Citizen Assessment of Critical Habitats & Priority Shorelines 2010

Grindstone Lake, Sawyer County, Wisconsin

Funded by the Wisconsin Department of Natural Resources
Lake Planning Grant Program

Sponsored by the Grindstone Lake Association

GIS Center
University of Wisconsin - Stevens Point

Document prepared by Douglas Miskowiak, GIS Education Specialist
Maps prepared by Jon Galloy and Mike Broton, GIS Student Interns
University of Wisconsin-Stevens Point, GIS Center

Table of Contents

List of Maps

Preface

The Grindstone Lake Association has an active history in learning more about lake and shore land resources and in leading conservation efforts to improve the ecology and aesthetics of Grindstone Lake. The effort to compile data included in this plan extends the association's efforts in conserving the area's special resources. In this initiative, citizens from Grindstone Lake partnered with professionals from various organizations to inventory watershed and shoreline characteristics important for lake planning and conservation efforts. Throughout the process citizens have invested generously with their time and energy. With professional training citizens inventoried emergent aquatic macrophytes, coarse woody habitat, aquatic invasive species, shoreline development, riparian trees, veteran trees, aesthetic characteristics, lake-bottom structure, and wildlife. Equipped with new skills, citizens inventoried over 12 miles of shoreline documenting ecological and aesthetic characteristics, features, and indicators.

Though past planning and management efforts are common on Grindstone Lake, this report is the first known systematic, spatial assessment of Grindstone Lake's characteristics. These spatial inventories provide an objective snapshot of the resources that exist along the Grindstone Lake shoreline, riparian area, and littoral zone during the summer of 2010. These data, preserved using Geographic Information Systems (GIS), not only serve the interests of this planning project, but will also serve to monitor changes on and around Grindstone Lake over time.

Summary of the Resource

The Grindstone Lake Watershed is located within the larger Couderay River Watershed and the Upper Chippewa River Basin. The Grindstone Lake Watershed is located entirely within Sawyer County, Wisconsin (see Map 1). The Grindstone Lake Watershed covers 11,700 acres and is dominated by deciduous and evergreen forested cover and open water. Although the majority of land held within the watershed is privately owned, the Lac Courte Oreilles Band of Ojibwe is the largest single landowner within the watershed.

Grindstone Lake is located within the Town of Bass Lake in Sawyer County. The lake has a water area of 3,193 acres, contains two islands, and has 12.46 miles of mainland and island shoreline. The islands account for 0.73 miles or almost six percent of total shorelines. The lake is recognized by the Wisconsin Department of Natural Resources (WDNR) as an "Outstanding Water Resource" with very clear water and healthy populations of small mouth bass, walleye, and musky. Grindstone Lake is fed largely by adjacent lands and the Grindstone Creek. Grindstone Lake drains out to Lake Lac Courte Oreilles, then to the Couderay River, before entering the Chippewa River system. Grindstone Creek and Lake Lac Courte Oreille are also designated by the WDNR as Outstanding Water Resources.

Grindstone Lake is located within the North Central Forest ecological landscape that provides habitat to many important and unique species. Grindstone Lake citizens have documented bald eagles, loons, fishers, mink, and bear among other notable species. Within the North Central Forest, Grindstone Lake is uniquely positioned between two landscapes that the WDNR had designated with "legacy" status – Lake Chippewa and the St. Croix National Scenic Riverway (see Map 1).

Overview of the Project

It is the Grindstone Lake Association's strategy to build upon previous studies and reports to address critical issues and engage its membership to help protect and manage aesthetic and ecological resources on Grindstone Lake. This plan builds upon previous reports and engages the membership to establish an objective record of ecological and aesthetic characteristics, features, and indicators of Grindstone Lake's shorelines. This information is fundamental to help develop a conservation strategy that takes advantage of the unique features and characteristics of Grindstone Lake and its watershed. Much of Grindstone Lake's shorelines are owned privately. With thoughtful management and strategic conservation, Grindstone Lake can remain clean and naturally beautiful, provide healthy and stable habitats for wildlife, and provide enjoyment to the people that inhabit and recreate there.

This project provides the first known systematic inventory of Grindstone Lake and its watershed since the Land Economic Inventory Maps from the 1930's. Updated spatial inventories and subsequent analyses are critical for sound lake and watershed planning. They provide useful information for identifying and managing shorelines that are important for maintaining healthy fish and wildlife habitats, high water quality, and areas of exceptional natural beauty. Information about land use, land cover, topography, impervious surfaces, sensitive features, and natural resources are documented in this report, providing local residents and decision-makers, including the Grindstone Lake Association, information in a comprehensive format. The intent is to provide this information for making well-informed lake, land, and watershed management decisions, including critical habitat assessment.

Grindstone Lake Association members learn how to conduct spatial inventories of various ecological and aesthetic shoreline indicators.

The Grindstone Lake Association has utilized the shoreline inventories to identify critical habitats as defined by the WDNR and to identify high-priority shorelines worthy of conservation. This process is intended to firstly inform the WDNR's process for critical habitat assessment on Grindstone Lake. Grindstone Lake is in the queue for a critical habitat assessment conducted by the WDNR. The Grindstone Lake Association intends to use its analysis of critical habitats to inform the WDNR's assessment of critical habitats and augment the dialogue between the association and the WDNR. Secondly, the association is prioritizing shorelines to assist in their own efforts to identify shorelines most worthy of conservation and those in need of rehabilitation.

Grindstone Lake Association

The Grindstone Lake Association is a community of neighbors dedicated to promoting the preservation and enjoyment of Grindstone Lake.

The mission of the association is to:

> ***Preserve and enhance the habitat of Grindstone Lake and the value of lake property ownership.***

The association works to accomplish its mission by:

1. Monitoring lake water quality and shoreline use and developing appropriate action plans.
2. Disseminating information about matters affecting Grindstone Lake.
3. Promoting activities that enhance the quality of lake ownership and association membership.

Project Partners and Participants

The Grindstone Lake Association recognizes and appreciates the cooperation and partnership of the following project partners, cooperators and contributors.

Grindstone Lake Association Board of Directors

- Steven Buss, President
- Bruce Paulson, Vice President
- Pat O'Leary, Secretary
- Vanessa Cossetta, Treasurer
- Frank Cossetta, Membership Coordinator
- Dag Sohlberg, Newsletter Coordinator
- Hal Meeker, At Large
- Larry Berg, At Large
- Brian Pabich, At Large
- Dan Tyrolt, LCO Conservation, LCO Liaison and Water Quality

Grindstone Lake Citizