is statistically significant. The water chemistry trend for Garden Lake is less clear, and would benefit from additional data.

Metals and Other Parameters.
Sampling for various metals in the water column at one location on Birch Lake and one location on White Iron Lake was performed in 2007 and 2012 (Baratono and Anderson 2012). Water column sampling was also performed in 1977-1981. Lake sediment sampling was added in 2012. The study sampled for the Iron Range Metals Suite 2012, which is composed on 21 biologically active metals determined to be most likely found in the Mesabi Range deposit based on previous sampling and analysis. This data was analyzed as part of the Project to determine current conditions and evaluate trends. It should be noted that the 1977-81 data may not be directly comparable to the newer data due to changes in field protocols and laboratory methods. In addition, the 2007 data was generally analyzed to parts per trillion, while the 2012 data was generally analyzed to parts per billion to reduce costs. That change in resolution may make it difficult to directly compare 2007 to 2012 but is still adequate for assessment and future trend assessment.

Except for one exceedance for aluminum in 1980, all concentrations were below state water quality standards. Trend assessment showed mixed results, with some analytes such as copper, mercury and nickel showing an increase and most others a decrease since 1977-81. The concentrations were so low that an increasing trend is not a concern at this time. The final report included recommendations for future monitoring to stay abreast of trends and to coordinate review of future data with future paleolimnology work.

2.2.3 Paleolimnology Results

Paleolimnology is the reconstruction of lake water quality history through the study of artifacts embedded in the lake sediments. Scientists use grains of pollen and fossils of diatoms, a type of algae with a silica structure, to reconstruct conditions over time. Each species of diatom has its own characteristic requirements, and from the array of species found in a slice of sediment paleolimnologists can infer the lake conditions when that layer was deposited. This technique is useful to show generally how a lake's condition may have changed over a long period of time, for example, since European settlement of the Americas, since logging operations began, etc.

Sediment cores from five lakes in the watershed were collected and analyzed: Fall, Farm, Garden, Birch and White Iron. These cores are intended to represent approximately the last 200 years of lake history. The preliminary results indicate that past use of the White Iron chain of lakes (WICOL) watershed has resulted in changes to lake ecology. While not a substantial change, there is evidence that an increase in organic material accumulation has occurred since settlement of the region (Reavie et al., unpublished data).

Although there are similarities in histories of the five lakes, they exhibited variations in their paleoecology. Ecologists use the term "productivity" to express the rate of production of biomass in an ecosystem. An increase in productivity may indicate a disturbance in the watershed or an increase in nutrients discharged to the lake, fueling more algal growth. As illustrated on Figure 2.5 below, Birch Lake's productivity, according to diatom accumulation, shows an increase in algal load in the last few decades. Farm Lake had a much longer period of increased productivity going back to initial settlement of the area. White Iron Lake had a significant increase in productivity following settlement, from 1900 through about 1980, but a return to pre-European diatom abundances in recent decades.

Pollen profiles reflect changes in terrestrial activities. Logging results in an increase in opportunist species such as ragweed appearing in greater abundance following deforestation in the late 1800s. Trends also indicate a decline in pine, particularly white pine, in the 20th century. There was also a slight relative increase in birch pollen.

Metals profiles indicate changing inputs to the sediments corresponding to development in the watershed. Several analytes (e.g. calcium, iron, silicon, magnesium, manganese) gradually increased throughout the 20th century. It is likely this is the result of increased erosion of soils and bedrock as the increases are occurring throughout the area sampled, some of which are upstream of any mining operations. There is also evidence in the surface sediments of sodium

accumulation from road salt applications, but it does not appear to persist in the sedimentary record.

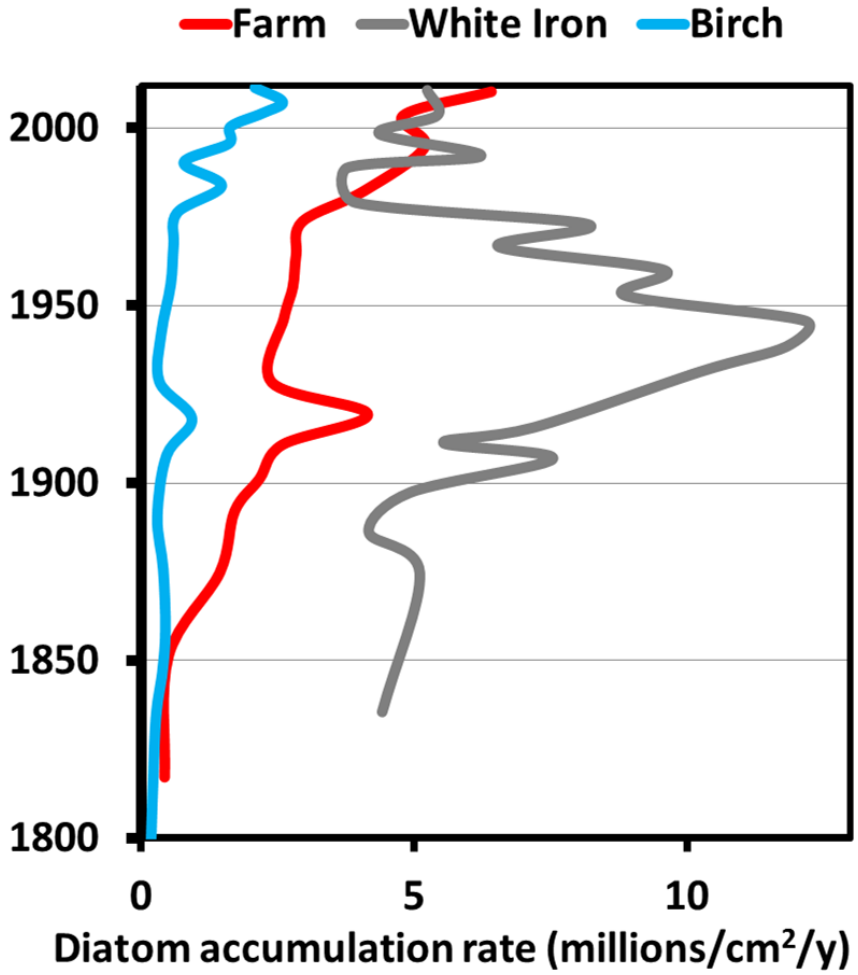


Figure 2.5. Estimated diatom accumulation rate in three lakes.
Source: Reavie et al., unpublished data.

Reconstructing the nutrient loading reveals no serious loading problem in the lakes. There have been changes over the years related to damming but loads appear to have stabilized recently, likely due to management and regrowth of forests. The results suggest that White Iron Lake may be continuing to experience some elevated nutrient loading.

Comparing the lakes, Birch Lake is changing most rapidly and recently. Because this is a large, complex system, additional coring should be conducted, including a sequence of cores from Kramer Bay through Dunka Bay and Klobuchar Bay. In addition, additional Fall Lake sampling should be considered to better understand the history of this complex lake system. Finally, additional sampling of "reference" lakes in the BWCAW should be considered to assess whether changes seen in the sediment record are a result of human activities or are climate or precipitation driven.

2.2.4 Subsurface Sewage Treatment Systems Inventory and Analysis

Most residents within the watershed boundary do not have municipal sewer or water treatment systems. Instead, dwellings use Subsurface Sewage Treatment Systems (SSTS, often referred to as septic systems) and private wells. As part of this study the existing condition of the SSTS within the watershed was assessed, including an evaluation of the susceptibility of shallow groundwater and surface water from the existing SSTS in the area. Using historic permitting information from St. Louis and Lake Counties, interviews with local personnel, and parcel size and type, the potential water quality impacts from SSTS was estimated and areas identified where impacts to water quality from SSTS are most likely to take place.

Of the 1,909 wastewater-generating parcels in the watershed, it was estimated that 1,173 contain SSTS that are noncompliant or fail to protect the groundwater (Wenck, 2012). Compliance was determined as follows:

Generally, the system was counted as compliant if the county data indicated that the system was:

- a mound, at-grade or system with pretreatment;
- a drainfield installed in the past 10 years appearing to conform to applicable rules; or
- a holding tank

If systems did not meet the above criteria they were generally considered non-compliant with Minnesota Rules Chapter 7080, unless county file review or visual evidence suggested otherwise. County-reviewed information also documented some existing non-compliant SSTS.

Properties that did not have any information on file with the counties and did not appear to have been upgraded in the recent past were counted as non-compliant. Properties that were vacant were documented with no compliance status, as no SSTS currently exists on the parcel. Dwellings that could not be easily viewed from the road had a determination of compliance status based solely on county records and known information about local soils. The SSTS that were documented as non-compliant were identified as such for a failure to protect groundwater (i.e. did not meet vertical separation requirements).

The SSTS assessment estimated the annual phosphorus load from all SSTS to surface water and shallow water to be about 3,462 pounds per year for the entire watershed, with an estimated 39% of that load coming from SSTS located within 500 feet of impaired water.

The 2011 MPCA report “A Water Quality Assessment of Select Lakes within the Kawishiwi River Watershed” described in Section 2.2.2 above noted that MINNLEAP modeling was conducted for select lakes, and annual phosphorus loading to the lakes estimated (MPCA 2011). The SSTS assessment estimated that potential load from SSTS was equal to about 19 percent of the total phosphorus load to Bear Island Lake, compared to about one percent for other studied lakes. Therefore, Bear Island Lake is the most susceptible to phosphorus impacts from SSTS compared

to Birch, White Iron, and Garden Lake. Nine Service Areas on six lakes were determined to pose the greatest threat of water quality impacts from SSTS within the watershed:

- Dunka Bay, Birch Lake
- Middle McDougal Lake
- Southwest Bear Island Lake
- North White Iron Lake
- Southwest White Iron Lake
- Finn Bay, Birch Lake
- Sand Lake
- Kawishiwi Trail, Farm Lake
- Sunset Road, White Iron Lake

The assessment recommended applying for funding from the MPCA to complete Community Assessment Reports (CAR) for each of these nine areas. CARs will provide a more thorough on-site assessment of SSTS compliance, and will identify options for and feasibility of infrastructure improvements.

2.2.5 AIS Inventory

Currently rusty crayfish is the only known aquatic invasive species found in the watershed while spiny water fleas, mystery snails, zebra mussels and Eurasian water milfoil have been found in nearby lakes. Actions have been taken to both mitigate and test for invasive species. To mitigate the rusty crayfish, smallmouth bass have been introduced in some lakes as a predator and trapping efforts at 267 different sites has taken place, while testing for spiny water flea has taken place at 20 different locations (unpublished monitoring data).

The WICOLA and Sea Grant have also been very active in distributing AIS information and trying to determine the best way to bring about AIS awareness. In summer 2012, surveys were mailed to 2,210 parcel holders within the watershed with a focus on determining the awareness, attitudes, knowledge, and behaviors of parcel taxpayers in the watershed. Of the 2,210 surveys mailed out, 810 responses (38%) were returned (Mason, 2012). Survey questions and responses are summarized in Table 2.9.

Table 2.9. AIS survey questions and responses.

Question	Response
1. What are the major problems within the watershed?	• Water level fluctuation (43.7% believed this was a major problem) • Aquatic invasive species (34.0%) • Trees lost to disease (30.8%) • Response of public officials (29.5%)

Question	Response
2. What AIS species do you believe are important to take action against?	• Zebra/quagga mussels (93.9% believed taking action was important) • Eurasian water milfoil (92.4%) • Asian Carp (90.6%) • Rusty crayfish (83.1%) • Purple Loosestrife (82.7%) • Spiny water fleas (84.4%) • VHS (82.5%) • Curly pondweed (80.4%)
3. What information sources are effective for disseminating AIS information?	• Water access signs (14.4% believed this was the most important source) • Newspapers and magazines (12.7% selected) • Television ads (11.5% selected) • Regulation books (11.4% selected)
4. What actions did you take in 2012 to prevent the spread of AIS?	• Drain water from bilge, bait and live wells (92.9%) • Inspect and remove aquatic plants (92.6%) • Dispose of unwanted live bait in trash (81.9%) • Dry everything for at least five days (62.2%) • Rinse watercraft with garden hose (33.1%) • Wash watercraft with high-pressure hot water (11.4%)
5. What do you believe motivates people to take action(s) to prevent the spread of AIS?	• It is their desire to keep AIS out of our lakes and rivers (92.7%) • They feel it is their personal responsibility; their actions make a difference (91.1%) • They see other watercraft users doing it (90.1%) • Friends, relatives or acquaintances told them to do it (89.5%) • Threat of fines that would cost them money (88.4%) • Laws or regulations that prevent transport of AIS affect their actions (85.6%) • Threat of enforcement action by conservation officers (85.5%).

2.2.6 Sensitive Areas

A sensitive area assessment was completed as part of the KWPP to identify points of interest in the watershed as well as wetlands, shorelines with steep slopes, and soils with high erodibility. Points of interest such as campsites (both formal and informal), boat and canoe landings, portages and other public shoreline areas that might be sources of sediment and nutrient loading were visited, photographed, GPS location recorded, and assessed for potential impacts to water quality.

This survey of points of interest found that most impacts to water quality are human caused, e.g. erosion from unvegetated or sparsely vegetated shorelines; septic systems; and runoff from the land, especially turf grass lawns treated with herbicides, pesticides, and fertilizers and mowed to the lakes' edge with no buffer to filter runoff and repel geese. It was observed that unmanaged and illicit campsites in Superior National Forest have more shoreline erosion and septic impacts than BWCAW campsites.

Community GIS compiled maps of existing and proposed land uses and identified sensitive lands based on wetlands, soil types and steep slopes. The GIS assessment included identifying sensitive areas where zoning and parcel ownership suggests a potential to subdivide, and the environmental, physical and regulatory constraints to development such as areas within 1,000 feet of a lake where the slope of the land is 20 percent or greater. Of particular sensitivity are parcels that include land that is highly sloped, and existing campsites and other points of interest located on land that is highly sloped. These lands are more susceptible to erosion.

3.0 Implementation Plan

3.1 IMPLEMENTATION PLAN OBJECTIVES

The purpose of this Implementation Plan is to identify a suite of actions to be undertaken by a partnership of federal, state, county, local, and private stakeholders to protect and improve the beneficial uses of the water resources within the watershed. These actions are both short and long term, and include both structural (capital and maintenance projects) and nonstructural (education, regulation, incentives) actions.

3.2 PRIORITY MANAGEMENT AREAS

A Beneficial Uses assessment was completed to identify the statutory and other beneficial uses of the resources in the watershed. Table 3.1 is an overview of the Beneficial Uses, expected outcomes, and potential actions to protect those Uses. This assessment and the input from stakeholders served as the basis for prioritizing management actions.

KAWISHIWI WATERSHED PRIORITY MANAGEMENT AREAS

1. Enforce shoreland management regulations as property develops and redevelops, and encourage voluntary actions to mitigate the impacts of past development.
2. Proactively protect beneficial uses by taking positive actions to halt or minimize the spread of Aquatic Invasive Species (AIS).
3. Protect and improve water quality by reducing the number of noncompliant Subsurface Treatment Systems (SSTS) and increase the number of SSTS that are properly operated and maintained.
4. Protect and improve water quality and aquatic and terrestrial habitat by implementing shoreland Best Management Practices (BMPs) to stabilize and restore eroding shoreline and establish native shoreline and emergent vegetation.
5. Continue to monitor water quality and evaluate water quality trends.
6. Coordinate education and outreach messages and delivery methods with and between federal and state agencies, county and local governments, lake associations and other groups.

Table 3.1. Beneficial Uses, protections, and general actions.

	Expected Outcomes	Existing Protection in addition to MN Statute 7050 and Narrative Standards	Possible and Plausible (Historic applies back to 1975)	Specific Actions	SSTS	AIS	Erosion	Thermal	Levels	Air	Shoreland BMPS	Forestry BMPS
Drinking Water Year Round	Ability to drink water w/ minimal filtration	MDH Drinking water standards (chronic)	Where historic or present usage	Effective sewage treatment, non-point runoff treatment, domestic animal waste, education on phosphorus reduction, stable water levels, zebra mussel control (water intakes), enforcement of existing ordinances and regulations	X	X	X		X		X	X
Drinking Water Occasional	Ability to drink water w/ minimal filtration	MDH Drinking water standards (acute)	Where historic or present usage	Effective sewage treatment, non-point runoff treatment, domestic animal waste, education on phosphorus reduction, stable water levels, zebra mussel control (water intakes), enforcement of existing ordinances and regulations	X	X	X		X		X	X
Beach/ Swimming	Safe, free from pathogens, floating debris, odor and excessive algal growth	MDH coliform and *Domestic Animal(?) standard*, MN Narrative Standards?	Where safe conditions allow	Effective sewage treatment, non-point runoff treatment, buffer from domestic animal waste, phosphorus reduction, invasive species control, manage beach to deter unwanted wildlife (geese)	X	X	X				X	X
Boating Motorized	Safety, access, pollution free water	DNR regulations	Where allowed, where access permits	Non-erodible boat landings, encourage cleaner emission motors, proper refueling and maintenance procedures, operation of boats to reduce wave erosion and protect wildlife, i.e. - nesting, control of AIS (zebra mussels, Eurasian watermilfoil)		X	X		X		X	
Boating Non-motorized	Safety, access, noise free	Fed. Wilderness Protection Leg., DNR regulations	Where allowed, where access permits	Non-erodible boat access points, stabilization of portage trails			X		X		X	
Fishing Warm Water Fishery	Stable fishery, uncontaminated fish for safe consumption by people and wildlife	DNR regulations for harvesting of fish, Invasive Species Control, DNR Protected Water Permit Program, Wildlife Protection criterion, 1854 Treaty Authority	Where environmental conditions permit (i.e. temp, DO, spawning substrate)	Control AIS, reduce thermal pollution, maintain natural riparian buffer, wetland protection, Forestry BMPs, reduce mercury inputs and bioavailability, maintain adequate water levels during low flow periods		X	X	X	X	X	X	X
Fishing Cold Water Fishery	Stable fishery, uncontaminated fish for safe consumption by people and wildlife	DNR regulations for harvesting of fish, Invasive Species Control, DNR Protected Water Permit Program, Wildlife Protection criterion, 1854 Treaty Authority	Where environmental conditions permit (i.e. temp, DO, spawning substrate)	Control AIS, reduce thermal pollution, maintain natural riparian buffer, wetland protection, forestry BMPS, reduce mercury inputs and bioavailability, maintain adequate water levels during low flow periods	X	X	X	X	X	X	X	X
Wild Rice	Healthy wild rice beds	DNR regulations for harvesting and disturbance, 1854 Treaty Authority	Where historic or present conditions permit	Rusty crayfish control, maintain sulfur levels consistent with state law, maintain stable water levels		X			X	X	X	X
Float Plane Landing	Safe landing areas	FAA, Federal Wilderness Protections	Where physical constraints allow	Control AIS, maintain adequate water level		X			X			

	Expected Outcomes	Existing Protection in addition to MN Statute 7050 and Narrative Standards	Possible and Plausible (Historic applies back to 1975)	Specific Actions	SSTS	AIS	Erosion	Thermal	Levels	Air	Shoreland BMPS	Forestry BMPS
Water for Fire Suppression (pumped and Airlifted)	Adequate water levels for aquatic life habitat	DNR water appropriations	Non-infested waterbodies	Control AIS, non-erosive surface at inlet or outlet (dry hydrants)		X	X		X		X	
Aesthetic Enjoyment	Peace, serenity and solitude, natural riparian areas, support property values	DNR Shoreland Ordinance, local ordinances, NEPA, MEPA		Enforcement of existing ordinances and regulations, education on value of wilderness, promote shoreland BMPS	x	x	x			x	x	x
Aquatic Wildlife	Healthy aquatic ecosystems	DNR Shoreland Ordinance, local ordinances, NEPA, MEPA, DNR Protected Waters Permits		Promote shoreland BMPS, control AIS (Faucet Snail)		x					x	
Hydropower Generation	Stable water flow for power production	FERC	Existing facilities	Maintain existing facilities and reservoirs		x			x			

3.3 BMP ALTERANTIVES AND ANALYSIS

This section sets forth Best Management Practices (BMPs) that will be considered to protect and improve the water resources in the Kawishiwi River watershed. Refer to Table 3.5 in Section 3.8 for stakeholder roles and responsibilities, Table 3.6 in Section 3.13 for specific education messages by stakeholder group, and Table 3.7 for estimated cost and schedule of implementation.

3.3.1 Land Use Regulation

Counties have a powerful tool available to manage land use adjacent to public waters – Shoreland Management ordinances. All three counties have promulgated shoreland management overlay district ordinances that specify lot dimensional standards such as lot sizes, widths, and setbacks from waters, bluff lines, and steep slopes and setbacks for new SSTS. The ordinances also regulate removal of existing vegetation, provide standards for erosion control and vegetation reestablishment, and for certain types of development require stormwater management. Tables 3.2, 3.3, and 3.4 summarize those standards by county. Figure 3.1 illustrates how some of these dimensional standards apply.

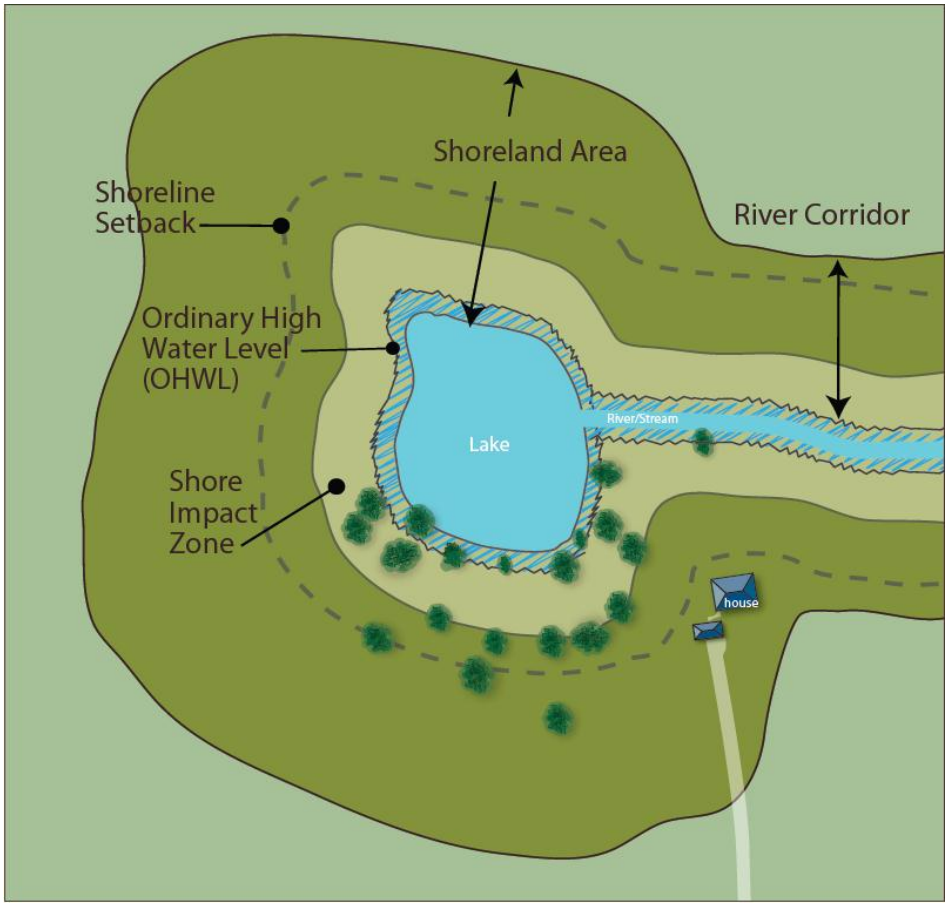


Figure 3.1. Identifying shoreland areas.
Source: Shoreland Guide for St. Louis County, Minnesota.

Stakeholders identified inconsistent application and enforcement of Shoreland Management ordinances as an issue of concern in the watershed. Stakeholders also noted that variances or deviations from the Shoreland Management requirements were sometimes allowed if a developer provided other features of equal or better public benefit, and those trade-offs were not known or understood by the public.

Work completed as part of the Kawishiwi Watershed Protection Project identified a number of parcels that are large enough to subdivide into lots that meet county Shoreland Management dimensional requirements. Consistent application and enforcement of Shoreland Management standards is key to protecting lakes and streams from future impacts due to development.

Land Use Regulation Implementation Objectives

1. Consistently apply and enforce existing Shoreland zoning and permitting regulations.
2. Increase transparency of land use decisions such as variances.
3. Increase awareness of the purpose and benefits of Shoreland Management.

Table 3.2. Shoreland Management ordinance dimensional standards by county.

County	Public Water	Classification	Lot Restrictions		Setback Distances (ft)		
			Minimum Lot Size (ac)	Minimum Water Frontage (ft)	Structure	Sewage Treatment System	Top of Bluff
Lake County	Lakes	Natural Environment	1.84	200	150	150	30
		Recreational Development	1.00	200	100	75	
	Rivers	Remote	Dependent on Zone District	300	200	150	30
		Forested and Transition		250	150	100	
		Tributary		200	100	75	
		Unclassified[1]		200	50	50	
St. Louis County	Lakes	Natural Environment	0.5-35 (Dependent on Zone District)	100 - 600 (Dependent on Zone District)	150	50	20
		Recreational Development			100		
	Rivers	Trout Streams	0.5-35 (Dependent on Zone District)	100 - 600 (Dependent on Zone District)	150	50	20
		Forest Rivers			150		
		All Other			100		
Cook County	Lakes	Natural Environment	2.00	200	150	150	30
		Recreational Development	1.00	150	100	100	
	Rivers	Remote	Dependent on Zone District	300	200	200	30
		Forested and Transition		200	150	150	
		Tributary		100	100[3]	100	

[1]An Unclassified watercourse is any watercourse with a defined bottom.

Table 3.3. Shoreland Management ordinance vegetation removal standards by county.

County	Standards for Vegetation Removal
Lake County	Removal of natural vegetation within the shore and bluff impact zones is limited to the following: 1. The removal of dead, diseased, dangerous and storm or fire damaged trees, shrubs, and plants, 2. The trimming and pruning of trees, shrubs and plants. 3. The removal of 25% of trees (greater than two inches in diameter at breast height), shrubs and plants.
St. Louis County	1. A vegetation management plan will be required for total vegetation removal of over ten thousand (10,000) square feet or twenty-five percent (25%) of lot area, whichever is lesser. 2. Selective removal of natural vegetation shall be allowed in order to provide a view corridor to water; however, such removal shall leave sufficient cover to screen cars, dwellings, and other structures from view from the water and selective vegetation removal shall be allowed in order to accommodate the placement of the following additional uses: placement of stairways and landings, picnic areas, access paths, livestock watering areas, beach and watercraft access, permitted water-oriented accessory structures. 3. Vegetative removal shall be limited along watercourses and streams in order to maintain and preserve the existing shading of streams that support trout fishery which are very sensitive to fluctuations in water temperatures. 4. In no case shall intensive vegetative clearing be allowed within the Shore Impact Zone (50 feet from the vegetation line) or the Bluff Impact Zone or on steep slopes.
Cook County	1. Intensive vegetation clearing within the shore and bluff impact zones and on steep slopes is not allowed. Intensive vegetation clearing for forest land conversion to another use outside of these areas is allowed as a conditional use if an erosion control and sedimentation plan is developed and approved by the Soil and Water Conservation District in which the property is located. 2. In shore and bluff impact zones and on steep slopes, limited clearing of trees and shrubs and cutting, pruning, and trimming of trees is allowed to provide a view to the water from the principal dwelling site and to accommodate the placement of stairways and landings, picnic areas, access paths, livestock watering areas, beach and watercraft access areas, and permitted water oriented accessory structures or facilities, provided that additional screening is not substantially reduced and shading of water source is preserved.

Table 3.4. Shoreland Management ordinance stormwater management standards by county.

County	Sediment and Stormwater Management Requirements
Lake County	Erosion and sediment control plans are required for the following excavations: 1. Greater than 1,000 sq. ft. (e.g., 31 ft. x 31 ft.) or 100 cubic yards. 2. 1,000 cubic yards of fill. 3. 10 cubic yards within the shore impact zone. 4. Within 300 feet of the shore or in the bluff impact zone.
St. Louis County	Shore Impact Zones (50% of shoreline setback in most areas): 1. Under 10 cubic yards (e.g., 23 ft. x 23 ft. x 6 inches deep) - no permit required. 2. Ten to 50 cubic yards - Land Use Permit required. 3. More than 50 cubic yards - Applications shall not be considered complete until plans approved by proper authority. Shoreland: 1. Less than 50 cubic yards - no permit required. 2. 50 to 500 cubic yards - Land Use Permit required. 3. More than 500 cubic yards - Applications shall not be considered complete until plans approved by proper authority.
Cook County	A grading and filling permit is required for: 1. Movement of more than 10 cubic yards of material on steep slopes or within shore or bluff impact zones. 2. Movement of more than 50 cubic yards of materials outside of steep slopes and shore and bluff impact zones. Stormwater Management Standards: 1. Impervious surface coverage of lots must not exceed 25 percent of the lot area. 2. When constructed facilities are used for stormwater management, documentation must be provided by a qualified individual that they are designed and installed consistent with the field office technical guide of the local Soil and Water Conservation District.

Action 1. Consistently apply Shoreland Management ordinance requirements to lot divisions and new development, and minimize variances from those standards. Provide education and outreach to zoning officials, elected officials, developers, and individual property owners on the purpose and benefits of Shoreland Management regulations.

Action 2. Increase civil penalties for violations of the Shoreland Management ordinances, and issue compliance and restoration orders.

Action 3. Determine the 'carrying capacity' of lakes expected to experience development and assess the adequacy of the existing shoreland and zoning ordinances regarding lot size and SSTS setbacks to protect lake water quality and biotic integrity. Carrying capacity is determined by lake physical characteristics, geology, soils and other parameters. Revise ordinances as necessary.

Action 4. Encourage voluntary compliance through incentives for Shoreland Management and shoreline restoration, such as the property tax rebates provided by Burnette County, Wisconsin for property owners who restore their shoreline and keep it in a natural state. Other incentives might include technical assistance to evaluate and plan improvements, cost-share grants or forgivable loans, or loans that are repaid at the time of property sale.

Action 5. Establish local variance advisory groups. Often the perception of inconsistency results from a lack of information about the reasons for variances, and potential other public benefits provided as a trade-off. Make information about the tangible outcomes of variances publicly available on the counties' websites and mailed notice to lake associations and neighboring properties.

Action 6. Undertake an education and outreach campaign to encourage owners of properties that developed prior to Shoreland Management Standards to consider taking action to mitigate some of the impacts that may have occurred due to development.

Action 7. Undertake demonstration projects to restore native vegetation on public and private property to buffer and filter runoff prior to discharge into lakes and streams.

3.3.2 SSTS Compliance

The SSTS Inventory and Analysis completed for this Project estimated that over 1,100 SSTS in the watershed were either noncompliant or were likely failing to protect groundwater. Bear Island Lake was found to be the most susceptible to water quality impacts from phosphorus loads contributed by wastewater from noncompliant SSTS. Nine Service Areas on six lakes were determined to pose the greatest threat of water quality impacts from SSTS.

More rigorous and detailed analysis, including individual site assessments, is necessary to better understand SSTS compliance in the targeted Service Areas. A Community Assessment Report (CAR) is a standardized analysis format for completing these onsite evaluations, and evaluating the feasibility and costs of wastewater infrastructure solutions to properties with non-compliant SSTS. Funding of up to $40,000 per CAR is available from the MPCA to undertake these analyses. As a rule of thumb, $40,000 would be sufficient to evaluate about 50-60 SSTS. There is legislation under consideration to increase that maximum grant to $60,000.

To apply for this funding, Unsewered Area Needs Documentation and Project Priority List Applications must be completed and submitted to the MPCA for scoring. These applications are typically due in March each year. It is recommended that one Service Area be selected to move forward, with consideration given to selecting an area that drains to an ORVW; is relatively dense with small lots with little room to site a new system; not exclusively seasonal; and with a high probability of actually implementing a project. Grant and revolving loan funding for implementation projects are also available. Completing a CAR and successfully implementing a project will increase the probability of future funding for additional CARs and implementation.

An additional important component of SSTS compliance assessment is water quality monitoring for fecal coliform bacteria to determine if noncompliance poses a threat to water quality, human health, and recreational use of the lakes in the watershed. As part of this Project, St. Cloud State University conducted some fecal coliform sampling and DNA fingerprinting to determine if the source was human or animal, but the results are not yet available.

Subsurface Treatment Systems (SSTS) Implementation Objectives

1. Protect and improve water quality by reducing the number of noncompliant SSTS.
2. Increase the number of SSTS that are properly operated and maintained.
3. Increase awareness of the purpose of SSTS compliance and impacts to water resources.

Action 1. Complete Unsewered Area Needs Documentations and Project Priority List Applications for each of the nine identified Service Areas to apply for funding to do a Community Assessment Report. Much of the background work necessary to complete the applications was completed as part of the SSTS Inventory for this project. The additional cost to complete the applications is estimated to be $1,000 each.

Action 2. Complete Community Assessment Reports for each of the nine Service Areas. The Community Assessment Reports will include a more rigorous onsite evaluation of soils and assessment of SSTS compliance status for each property in the Service Area, and evaluate the feasibility and costs of various wastewater infrastructure solutions for properties with non-compliant SSTS. The cost of each report will vary based on the number of SSTS in the area to be evaluated. MPCA grant funds will pay the full cost of completing these assessments.

Action 3. Complete upgrades to wastewater treatment infrastructure in each of the Service Areas based on Community Assessment Report Findings to protect water quality. Apply for grant funding to help reduce/eliminate costs to Service Area residents for wastewater treatment upgrades based on eligibility of each area for available grants.

Action 4. Sample the six lakes associated with the nine targeted Service Areas identified in the SSTS Inventory and known public beaches for fecal coliform to determine if leachate from noncompliant SSTS poses a threat to water quality, human health, and recreation.

Action 5. Increase the number of SSTS that are properly operated and maintained. Provide homeowner education such as the Property Owners Resource Guide prepared by Lake County, the Septic System Owner's Guide prepared by University of Minnesota Extension and other resources to new property owners who may not know how to maintain an SSTS and to current property owners as a reminder.

Action 6. Encourage voluntary upgrades to non-compliant septic systems. While continuing to require point of sale septic inspections and inspections at the time of building permit issue, undertake a series of actions to encourage voluntary compliance with SSTS standards. Educate property owners on what makes an SSTS noncompliant and the effects of noncompliance on public health and the environment. Encourage inspections at the time of maintenance, and encourage local system maintenance contractors to offer an inspection package with tank pumping. Provide cost share or revolving loan assistance to property owners to upgrade their systems.

Action 7. Improve record keeping by computerizing and maintaining county SSTS inventory and inspection records by property and not by ownership.

Action 8. Conduct septic system maintenance classes to educate homeowners on the importance of properly maintaining SSTS to protect water quality. Partner with UM Extension to conduct a train the trainer session for county staff and other partners.

3.3.3 AIS Management

A survey conducted with property owners in this watershed as part of this Project revealed that stakeholders have a high level of awareness about Aquatic Invasive Species (AIS), and a greater than 90 percent self-reported taking measures to prevent the spread of AIS such as draining the water from bilge, bait, and live wells and removing aquatic plants from boats and trailers. Reinforcing messages and education of new property owners will be important in maintaining awareness and diligence. Educating transient boaters and providing convenient inspection and decontamination opportunities are additional key actions that can be pursued to further protect the lakes and streams from the spread of AIS.

There is a considerable amount of education and outreach material in a variety of formats already produced by the DNR, Minnesota Sea Grant, and other parties documenting the different types of AIS that are a threat to Minnesota's waters and actions that can be taken to halt or minimize the spread of these plants and organisms. Some ideas generated by the stakeholders for dissemination of these materials and raising awareness include:

- Encourage fishing tournament operators to provide AIS education and require inspections and decontamination of boats and trailers prior to tournament participation. This would apply to both permitted tournaments and smaller events that do not require a permit.
- Provide targeted education to resort owners, outfitters, and bait shops, and offer an "AIS trained" certification or other recognition.
- Raise awareness by hosting *Stop Aquatic Hitchhikers!* booths at events such as Blueberry Fest, Harvest Festival, art and water festivals, county fair, boat and sport shows, fishing tournaments, 4th of July festivities, and other celebrations.
- Encourage the Chamber of Commerce, visitor centers, faith communities, and service and civic organizations to join the campaign.

Aquatic Invasive Species (AIS) Implementation Objectives

1. Increase awareness of AIS and actions that can be taken to prevent the spread of invasive species.
2. Continue to monitor the watershed for the presence of AIS.
3. Take steps to stop spread of invasive species in the watershed.
4. Assess impact of AIS on beneficial uses.

Action 1. Maintain a partnership between state and local agencies, WICOLA, other lake associations, the 1854 Treaty Authority, and other interested parties to develop a comprehensive education and outreach plan and deliver information about AIS and AIS management actions

Action 2. Train volunteer water quality monitors to identify and report observations of AIS as part of their routine lake and stream monitoring.

Action 3. Coordinate periodic boat and trailer inspection events at points along the four corridors leading into the watershed, and provide convenient decontamination stations. Offer information about AIS and their impacts, the purpose of the inspection and decontamination, and information about other actions that can be taken to halt or minimize the spread of AIS.

Action 4. Coordinate with state agencies and educational institutions to perform research exploring and establishing the characteristics of water resources that may make them more vulnerable to AIS. Use this research to help identify the resources that may be at most risk, increase monitoring, and target the users of those resources with more intensive education and inspection.

Action 5. Coordinate with state agencies, education institutions, and other interested parties such as the 1854 Treaty Authority to conduct field research of experimental management actions such as Rusty Crayfish wild rice exclosures.

3.3.4 Shoreland BMPs

A healthy lakeshore provides many ecosystem benefits. Natural upland and emergent vegetation provides physical habitat and contributes woody and other organic matter to the lake; stabilizes the shoreline from the erosive effects of wind and ice; provides shady near-shore zones; is aesthetically pleasing; and filters sediment and nutrients from running off into the lake. These benefits can be maintained or restored while still providing for boating and swimming access to the water through Shoreland Management Best Management Practices (BMPs).

Shoreland BMPs include actions such as establishing and maintaining healthy native vegetation buffers; correcting erosion and preventing future erosion; and enhancing and managing vegetation for habitat. The Kawishiwi watershed includes a variety of lakeshore, including private developed and undeveloped lands; National Forest and BWCAW campsites, accesses, and portages; and National Forest and BWCAW natural shoreline.

The sensitive uses survey completed as part of this Project identified a number of shoreline locations with thin or no ground cover; areas of erosion ranging from minor rilling to more

severe shoreline mass wasting; and shoreline maintained in turf grass with no shoreline buffer. Stabilizing and revegetating eroded shoreline and establishing buffers are priority actions to protect water quality and improve lakeshore habitat.

The need for shoreland BMPs can be assessed using a standardized tool such as Score Your Shore, developed by the DNR Division of Ecological and Water Resources, supplemented to include an assessment of the severity and dimensions of erosion. Score Your Shore allows users to systematically evaluate vegetation conditions of the upland, shoreline, and aquatic zones, with an emphasis on beneficial habitat, runoff filtering, stabilized shoreline, and aquatic habitat. Wenck Associates developed a companion scoresheet to assess the severity of existing erosion. These scores can be used to prioritize and estimate the cost of Shoreland projects. In Appendix B, this scoring system was used to evaluate photos of sites on Bear Island Lake that were reviewed as part of the Sensitive Uses assessment conducted for this Project.

During the course of this Project the Technical Advisory Team identified the need to organize more lake associations to serve as advocates for the lakes and better disseminate information. Shoreland Management assessment and BMP installation can be a useful topic around which to organize lake groups.

Shoreland Best Management Practices Implementation Objectives

1. Identify and prioritize Shoreland Management needs.
2. Restore native vegetation and mitigate erosion.
3. Increase awareness of the purpose and benefits of Shoreland Best Management Practices.

Action 1. Train knowledgeable volunteers to periodically evaluate the quality of shoreline conditions using a standardized tool such as Score Your Shore, developed by the DNR Division of Ecological and Water Resources, supplemented to include an assessment of the severity and dimensions of erosion. This condition inventory data can be used to assess changing conditions and to identify potential mitigation projects to restore eroded shoreline contributing excess sediment and nutrients to public waters, and prevent future erosion. This activity is a good way to get lake associations organized.

Action 2. Mitigate erosion on campsites, picnic areas, and boat landings and encourage private property owners to complete restoration projects on their properties. Using the prioritization data collected through periodic condition surveys, assemble

bundles of shoreline restoration projects and apply for grants from sources such as the DNR Shoreland Habitat Restoration Grant Program. Grants through this program generally range from $25,000 to $100,000, require a 25% match, and must include components to reestablish or enhance habitat.

The cost of shoreline restoration including establishing a minimum 30 foot buffer ranges from $10 per linear foot for sites simply requiring minor site preparation and native seeding; $50 per linear foot for sites requiring some grading and shoreline biorestoration; and $100 per linear foot for sites experiencing more severe erosion requiring hardscaping such as boulder toes or riprap. Projects requiring hardscaping may not be eligible for certain types of grant funding.

Action 3. Encourage voluntary shoreline restoration by providing incentives such as technical assistance and cost-share assistance to property owners who agree to maintain their shoreline in a native condition in perpetuity.

Action 4. Educate shoreline property owners and lake associations regarding the water quality and habitat benefits and values of naturally-maintained shorelines. Numerous organizations including the DNR and Minnesota Sea Grant offer informational brochures, booklets, online materials, workshops, and other resources regarding shoreline management that can be made available to individual property owners, lake associations, local governments, youth and service groups, and other interested stakeholders.

Action 5. Minimize opportunity for future erosion. Remove unused or inappropriate campsites, picnic areas and boat landings and restore native vegetation.

3.3.5 Monitoring

Water quality and biologic monitoring is essential to evaluate not only the current conditions of lakes and streams in the watershed but also trends. Most of the lakes in the watershed have limited water chemistry data, but several have a record of water clarity data going back to the 1970s. This limited data set suggests that a few of the lakes in the WICOL chain – Farm and to a lesser extent Birch – may be on a declining trend in water quality (see Appendix A.) A paleolimnology study of selected lake sediments was completed to supplement the surface water data, and showed increased algal productivity in the lakes since development, with Birch in particular showing an increase in algal load in the past few decades.

This trend data is important to bear in mind when targeting Best Management Practices as well as making land use decisions such as evaluating the impacts of potential future development. Lakes on a declining trend may require larger lot sizes to provide adequate SSTS setback and separation and to create less impervious building, driveway, and roadway surfaces.

A long-term monitoring plan that includes both clarity and chemistry/condition monitoring should be developed for the watershed. Not every lake needs to be monitored every year, but certain high-priority lakes – those that appear to be on a declining trend and those at pressure for additional development – should be targeted for routine monitoring. Of equal important is the need to compile, assess, and publish the results. This could take the form of annual "report cards" that display data in a way that is easily understood by lay persons. Biological data such as DNR fish survey results can be included on such a report card to provide a broader picture of the chemical and biological health of the lake. Vermillion Community College students may be an ongoing resource, both in conducting some monitoring and in annually updating the report cards.

Monitoring Program Implementation Objectives

1. Develop and implement a long-term monitoring program.
2. Partner with federal, state, and local agencies, volunteers and other parties to collect water chemistry, clarity and condition data on select lakes.
3. Maintain a water quality database and periodically publish water quality trends.

Action 1. Develop and implement a monitoring plan that continues to build a water quality period of record and which is sufficient to evaluate trends. Not all lakes need to be monitored every year; such a plan could establish a priority system of lakes and establish a schedule based on that system. This plan could be developed in partnership with the MPCA and DNR as part of the Rainy River WRAP.

Action 2. Maintain a database of water quality data, and use that database to evaluate current conditions and trends. Develop and publish an annual report of water quality, including easy-to-understand summaries such as lake report cards.

Action 3. Conduct baseline and follow up monitoring after implementation of structural BMPs such as SSTS upgrades.

Action 4. Partner with research institutions to conduct follow up monitoring suggested by the paleolimnology study.

Action 5. Conduct heavy metals testing every five years to assess potential changes to water quality.

Action 6. Add calcium monitoring to the water quality monitoring plan to assess the potential for zebra mussel infestations.

3.3.6 Education and Outreach

Education and outreach are activities that are integral to all of the priority management areas. Many of the objectives identified in this Plan rely on voluntary participation or compliance by individual users or property owners.

Many different organizations provide education and outreach on a variety of topics. The primary need in the Kawishiwi Watershed is to identify the key messages and ensure those messages are being delivered to the right audiences at the right time. As a part of this Plan process the Technical Advisory Team identified key messages and delivery mechanisms, which are shown in Table 3.6 in Section 3.8 below.

Education and Outreach Implementation Objectives

1. Develop and implement an education and outreach plan.
2. Provide information and education targeted to stakeholder group and need.
3. Provide general information about water resources in the watershed.
4. Update activities as new issues and needs emerge.

Action 1. Coordinate an education and outreach plan. Section 3.8 of this Plan identifies key stakeholder groups and potential messages and delivery mechanisms. The Technical Advisory Team will periodically review education and outreach needs and messages and coordinate the delivery of that information by the appropriate partner.

Action 2. Use existing education and outreach material where possible to assure consistency of message and avoid duplication of effort and expense.

Action 3. Inform the public about the Kawishiwi Watershed Protection Project results through presentations at public events, conferences, service group meetings, etc. and by displays at events and public places.

3.4 BMP SELECTION AND JUSTIFICATION

Prioritization and selection of structural BMPs will be based on the following:

Shoreland BMPs. The DNR tool Score Your Shore, supplemented by an erosion severity scoring system developed by Wenck Associates, will be used to rank and prioritize shoreland restoration projects. Sensitive areas such as campsites, beaches, portages, and launches were inventoried, located by GPS, and photographed as part of this Project. Volunteers will use the modified scoring tool to assess conditions at each site. A goal will be developed that is appropriate for each lake – for example, to raise the condition of all sites by 10 points, or to restore all sites scoring less than a target threshold. Follow up surveys will be periodically conducted to document improvement at restored sites and to monitor conditions at other sites.

SSTS Infrastructure Improvements. Community Assessment Reports (CAR) will be completed for the nine targeted Service Areas, and BMP selection and justification will be based on the findings of those Reports.

3.5 IMPLEMENTATION MONITORING AND EVALUATION

As structural BMPs are completed, it is important to assess their performance to be sure they are operating correctly and are achieving the desired load reduction or other outcome. These actions will be incorporated into the SSTS Implementation and Monitoring Plan described in Section 3.3.2 and Section 3.3.5 above.

SSTS- Specific Monitoring and Outreach. For lakes that have a high density of SSTS per surface area of the lake, monitor lake water quality more closely for phosphorus and bacteria/pathogen impacts from SSTS. Perform baseline monitoring and repeat that work periodically as systems are improved. The top five lakes to monitor include:

- Middle McDougal
- Gunsten
- Farm
- One Pine
- Garden

Additional potential monitoring should focus on dense development areas to identify potential water quality impacts to wells:

- Dunka Bay, Birch Lake
- North White Iron Lake
- Southwest Bear Island Lake
- Finn Bay, Birch Lake
- Sand Lake
- Middle McDougal Lake

3.6 ROLES AND RESPONSIBILITIES OF PROJECT PARTICIPANTS

Implementation of this Plan will be managed by a Project Coordinator employed by the Lake County SWCD. Many of the agency and other local governments and groups that participated in the Kawishiwi Watershed Protection Project (KWPP) will be invited to continue to participate as a Technical Advisory Team (TAT). It is envisioned that the Team would meet annually to review progress and provide updates, supplemented by quarterly teleconferences focused on specific topics. It is anticipated that ongoing updates and information generated by and about Implementation Plan activities will be available on a project website for public information. Figure 3.2 shows a general organizational chart for implementation, with the Project Coordinator advised by a number of agencies, local governments and organizations. Other interested parties may be tapped to advise the TAT based on their special experience, such as: Minnesota Sea Grant, Vermillion Community College, Friends of the BWCA, Lake Country Power Company, Duluth Metals, Natural Resources Research Institute (NRRI), etc. Generalized stakeholder roles and responsibilities are shown in Table 3.5.

Figure 3.2. Organizational structure, KWPP Implementation Plan.

Table 3.5. Stakeholder roles and responsibilities.

Actor	Land Use Regulation	SSTS Compliance	AIS Management	Shoreland BMPs	Monitoring	Education and Outreach	Other
Counties	• Consistent enforcement of shoreland ordinances • Enforce violations • Limit the number of variances allowed and clearly communicate the reasons and any beneficial trade-offs • Increase awareness of the purpose and benefits of shoreland management: property owners, public officials, agency and local government staff • Assess minimum lot requirements based on water quality of lakes • Analysis of existing shoreland and zoning ordinances based on 'carrying capacity	• Inspect SSTS at property transfer • Provide additional funding at county level for inspections of current SSTS conditions • Connect SSTS & property owner computerized records • Lead public education and outreach campaign raising awareness of SSTS compliance requirements, and the purpose and benefits of compliance. • Distribute SSTS operations and maintenance handbook to current and new property owners • Educate SSTS maintenance contractors • Apply for funding to complete Community Assessment Reports	• Participate in education and outreach campaign raising awareness about AIS • Stay current on AIS issues and actions to control AIS	• Consider incentives to restore shoreland such as property tax relief • Participate in education and outreach campaign raising awareness about shoreland maintenance and restoration	• Participate in monitoring working groups • Disseminate information on current water quality and water quality trends	• Actively participate in education and outreach working groups developing and implementing campaigns on water quality, shoreland, AIS, and other issues • Update and distribute property owners resources guide and other materials	• Encourage establishment of lake associations
SWCDs/BWSR	• Comment on shoreland variance applications • Technical recommendations to land owners • Participate in education and outreach campaign raising awareness about shoreland management purpose and benefits	• Participate in education and outreach campaign raising awareness about the purpose and benefits of SSTS compliance	• Participate in education and outreach campaign raising awareness about AIS	• Provide cost share assistance & technical help on shoreline erosion issues • Apply for DNR shoreland block grants for multi-landowner projects	• Contract with the MPCA to continue monitoring • Pursue SWAG grants to expand monitoring program • Build relationships with Vermillion Community College to provide monitoring opportunities for student interns	• Lead education and outreach working groups developing and implementing campaigns on water quality, shoreland, AIS, and other issues • Take additional public input via water plan	• Encourage establishment of lake associations • Coordinate lake associations councils
Forest Service	• Undertake forestry BMPs in shoreland areas	• Regulate social campsites on USFS land that is unsuitable for sewage disposal systems • Determine the impact of USFS latrines and land disposal of graywater in the BWCAW/ Superior National Forest (SNF).	• Participate in education and outreach campaign raising awareness about AIS • Provide focused information to BWCWA users and transient boaters	• Implement shoreland BMPs at USFS campsites, boat landings and portages. • Install Houseboat anchoring facilities to protect existing vegetation.	• Share USFS monitoring data in common database (EQUIS)		

Actor	Land Use Regulation	SSTS Compliance	AIS Management	Shoreland BMPs	Monitoring	Education and Outreach	Other
MPCA	• Maintain and enforce stormwater regulations under the state's NPDES permits	• Fund development of Community Assessment Reports		• Enforce NPDES stormwater permits	• Fund and provide oversight of the Rainy River monitoring project (WRAP) and HSPF modeling • Fund continued monitoring by the SWCD • Determine water quality trends on lakes in the watershed. • Assess all lakes and AUIDs for beneficial uses • Enforce NPDES stormwater permits	• Undertake public input and review as part of the Civic Engagement part of the WRAP process	
DNR	• Implement and revise forest use management plans as necessary • Alternate shoreline development standards • Participate in education and outreach campaign raising awareness about the purpose and benefits of shoreland management	• Undertake research to evaluate the impact of noncompliant SSTS on aquatic life	• Lead education and outreach campaign raising awareness about AIS • Enforce AIS regulations • Provide boat landing signage grants • Coordinate inspection stations on the four major routes into the watershed and at state parks • Establish boat decontamination stations • Lead and provide technical assistance to working groups implementing AIS management activities	• Provide aquatic habitat restoration grants • Provide technical assistance for shoreland restoration for improved habitat • Use FERC funding for shoreland restoration and protection projects • CPL grants	• Continue to manage and monitor fish populations • Monitor water appropriation permits	• Actively participate in education and outreach working groups developing and implementing campaigns on water quality, shoreland, AIS, and other issues	• DNR shoreland grant program • Undertake near shore fish habitat projects (possibly partnered with USFS)
WICOLA	• Report violations to the appropriate authority • Participate in local variance review groups • Participate in education and outreach campaign raising awareness about the purpose and benefits of shoreland management	• Participate in education and outreach campaign raising awareness about SSTS compliance and proper operation and maintenance	• Participate in education and outreach campaign raising awareness about AIS • Certify or acknowledge resorts and businesses who complete AIS training	• Host presentations on and tours of shoreland BMPs and demonstration projects • Host demonstration lawns • Participate in education and outreach campaign raising awareness about shoreland maintenance and restoration	• Volunteer lake/stream monitoring	• Actively participate in education and outreach working groups developing and implementing campaigns on water quality, shoreland, AIS, and other issues	• Assist with grant writing
Private Property Owners	• Comply with shoreland management requirements • Report violations to the appropriate authority • Participate in education and outreach campaign raising awareness about the purpose and benefits of shoreland management	• Properly operate and maintain SSTS systems • Participate in education and outreach campaign raising awareness about SSTS compliance and proper operation and maintenance • Voluntarily upgrade SSTS	• Follow shoreland guidelines • Resort/lodge/outfitter training on AIS management	• Participate in education and outreach campaign raising awareness about shoreland maintenance and restoration	• Volunteer lake/stream monitoring	• Actively participate in education and outreach working groups developing and implementing campaigns on water quality, shoreland, AIS, and other issues	

Actor	Land Use Regulation	SSTS Compliance	AIS Management	Shoreland BMPs	Monitoring	Education and Outreach	Other
Volunteers			• Staff information booths, awareness events, etc. • Become trained on and conduct AIS monitoring and reporting	• Participate in events to clear invasive vegetation and plant native vegetation • Become trained on and conduct shoreline condition assessments	• Volunteer lake/stream monitoring • Compile and disseminate monitoring data	• Staff information booths, awareness events, etc. • Disseminate information to the community • Recruit volunteers	
Other	• Research: Mass balance modeling • MnPower under FERC licensing for Winton dam	• Extension: SSTS operation and maintenance classes and presentations • MDH: beach monitoring • Research: water quality studies	• Sea Grant Extension: educational messages • Research: inspection and prevention effectiveness analysis • 1854 Treaty Authority: coordinate use of decontamination unit • 1854 Treaty Authority: determine impact of AIS on Wild Rice.	• Extension: shoreland restoration presentations and demonstration projects • Lake associations: participate in education and outreach campaign raising awareness about shoreland maintenance and restoration	• Vermillion Community College: internships to collect, compile, and disseminate monitoring data	• Research: field programs and classes	

3.7 BMP OPERATION AND MAINTENANCE PLAN

In general, maintenance of structural BMPs undertaken as a result of this Plan will be the responsibility of the stakeholder undertaking the project, which in most cases will be the property owner.

3.8 INFORMATION AND EDUCATION PROGRAM

This Plan identified a focused information and education program that tailors messages by stakeholder group.

Table 3.6. Priority information and education program stakeholders and messages.

Stakeholder	Messages	Delivery Mechanism(s)	Delivery Partner
Lakeshore property owners	Value of shoreland BMPs and how to restore the shore	Person to person, displays at events, presentations, workshops, stories in local papers, radio programs, recognition awards, Facebook	SWCD, DNR, neighbors, Lake Associations, local contacts, UM Extension
	Value of compliant SSTS and proper maintenance and operation of SSTS	Distribute information with permits, stories in local papers, county websites, SSTS maintenance contractors, Facebook, workshops/ presentations	Counties, neighbors, Lake Associations, local contacts, UM Extension
	General information about lakes & stream water quality and biological condition	Displays at events, presentations, workshops, stories in local papers, radio programs, online resources	SWCDs, DNR, neighbors, Lake Associations, Chamber of Commerce, service & faith groups
Watershed property owners	Value of compliant SSTS and proper maintenance and operation of SSTS	Distribute information with permits, stories in local papers, county websites, SSTS maintenance contractors, Facebook	Counties, neighbors, local contacts, UM Extension
	General information about lakes & stream water quality and biological condition	Displays at events, festivals, presentations, workshops, stories in local papers, radio programs, online resources	SWCDs, DNR, neighbors, Chamber of Commerce, service & faith groups,
Lake users: boaters	-AIS prevention and eradication -Report observations of AIS	Presentations at sportsman's groups ,info at inspection checkpoints, posters, signs, billboards	Chamber of Commerce, DNR, MN Sea Grant, lake associations, townships, tournament organizers, outfitters, bait shops, resorts, local retail, 1854 Treaty Authority
	Water quality and fishing BMPs – proper handling and disposal of motors, oil, trash, excess bait	Signs at landings and ramps	DNR, lake associations, resorts and lodges

Stakeholder	Messages	Delivery Mechanism(s)	Delivery Partner
Lake users	-Report observations of AIS -Proper disposal of trash	Signs at landings and ramps	DNR, lake associations, resorts and lodges, 1854 Treaty Authority
Campers	-Campsite maintenance for water quality -Avoid "unofficial" campsites -Citizen science opportunities	Signage at entries and permitting stations, education opportunities with youth groups, school groups	USFS, DNR, outfitters
County/SWCD staff	-Value of shoreland management ordinance standards - Need for transparency in land use decisions such as variances - Potential impact of land use decisions on water quality -Impact of water quality on land values	Personal contacts, presentations at meetings, reports	SWCDs, DNR, lake associations, local contacts
Local government staff	-Value of shoreland management ordinance standards - Need for transparency in land use decisions - Potential impact of land use decisions on water quality	Personal contacts, presentations at meetings, reports	Counties, SWCDs, DNR, lake associations, local contacts
Media	They are a valuable partner in protecting resources in the watershed by relaying accurate information	News articles, documentaries, feature stories, YouTube videos	SWCDs, DNR, lake associations, MN Sea Grant
Business owners	"Green" and "water friendly" maintenance practices	Person to person, displays at events, presentations, workshops, stories in local papers, radio programs, brochures, booklets, online resources	SWCDs, DNR, Chamber of Commerce, service organizations

3.9 PERMITS REQUIRED FOR COMPLETION OF PROJECT

In general, any permits required to undertake structural BMPs as part of this plan will be the responsibility of the stakeholder undertaking the project.

3.10 IDENTIFICATION AND SUMMARY OF PROGRAM ELEMENTS

Based on the information gathered as part of the Kawishiwi Watershed Protection Project, the future work of the Kawishiwi Project Coordinator, Technical Advisory Team, and other parties will focus on the following elements:

- Further assessment of SSTS conditions, acquisition of funding, and implementation of structural improvement projects identified in Community Assessment Reports;
- Identification of Shoreland BMP projects, acquisition of funding, and completion of shoreline restoration and stabilization projects;
- Coordination of ongoing research, monitoring, analysis of conditions in the lakes and streams in the watershed, and dissemination of findings;
- Participation in education and awareness programs about Aquatic Invasive Species (AIS), future research projects, and monitoring; and
- Furthering ongoing partnerships and information sharing by regular TAT meetings and teleconferences.

3.11 SCHEDULE AND ESTIMATED COST

Table 3.7 provides an estimated schedule and cost for actions priority implementation actions by the Kawishiwi Watershed Protection Project. This will provide a guide for future activities, and will be periodically reviewed and revised based on future needs and opportunities.

Table 3.7. Estimated cost and schedule for implementation actions.

Action	Estimated Cost/ Staff Hours	Funding Source	Schedule
Continue KWPP coordinator to manage implementation: - Continue annual Technical Advisory Team meetings and quarterly teleconferences - Coordinate an education and outreach plan -Coordinate annual and special monitoring - Coordinate an AIS education and outreach plan - Coordinate with researchers exploring what characteristics may make resources more "invadable" - Coordinate with field researchers -Assist in developing grant applications -Coordinate with lake associations	20 - 30 hours/week	SWCDs, Counties, state and/or federal grants	Ongoing
- Provide education and outreach on the purpose and benefits of Shoreland Management regulations - Provide education and outreach to encourage voluntary adoption of shoreland BMPs - Distribute existing education and outreach material -Maintain a water quality database and develop and publish annual report of trends	10 hours/week	SWCD and County staff, DNR staff	Ongoing
- Train volunteers to ID and report AIS observations	Periodic workshops	DNR staff	Ongoing
- Develop and implement a long-term monitoring plan	Develop plan and costs as part of the Rainy River WRAP	MPCA, DNR, SWCD, and county staff and volunteers	2014 and later
Consider options to penalize violations of Shoreland Management standards and achieve compliance and restoration	Variable	Counties	As needed
Consider incentives for voluntary adoption of shoreland BMPs	Variable to establish; ongoing annual cost depends on type of incentive and extent of adoption	Counties	2014 and later
Establish local variance advisory groups	Variable	Counties	As needed
Undertake demonstration projects to restore shoreline on public sites	$10,000 - $20,000 depending on sites	DNR Shoreland grants, FERC funds, counties, SWCDs	2014 and later
Apply for funds to complete Community Assessment Reports	$1,000 each for the 9 Service Areas	Counties	Submit one by March 2014
Complete Community Assessment Reports for nine priority Service Areas	$40,000 for first report	MPCA	Complete first CAR in 2014-2015

Action	Estimated Cost/ Staff Hours	Funding Source	Schedule
Upgrade wastewater infrastructure as recommended in the Community Assessment Reports	Cost and staff time depends on project	Grants, counties, property owners	2015-2018
Ongoing fecal coliform bacteria and TP sampling in six priority lakes	$2,000 for six lakes each visit	MPCA, Counties	2014 and every 5 years thereafter
Provide property owner SSTS operations and maintenance education to new and current owners	8 hours/month	Counties, SWCDs	Ongoing
Provide information and incentives to voluntarily upgrade noncompliant SSTS	12 hrs/month, ongoing annual cost depends on type of incentive	Counties, State Revolving Fund	Apply for grant funds in 2013 and 2014 to initiate projects
Maintain computerized SSTS records by property	Variable	Counties	Ongoing
Coordinate inspection points along the four corridors into the watershed	Variable	DNR, volunteers	At least once annually
Evaluate shoreline conditions using a prioritizing tool	100 hours/year to train, coordinate, and log conditions	SWCDs	2013-2014 and then periodically
Mitigate erosion on campsites, boat launches, picnic areas, and other public lands	$25,000 - $50,000 each project, depending on need	DNR Shoreland grants, Legacy funding, LCMR grants, FERC funds, counties, SWCDs	Apply for grant funds in 2013 and 2014 to initiate projects
Provide technical and cost-share assistance to encourage voluntary shoreline restoration	12 hrs/month, ongoing annual cost depends on project and popularity	DNR, SWCDs, Legacy funding, LCMR grants, property owners	Apply for grant funds in 2013 and 2014 to initiate project
Minimize opportunity for future erosion by removing unused or inappropriate campsites and restoring	Variable	US FS, DNR	Ongoing
Conduct baseline and follow up monitoring after implementation of structural BMPs	$5,000 - $10,000, depending on project and parameters	Build into cost of project	As needed

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Appendix A

Kawishiwi Watershed Protection Project
Water Quality Trend Data and Graphs

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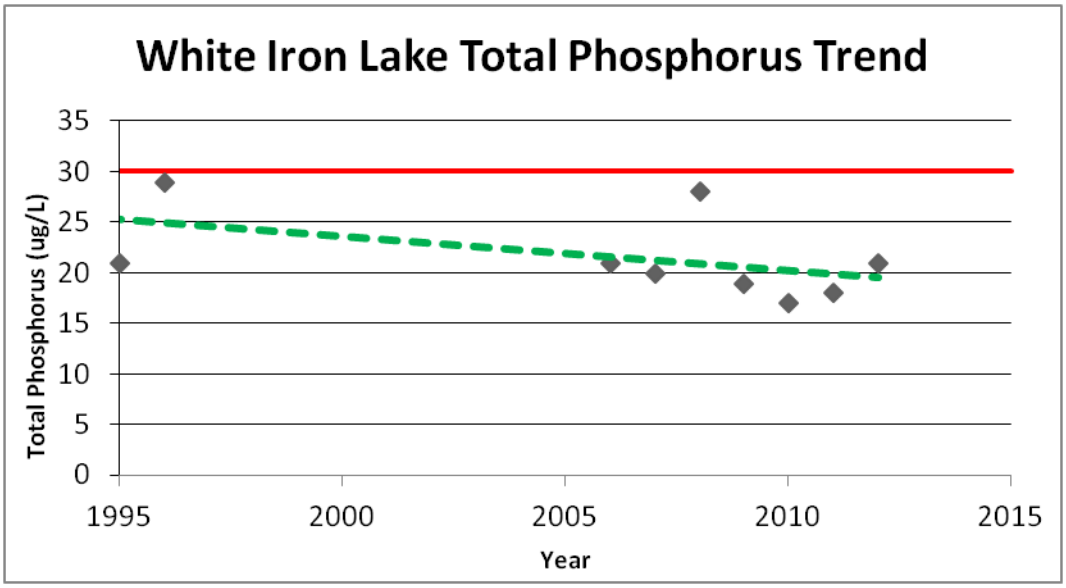
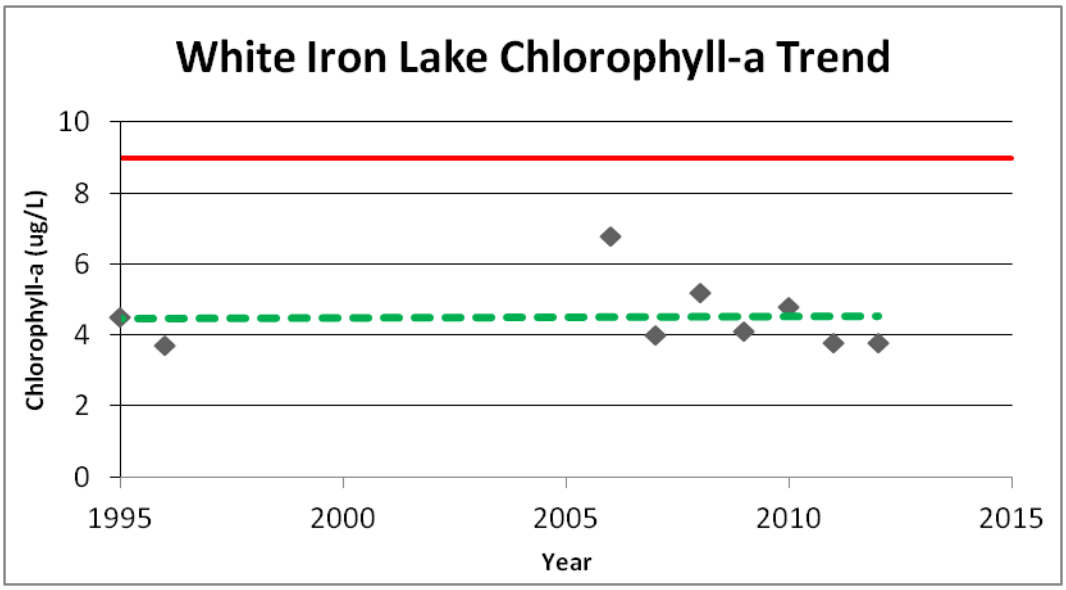
Table A.1. White Iron Lake summer average historic water quality data.

Year	Total Phosphorus		Chlorophyll-a		Secchi Depth	
	N	TP (µg/L)	N	Chl-a (µg/L)	N	SD (m)
2012	6	21	6	3.8	6	1.4
2011	10	18	10	3.8	27	1.8
2010	11	17	11	4.8	31	2.0
2009	11	19	11	4.1	29	1.5
2008	11	28	11	5.2	34	1.6
2007	5	20	5	4.0	36	1.7
2006	11	21	10	6.8	34	1.7
2005					22	1.8
2004					30	2.0
2003					15	1.8
2002					34	1.5
2001					33	1.4
2000					42	1.3
1999					27	1.3
1998					28	1.6
1997					34	1.6
1996	14	29	10	3.7	45	1.5
1995	13	21	6	4.5	44	1.6
1994					30	2.0
Average		22		4.5		1.6

Note: N = number of observations.
Source: MPCA Environmental Data Access.





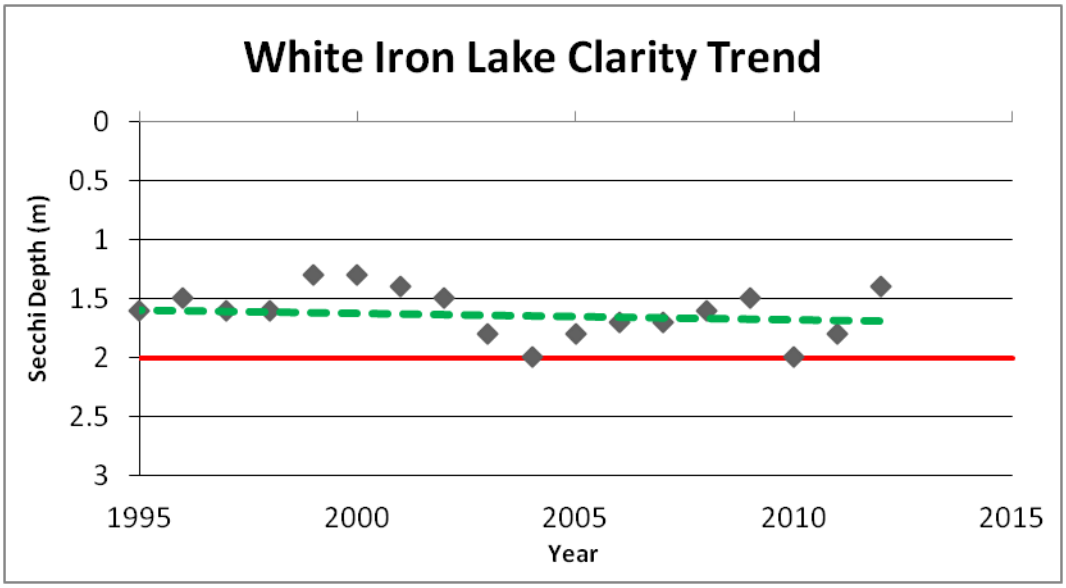
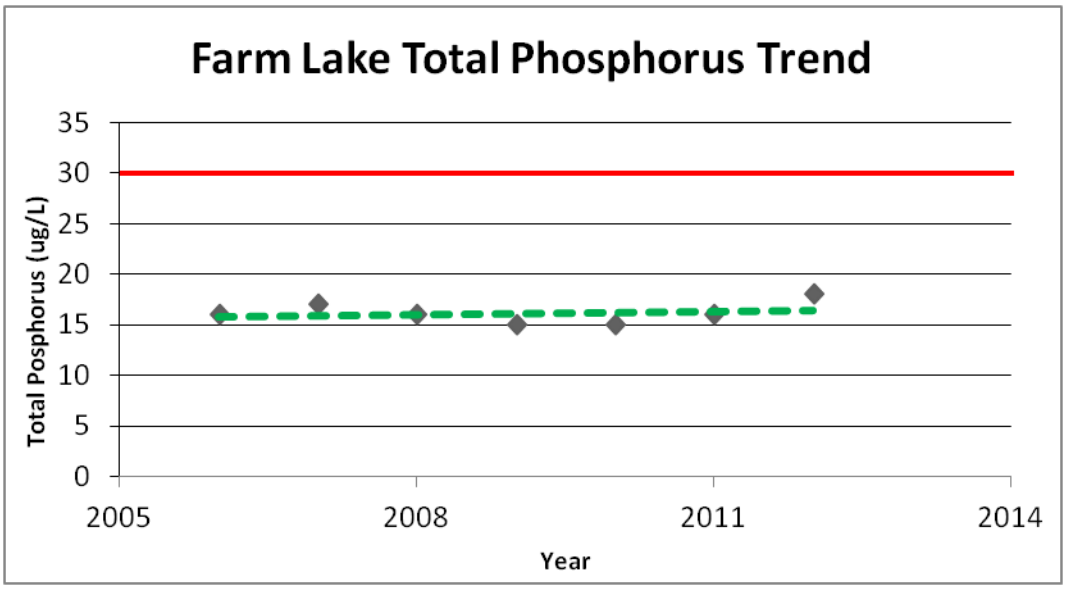


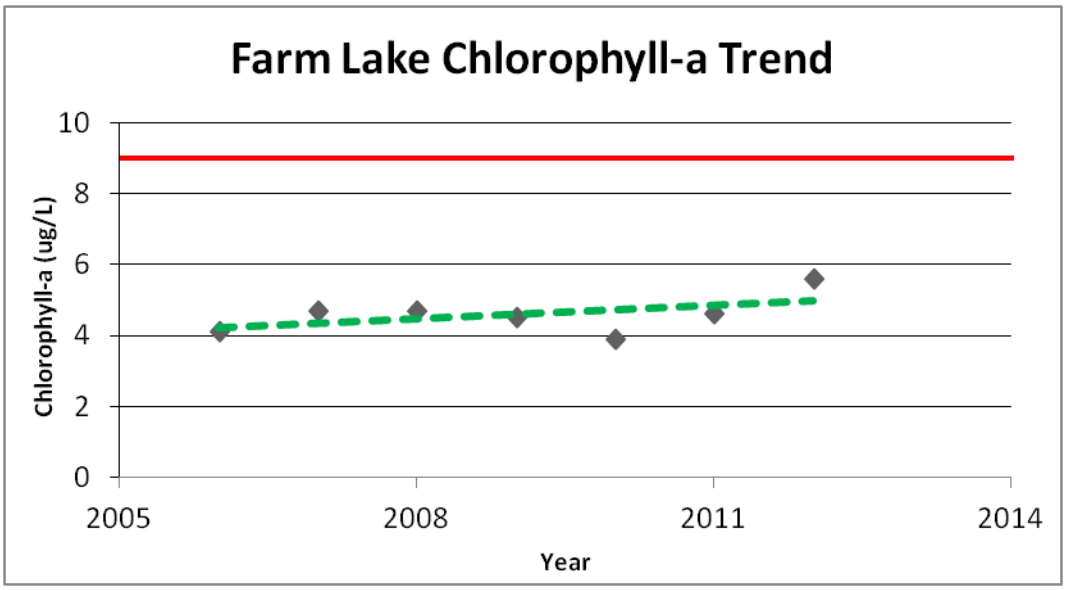
Figure A.1. White Iron Lake water quality trends.

TableA.2. Farm Lake summer average water quality historic data.

Year	Total Phosphorus		Chlorophyll-a		Secchi Depth	
	N	TP (µg/L)	N	Chl-a (µg/L)	N	SD (m)
2012	15	18	15	5.6	14	1.6
2011	15	16	15	4.6	38	2.0
2010	15	15	15	3.9	36	2.1
2009	15	15	15	4.5	51	1.8
2008	18	16	18	4.7	47	1.6
2007	15	17	15	4.7	38	2.0
2006	15	16	15	4.1	43	1.9
2005					32	1.9
2004					30	2.1
2003					30	2.6
2002					34	2.1
2001					24	2.1
2000					27	1.9
1999					31	1.9
1998					30	1.8
1997					37	2.6
1996					43	2.2
1995					44	1.9
1994					48	2.2
Average		16		4.6		2.0

Note: N = number of observations.
Source: MPCA Environmental Data Access.





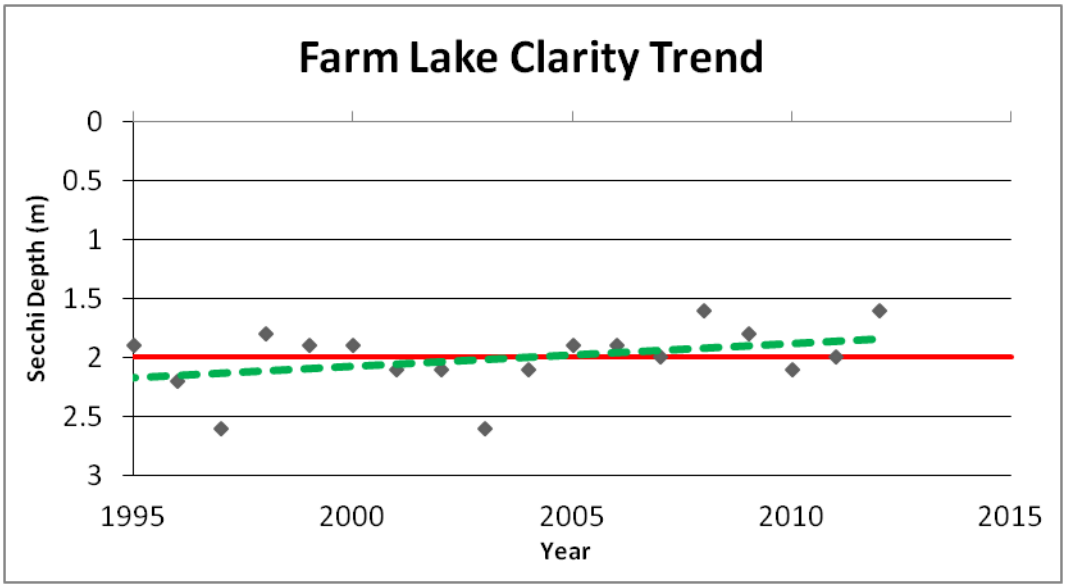
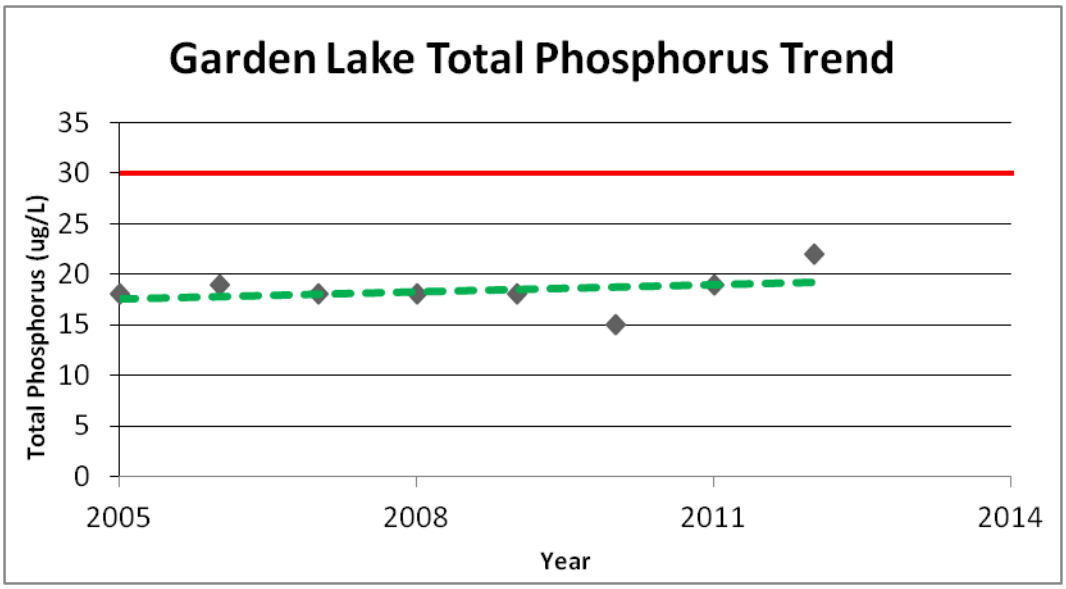


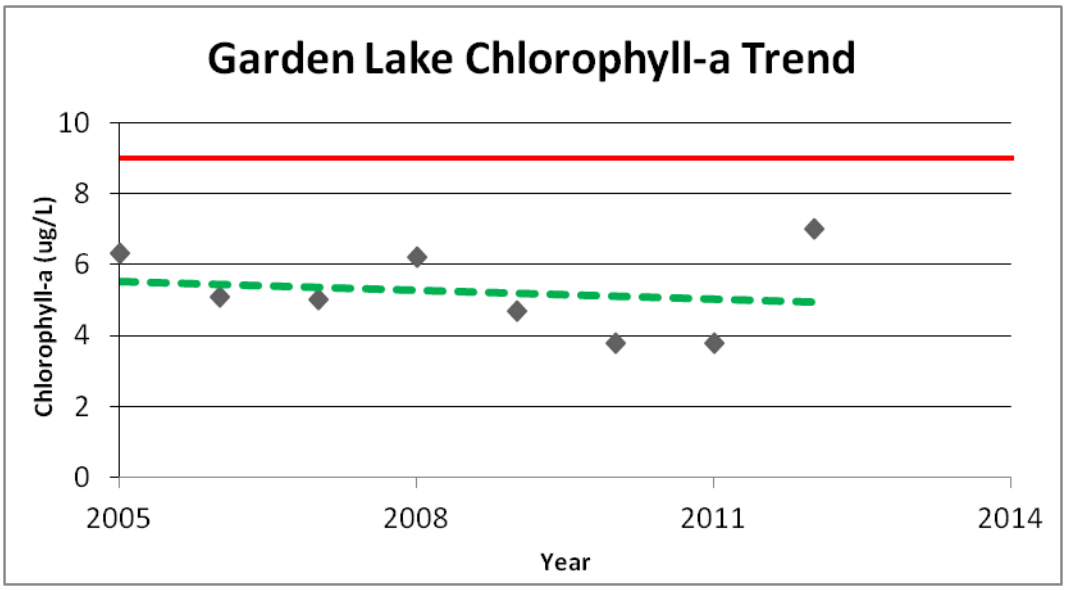
Figure A.2. Farm Lake water quality trends.

Table A.3. Garden Lake summer average water quality historic data.

Year	Total Phosphorus		Chlorophyll-a		Secchi Depth	
	N	TP (µg/L)	N	Chl-a (µg/L)	N	SD (m)
2012	5	22	5	7.0	20	1.1
2011	5	19	5	3.8	29	1.4
2010	5	15	5	3.8	23	1.7
2009	9	18	9	4.7	39	1.3
2008	5	18	5	6.2	24	1.4
2007	5	18	5	5.0	26	1.6
2006	5	19	6	5.1	32	1.6
2005	5	18	5	6.3	31	1.6
2004					36	1.7
2003					42	2.0
2002					57	1.7
2001					60	1.4
2000					69	1.5
1999					57	1.3
1998					63	2.0
1997					57	2.0
1996					51	1.7
1995					54	2.1
1994					45	1.6
Average		18		5.2		1.6

Note: N = number of observations.
Source: MPCA Environmental Data Access.





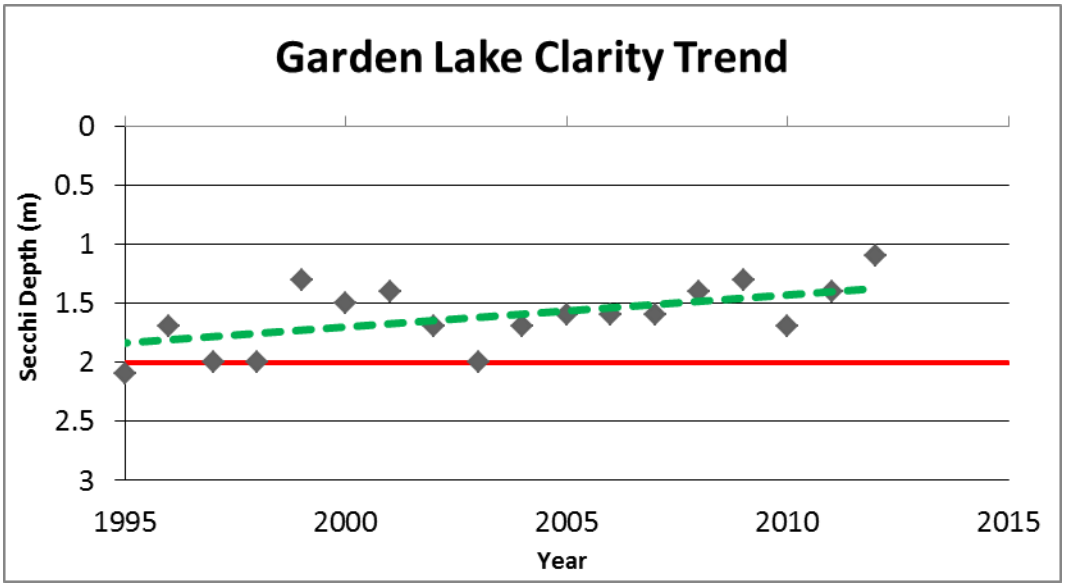
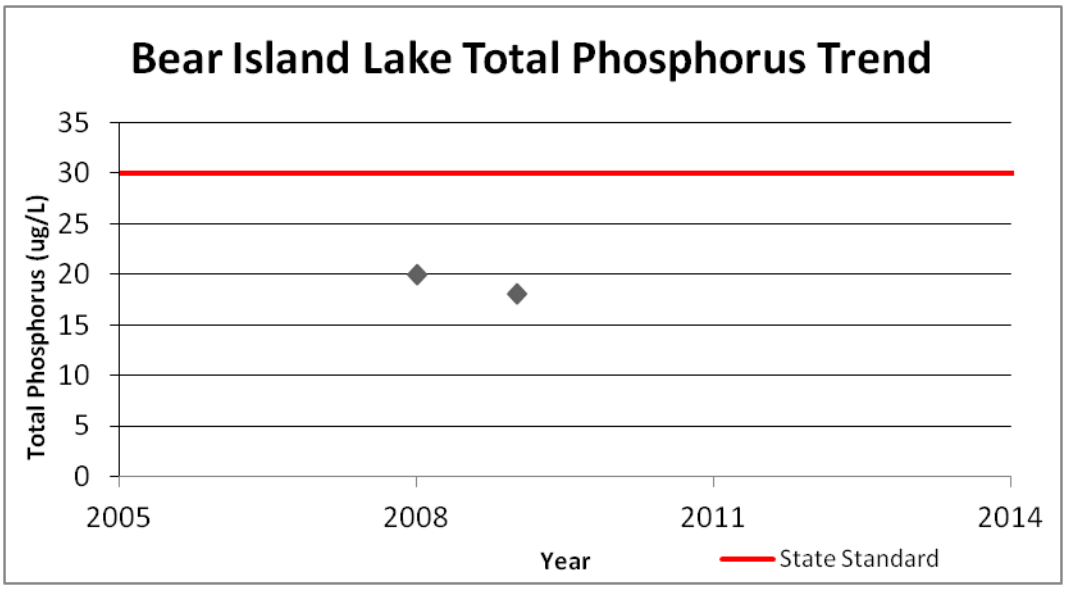


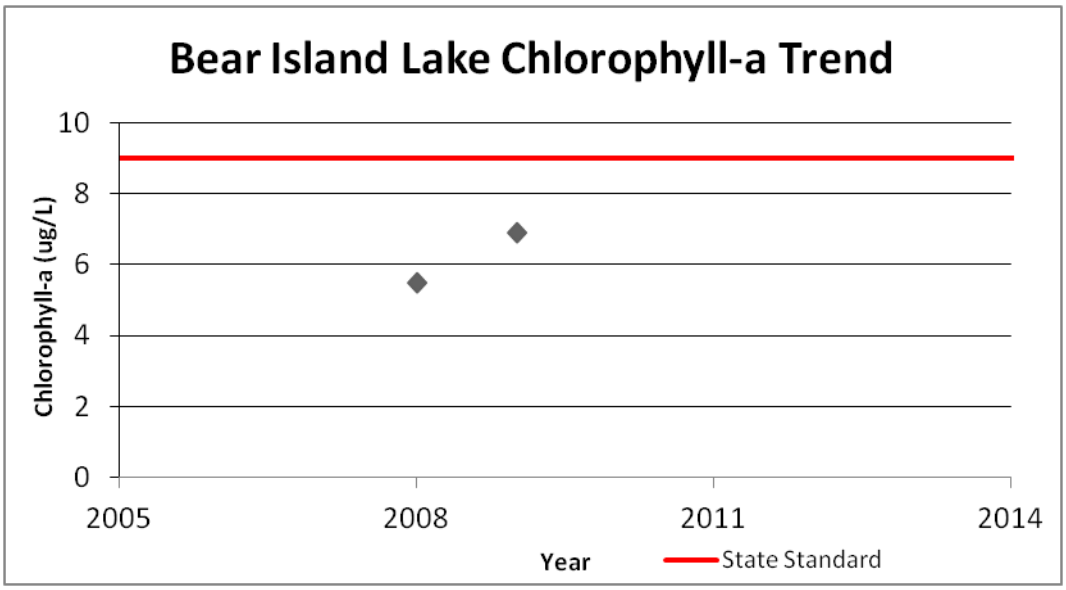
Figure A.3. Garden Lake water quality trends.

Table A.4. Bear Island Lake summer average water quality historic data.

Year	Total Phosphorus		Chlorophyll-a		Secchi Depth	
	N	TP (µg/L)	N	Chl-a (µg/L)	N	SD (m)
2012					6	2.6
2011					8	2.8
2010					4	2.6
2009	5	18	5	6.9	10	2.3
2008	5	20	5	5.5	5	1.6
2001					4	2.0
Average		19		6.2		2.3

Note: N = number of observations.
Source: MPCA Environmental Data Access.





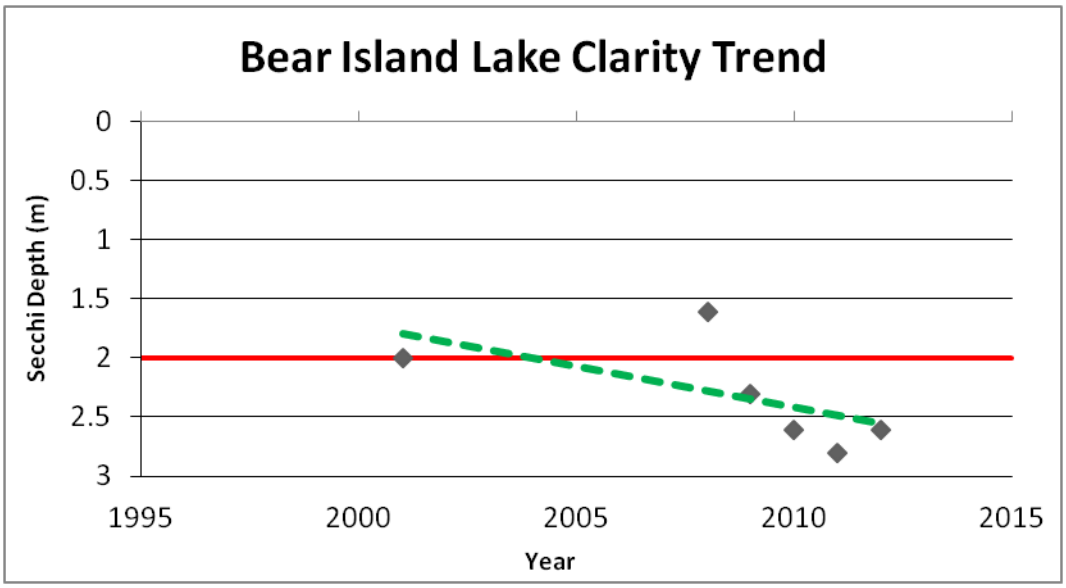
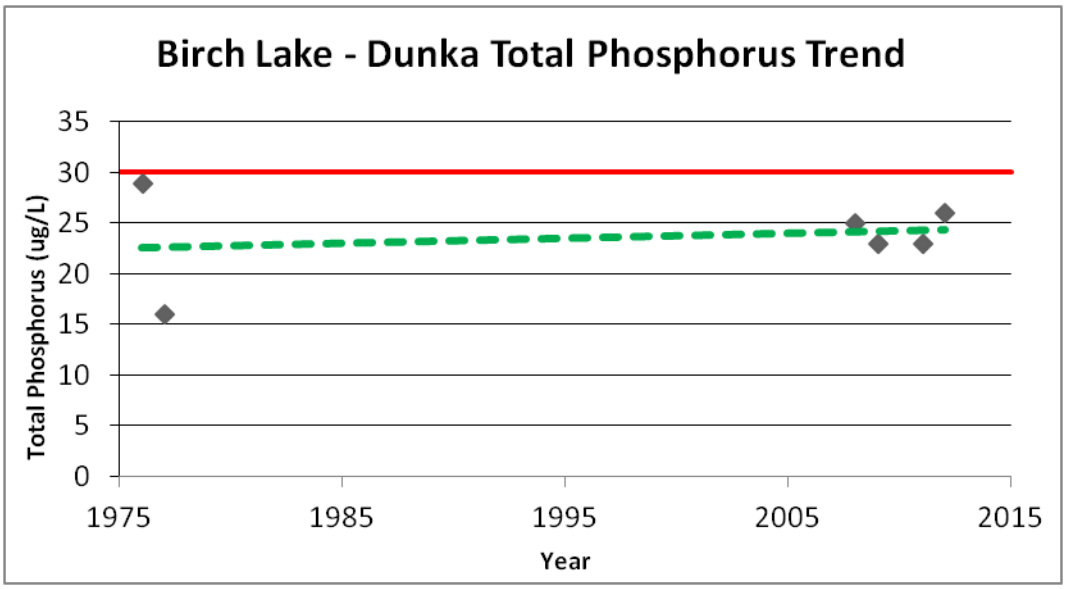


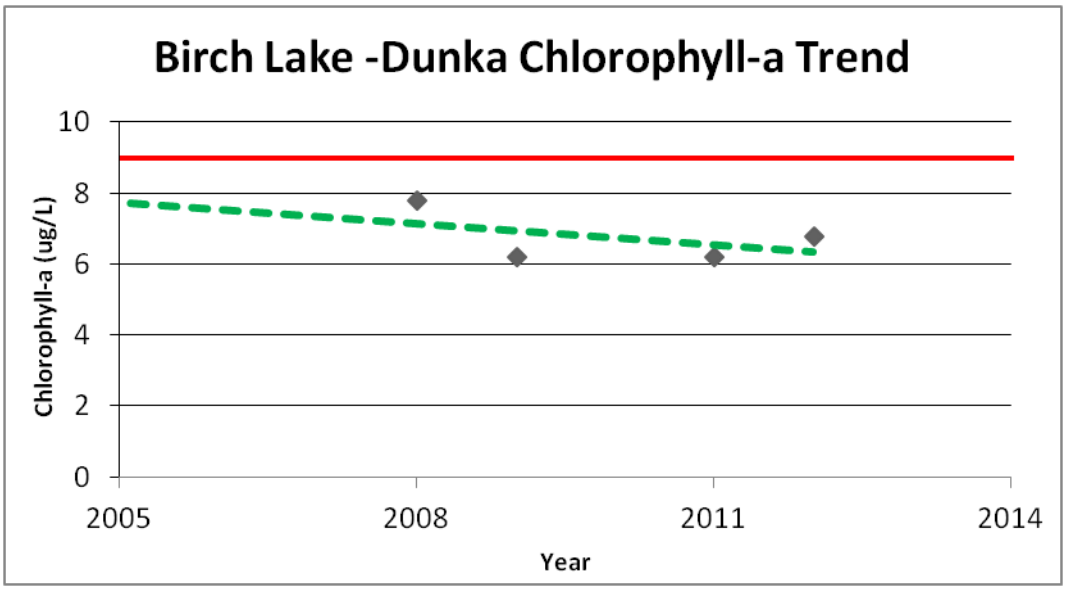
Figure A.4. Bear Island Lake water quality trends.

Table A.5. Birch Lake - Dunka summer average water quality historic data.

Year	Total Phosphorus		Chlorophyll-a		Secchi Depth	
	N	TP (µg/L)	N	Chl-a (µg/L)	N	SD (m)
2012	5	26	5	6.8	3	1.8
2011	5	23	5	6.2	12	1.4
2010					7	1.6
2009	5	23	5	6.2	13	1.4
2008	5	25	5	7.8	5	1.2
1977	4	16			1	1.8
1976	3	29			2	1.6
Average		24		6.8		1.5

Note: N = number of observations.
Source: MPCA Environmental Data Access.





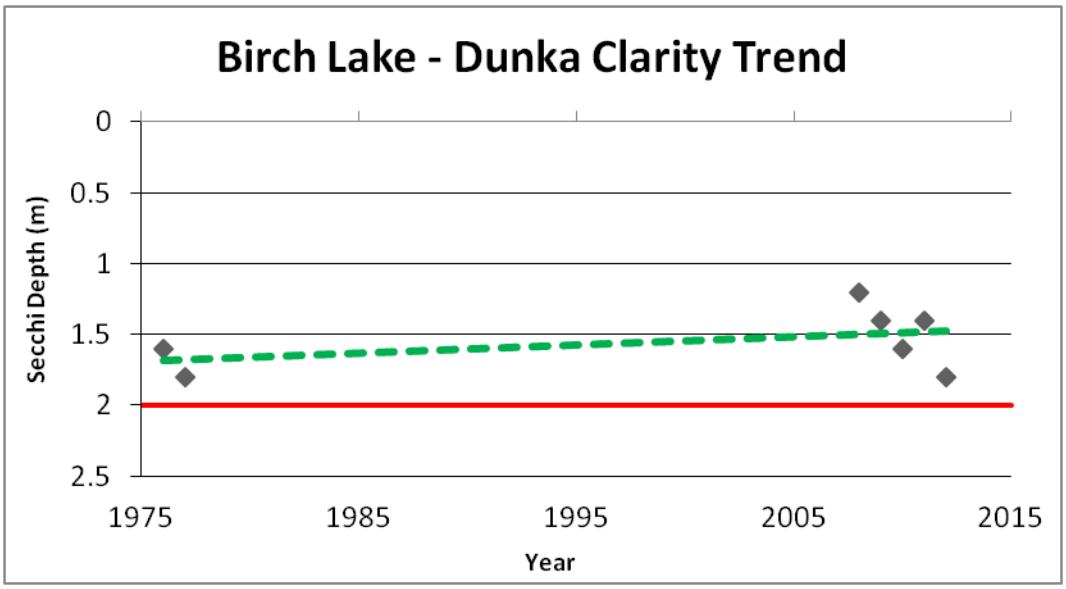
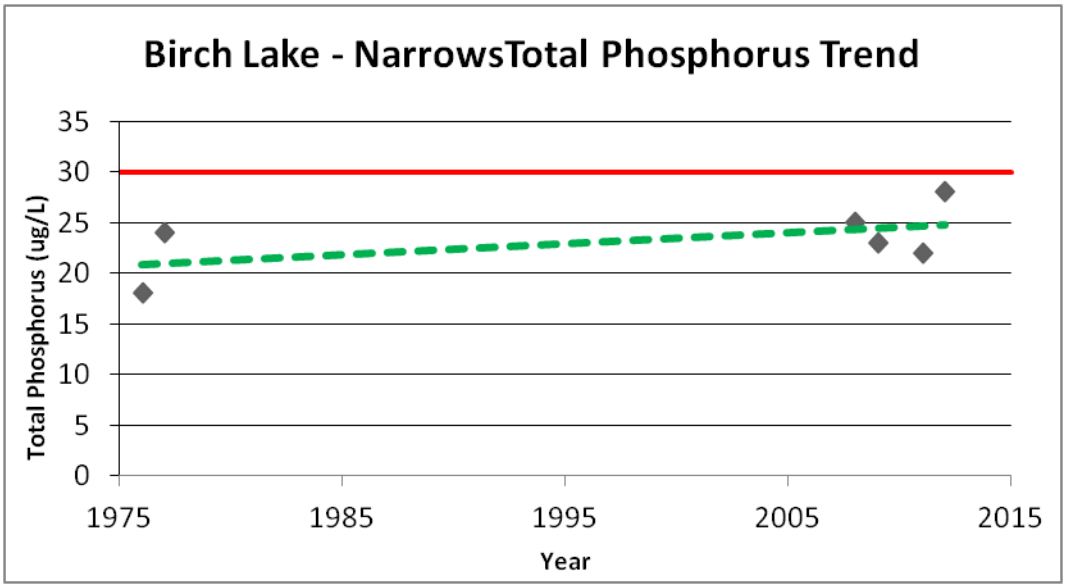


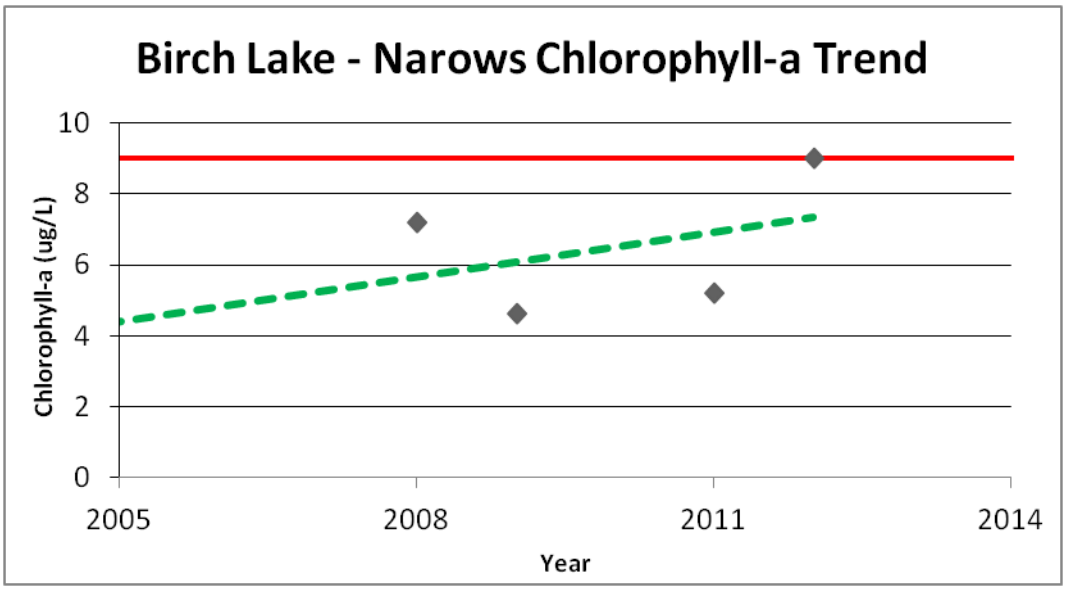
Figure A.5. Birch Lake - Dunka water quality trends.

Table A.6. Birch Lake – Narrows summer average historic water quality data.

Year	Total Phosphorus		Chlorophyll-a		Secchi Depth	
	N	TP (µg/L)	N	Chl-a (µg/L)	N	SD (m)
2012	5	28	5	9.0	4	1.1
2011	4	22	4	5.2	4	1.2
2010						
2009	5	23	5	4.6	5	1.3
2008	5	25	5	7.2	4	1.0
1977	6	24			3	1.6
1976	4	18			4	1.6
Average		23		6.5		1.3

Note: N = number of observations.
Source: MPCA Environmental Data Access





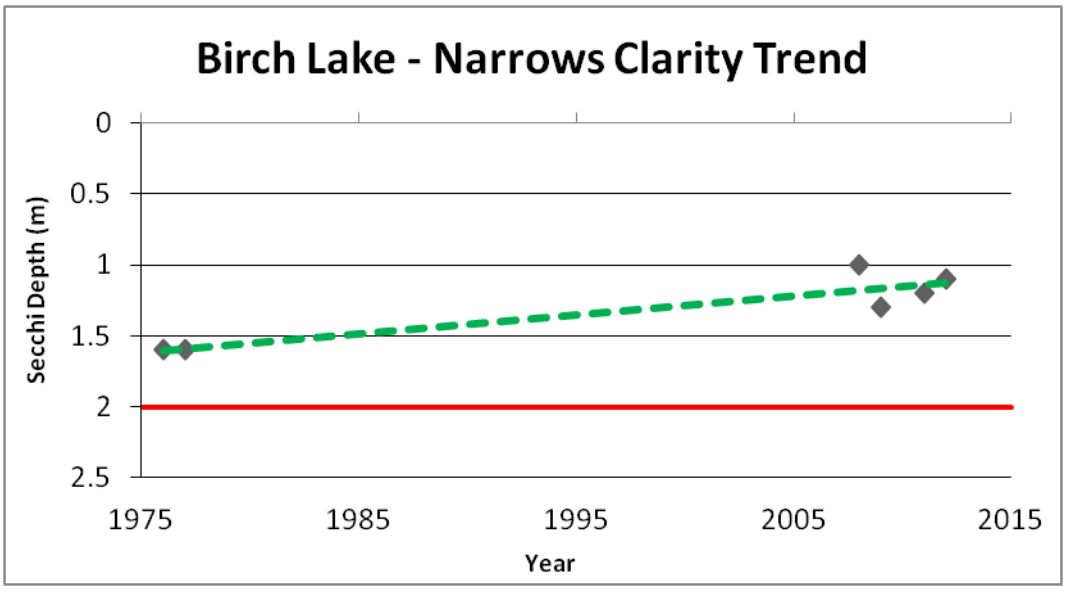


Figure A.6. Birch Lake - Narrows water quality tends.

Appendix B

Kawishiwi Watershed Protection Project
Bear Island Lake Shoreland Assessment Case Study

The Kawishiwi Watershed Protection Project Implementation Plan identified several priority management stratgies to potect and improve the water resources in the watershed. One of those strategies was Shoreland Best Management Practices (BMPs). Shoreland BMPs include actions such as establishing and maintaining healthy native vegetation buffers; correcting erosion and preventing future erosion; and enhancing and managing vegetation for habitat. The Kawishiwi Watershed includes a variety of lakeshore, including private developed and undeveloped lands; National Forest and BWCAW campsites, accesses, and portages; and National Forest and BWCAW natural shoreline.

The need for shoreland BMPs can be assessed using a standardized tool such as Score Your Shore, developed by the DNR Division of Ecological and Water Resources, supplemented to include an assessment of the severity and dimensions of erosion. Wenck Associates developed a companion scoresheet to quantify condition. To illustrate how this scoring system can be used, photos of sites on Bear Island Lake that were reviewed as part of the KWPP Sensitive Uses Assessment were evaluated using a Condition Assessment scorecard. Potential BPMs were identified and the project cost was estimated.

The Condition Assessment uses a six-metric scoring system to estimate the relative condition and risk of erosion and instability as shown in Table 1 below, then the results are summed. Table 2 presents a general categorization of conditions and instability risk. The following case study presents photos of the existing conditions and the Condition Assessment rating for each of six sites. The following section sets forth recommended shoreland BMPs. Following the case study is an overview of the Condition Assessment scorecard and the individual metrics.

Table 1. Shoreline Condition Assessment metrics.

Scoreable condition features in Shoreline Zone.			**Maximum**	
Factor	**Feature**	**Potential Points**	**Subscore**	**Total Score**
Physical Character	Shoreline slope	0-20	40	**100**
	Shoreline vertical height	0-10		
	Shoreline material	0-10		
Existing Condition	Vegetative coverage	0-15	40	
	Observed erosion	0-25		
Erosion Potential	Depth of water 10’ from shore	0-20	20	

Table 2. Shoreline Condition Assessment ratings.

Summary Score	**Condition Assessment**
70-100	Generally stable shoreline, some improvements or enhancements could be made.
40-69	Sites are at risk for erosion and instability. Spot repairs may need to be made or areas of shoreline stabilized.
0-39	Highest risk of erosion and instability. Significant shoreline restoration and stabilization may be necessary.

Bear Island Lake Site Assessments

Note: These site descriptions and potential identification of potential BMPs were based on site and aerial photographs, and no site reconnaissance was performed. Dimensions were not verified in the field.

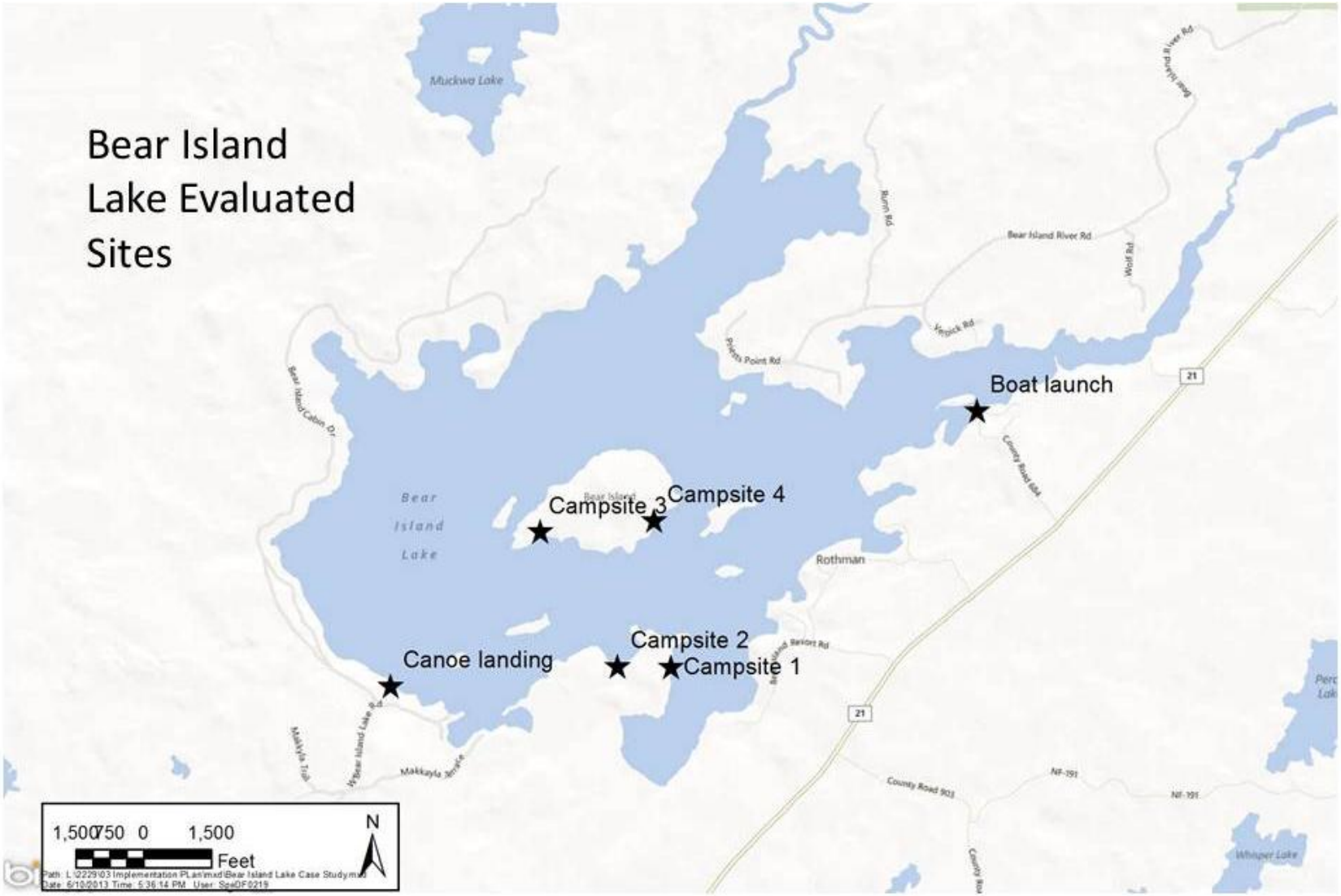


Figure 1. Bear Island Lake locations assessed for this study.

Canoe Landing

Canoe Landing

Beach (Above)
Campsite (Upper Right)
Launch (Lower right)

Condition Assessment	Score
Slope	20 of 20
Bank height	10 of 10
Shoreline material	5 of 10
Vegetative cover	10 of 15
Observed erosion	20 of 25
Water depth at 10' (assumed)	10 of 20
TOTAL	**85 of 100**

Path to Beach (Above)

Campsite 1

Condition Assessment	Score
Slope	15 of 20
Bank height (assumed)	5 of 10
Shoreline material	5 of 10
Vegetative cover (assumed)	10 of 15
Observed erosion	10 of 25
Water depth at 10' (assumed)	10 of 25
TOTAL	**55 of 100**

Path to Beach (Left)
Campsite (Right)

Campsite 2

Condition Assessment	Score
Slope	15 of 20
Bank height (assumed)	5 of 10
Shoreline material	5 of 10
Vegetative cover (assumed)	10 of 15
Observed erosion	10 of 25
Water depth at 10' (assumed)	10 of 20
TOTAL	**55 of 100**

Path to Beach (Left)
Campsite (Right)

Campsite 3

Condition Assessment	Score
Slope	5 of 20
Bank height (assumed)	0 of 10
Shoreline material	5 of 10
Vegetative cover (assumed)	5 of 15
Observed erosion	10 of 25
Water depth at 10' (assumed)	10 of 20
TOTAL	**35 of 100**

Campsite 4

Campsite (Left)
Path to Beach (Right)

Condition Assessment	Score
Slope	5
Bank height (assumed)	0
Shoreline material	5
Vegetative cover (assumed)	5
Observed erosion	10
Water depth at 10' (assumed)	10
TOTAL	**35**

Boat Launch

Boat Launch

Boat Launch

Condition Assessment	Score
Slope	20 of 20
Bank height (assumed)	5 of 10
Shoreline material	5 of 10
Vegetative cover (assumed)	5 of 15
Observed erosion	20 of 25
Water depth at 10' (assumed)	10 of 20
TOTAL	**65 of 100**

Bear Island Lake Site Recommended Best Management Practices

These site descriptions and potential identification of potential BMPs were based on site and aerial photographs and no site reconnaissance was performed. Dimensions were not verified in the field.

Recommended Shoreland Best Management Practices

Canoe Launch

The condition assessment is 85, which indicates a generally stable shoreline that may need some spot repairs or stabilization. Runoff from the parking area is creating rills through the beach to the lake. Recommended improvement is to install an infiltration basin parallel to the beach to capture and infiltrate or filter and slow runoff. Cost estimate assumes a 75' x 10' linear basin 12" deep, with a basin planting medium comprised of 1/3 native soil, 1/3 topsoil, and 1/3 compost. Native herbaceous and woody plugs supplemented by shrubs are recommended for the basin. The cost estimate includes an interpretive sign that could be used to inform launch users about the value of native buffers and native vegetation on lakeshores.

NO.	ITEM	UNIT	QTY.	UNIT PRICE	TOTAL PRICE
1	Mobilization/Demobilization	EACH	1	$ 2,000.00	$ 2,000.00
2	Site prep	LS	1	$ 1,000.00	$ 1,000.00
3	Top soil	CY	9	$ 50.00	$ 450.00
4	Compost	CY	9	$ 20.00	$ 180.00
5	Herbaceous plugs	EACH	350	$ 2.00	$ 700.00
6	Shrubs	EACH	5	$ 40.00	$ 200.00
7	Mulch + ECB	SY	85	$ 3.00	$ 255.00
8	Exclusion fence	LF	170	$ 1.50	$ 255.00
9	Interpretive sign	EACH	1	$ 1,000.00	$ 1,000.00
			TOTAL BASE COST		**$6,040**
			CONTINGENCY (25%)		**$1,510**
			TOTAL COST ESTIMATE		**$7,550**

Campsite 1

The condition assessment is 55, which indicates a a site at risk for or experiencing erosion and instability that may need repair or stabilization. Based on photos, the primary issue at Campsite 1 is the path from the beach to the campsite, which is eroding and rilling. Recommended improvement is to install turf reinforcement mat along the eroded pathway, top dressing with top soil and overseeding with a native seed that is locally hardy to foot traffic and shade.

NO.	ITEM	UNIT	QTY.	UNIT PRICE	TOTAL PRICE
1	Mobilization/Demobilization	EACH	1	$ 2,000.00	$ 2,000.00
2	Site prep	LS	1	$ 1,000.00	$ 1,000.00
3	Reinforcement matting	SY	40.0	$ 20.00	$ 800.00
4	Topsoil	CY	4	$ 50.00	$ 200.00
5	Native seed + mulch + ECB	SY	50.0	$ 5.00	$ 250.00
			TOTAL BASE COST		**$4,250**
			CONTINGENCY (25%)		**$1,060**
			TOTAL COST ESTIMATE		**$5,310**

Campsite 2

Similar to Campsite 1, the condition assessment is 55 and the primary issue at Campsite 2 is the path from the beach to the campsite. Runoff down the path has washed soil away from timber steps, leaving exposed mineral soil. Recommeded improvement is to install turf reinforcmeent mat along the eroded pathway, top dressing with top soil, back filling around the steps and, overseeding with a native seed that is locally hardy to foot traffic and the light conditions. Spot repair other observed erosion along the lakeshore.

NO.	ITEM	UNIT	QTY.	UNIT PRICE	TOTAL PRICE
1	Mobilization/Demobilization	EACH	1	$ 2,000.00	$ 2,000.00
2	Site prep	LS	1	$ 2,000.00	$ 2,000.00
3	Reinforcement matting	SY	70.0	$ 20.00	$ 1,400.00
4	Topsoil	CY	8	$ 50.00	$ 400.00
5	Native seed + mulch + ECB	SY	100.0	$ 5.00	$ 500.00
		TOTAL BASE COST			**$6,300**
		CONTINGENCY (25%)			**$1,580**
		TOTAL COST ESTIMATE			**$7,880**

Campsite 3

Similar to Campsite 2, there is some erosion and bare soil exposed along the path form the beach to the campsite, although this is less severe than the other sites. The timber steps are in disrepair and should be reset or replaced. Recommended improvement is to install turf reinforcement mat along the eroded pathway, top dressing with top soil, back filling around the steps, and overseeding with a native seed that is locally hardy to foot traffic and the light conditions. The condition assessment is 35, indicating a high risk of instability, primarily due to the vertical height of the shoreline and the shoreline slope. Spot repair other observed erosion along the lakeshore.

NO.	ITEM	UNIT	QTY.	UNIT PRICE	TOTAL PRICE
1	Mobilization/Demobilization	EACH	1	$ 2,000.00	$ 2,000.00
2	Site prep + repair steps	LS	1	$ 2,000.00	$ 2,000.00
3	Reinforcement matting	SY	8.0	$ 20.00	$ 160.00
4	Topsoil	CY	3	$ 50.00	$ 125.00
5	Native seed + mulch + ECB	SY	20.0	$ 5.00	$ 100.00
		TOTAL BASE COST			**$4,385**
		CONTINGENCY (25%)			**$1,100**
		TOTAL COST ESTIMATE			**$5,485**

Campsite 4

Typical of the other sites, the primary issue for Campsite 4 appears to be the eroded path from the beach to the campsite. The condition assessment is 35, which like Campsite 3 indicates a high risk of instability based on bank vertical height and slope. Unlike the other campsites, this path is very rocky with boulders and outcroppings. The embedded rocks are stabilizing the bank, although sheet flow is washing away the soil around them. Recommended improvement is to leave the embedded rock in place, top dress with top soil, install turf reinforcement mat and overseeding with a native seed that is locally hardy to foot traffic and the light conditions. Spot repair other observed erosion along the lakeshore.

NO.	ITEM	UNIT	QTY.	UNIT PRICE	TOTAL PRICE
1	Mobilization/Demobilization	EACH	1	$ 2,000.00	$ 2,000.00
2	Site prep	LS	1	$ 1,000.00	$ 1,000.00
3	Reinforcement matting	SY	15.0	$ 20.00	$ 300.00
4	Topsoil	CY	4	$ 50.00	$ 200.00
5	Native seed + mulch + ECB	SY	15.0	$ 5.00	$ 75.00
		TOTAL BASE COST			**$3,575**
		CONTINGENCY (25%)			**$890**
		TOTAL COST ESTIMATE			**$4,465**

Boat Launch

The condition assessment is 65, which is on the line between a generally stable shoreline and one that is somewhat at risk for instability and erosion. Some of the shoreline appears to be vegetated, with the area closest to the launch sparsely vegetated or bare. Recommended improvement is to install a native buffer on approximately 80 feet of shore, averaging 30' in depth. Native seed supplemented by shrubs are recommended for the buffer, as well as an exclusion fence during the plant establishment period (2-3 years) to reduce predation from geese and other wildlife. The cost estimate includes an interpretive sign that could be used to inform launch users about the value of native buffers and native vegetation on lakeshores. The dock is in need of repair, which is not included here.

NO.	ITEM	UNIT	QTY.	UNIT PRICE	TOTAL PRICE
1	Mobilization/Demobilization	EACH	1	$ 2,000.00	$ 2,000.00
2	Site prep	LS	1	$ 1,000.00	$ 1,000.00
3	Buffer native seed +mulch + ECB	SY	300	$ 5.00	$ 1,500.00
4	Shrubs	EACH	10	$ 40.00	$ 400.00
5	Exclusion fence	LF	250	$ 1.50	$ 375.00
6	Interpretive sign	LS	1	$ 1,000.00	$ 1,000.00
		TOTAL BASE COST			**$6,275**
		CONTINGENCY (25%)			**$1,570**
		TOTAL COST ESTIMATE			**$7,835**

Kawishiwi Watershed Protection Project
Lakeshore Condition Assessment

Score Your Shore
Lakeshore Condition Assessment

The Minnesota DNR has developed a standardized method of assessing the habitat conditions of lake lots called Score Your Shore. This tool was designed for use by lakeshore property owners to self-assess habitat and stewardship on their land and adjacent areas. This tool can help determine the need for Shoreland Best Management Practices (BMPs) such as installation of native vegetation on the shoreline as a buffer or addition of woody habitat in the near-shore area. More information about Score Your Shore can be found on the DNR's website at: http://www.dnr.state.mn.us/scoreyourshore/index.html

The Score Your Shore tool divides the shoreline area into three zones: Upland, Shoreline, and Aquatic (Figure 1). Assessors score conditions in several categories for each of these areas, then sum the scores for an overall rating that falls between 0 and 100, with 100 being the highest score. The various categories and their scores are shown in Table 1 and Table 2.

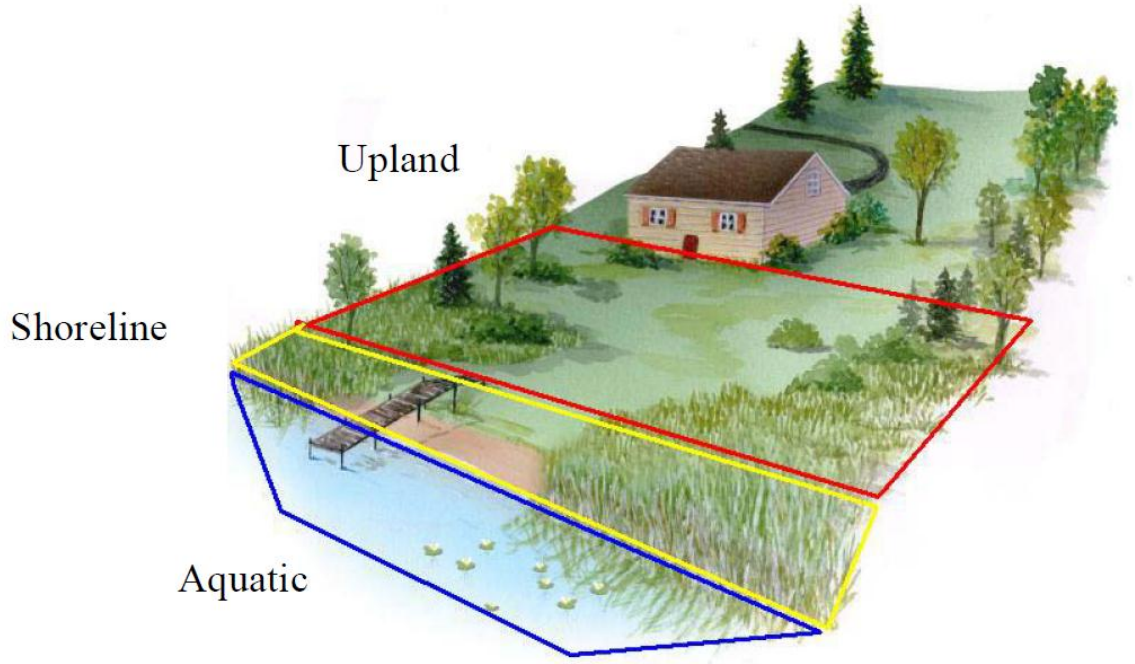


Figure 2. Score Your Shore Habitat Zones.
Source: Minnesota DNR.

Table 1. Scoreable habitat features in Upland and Shoreline Zones.			Maximum Score	
Land Zones	**FEATURE**	**Potential Points**	**Zone Score**	**Total Land Score**
Upland	1. Percent of lot frontage with Trees	0-25	65	**100**
	2. Percent of lot frontage with Shrubs	0-20		
	3. Percent of lot frontage with Natural Ground Cover	0-20		
Shoreline	4. Percent of lot frontage with Trees/Shrubs	0-20	35	
	5. Percent of lot frontage with Natural Ground Cover	0-15		

Source: Minnesota DNR.

Table 2. Scoreable habitat features in Aquatic Zone.				Maximum	
Zone	**FEATURE**		**Potential Points**	**Sub Score**	**Total Aquatic Score**
Aquatic	Emergent and Floating-leaf	1. Percent of lot frontage with Emergent and/or Floating-leaf plants	0-40	45	**100**
		2. Continuity of Emergent and/or Floating-leaf plants (amount of fragmentation)	0-5		
	Submerged	3. Abundance of Submerged growth	0-35	35	
	Woody Habitat	4. Presence of Overhanging vegetation	0-10	20	
		5. Presence of Woody Habitat	0-10		

Source: Minnesota DNR.

Because its emphasis is on habitat quality, Score Your Shore includes only a limited assessment of the physical conditions of the shoreline and its potential for erosion. As part of the Kawishiwi Watershed Protection Project Wenck Associates developed a companion tool to Score Your Shore that can be used to estimate the current severity of eosion and the potential for future erosion (Table 3.) These tools can be used together to provide a more complete picture of shoreline conditions and priorities.

The six features comprising the Condition Assessment score fall into three categories: Physical Character, Existing Condition, and Erosion Potential. They are scored using the following metrics, and then summed to get the total Condition Score.

Table 3. Scoreable condition features in Shoreline Zone.			**Maximum**	
Factor	**Feature**	**Potential Points**	**Subscore**	**Total Score**
Physical Character	Shoreline slope	0-20	40	**100**
	Shoreline vertical height	0-10		
	Shoreline material	0-10		
Existing Condition	Vegetative coverage	0-15	40	
	Observed erosion	0-25		
Erosion Potential	Depth of water 10' from shore	0-20	20	

Source: Wenck Associates, Inc.

1. **Shoreline slope.**
   The slope of the shoreline is an important factor in determining shoreline stability. Wave energy can more easily dissipate on shores with flatter slopes, while steeper slopes are more prone to erosion and instability. Estimate the average slope of the land from the water's edge to the top of the bank.

Description within the Shoreline Zone	**Points**
Shoreline is flat to gently sloped, less than 3:1 (18%)	20
Shoreline is moderately sloped, 3:1 (18%) to 1:1 (45%)	15
Shoreline is highly sloped, steeper than 1:1 (45%)	5
Shoreline is vertical or nearly vertical	0

2. **Shoreline vertical height.**
   Similar to shoreline slope, shorelines with a shorter vertical height allow waves to dissipate on shore, instead of against the shoreline edge. Estimate the vertical height of the shoreline from the lake bottom at the water's edge to the top of the bank.

Description within the Shoreline Zone	**Points**
Shoreline is less than 2 feet high	10
Shoreline is 2 to 4 feet high	5
Shoreline is more than 4 feet high	0

3. **Shoreline material.**
   Some shoreline material is more resistant to erosion, while other types of material are more susceptible to erosion. Indicate the primary composition of the shoreline.

Description within the Shoreline Zone	Points
Rock face	10
Sand	5
Loam or other material with embedded rocks and cobble	5
Loam, loam-sand, or loam with small gravels	0

4. **Shoreline vegetative coverage.**
   Shoreline vegetation provides a number of benefits. Plant roots hold soil in place, stabilizing the shoreline and reducing susceptibility to erosion from wave action. Vegetation also slows down runoff from the land to the lake, reducing rilling and erosion from stormwater runoff. Native vegetation is preferred for its deep roots, long stems and leaves, and roughness. Estimate the percent of the shoreline that is covered in vegetation.

Description within the Shoreline Zone	Points
More than 75% coverage of native vegetation, unmowed grass at least 5 feet deep, or impervious; balance of shoreline vegetated	15
25-75% coverage of native vegetation, unmowed grass at least 5 feet deep, or impervious; balance of shoreline vegetated with limited areas of bare soil	10
Shoreline is vegetated but more than 25% of the area is bare soil	5
Entire shoreline is mowed turf or bare	0

5. **Observed erosion.**
   Erosion can range in severity from minor rilling (narrow, shallow channels) to gullying (deeper channels) to mass wasting (material moving downslope due to gravity). Indicate the type and severity of erosion that is present.

Description within the Shoreline Zone	Points
None or very limited	25
A few rills marking overland flow paths	20
Moderate rills and/or mass wasting at several locations	10
Rills, ravines, mass wasting and loss of shoreline at localized areas	5
Rills, ravines, mass wasting and loss of shoreline affecting the entire shoreline	0

6. **Depth of water 10 feet from shore.**
   Wave energy and force can be predicted from the depth of water near the shore. Shallow waters near shore allow waves to break and dissipate energy before meeting the shoreline.

Deeper waters near shore provide no energy dissipation benefits. Measure or estimate the depth of water 10 feet from shore.

Description within the Shoreline Zone	Points
Less than one foot deep	20
One to three feet deep	10
More than three feet deep	0

Scoring

The DNR can provide guidance regarding desirable habitat assessment targets. The Condition Assessment can be used to evaluate current conditions and can be repeated at intervals to track changes in condition, especially at high-risk or high-profile locations. While each site has its unique features that may not be entirely captured by this tool, the summary score can help to prioritize locations for certain management actions according to the following scorecard:

Summary Score	Condition Assessment
70-100	Generally stable shoreline, some improvements or enhancements could be made.
40-69	Sites are at risk for erosion and instability. Spot repairs may need to be made or areas of shoreline stabilized.
0-39	Highest risk of erosion and instability. Significant shoreline restoration and stabilization may be necessary.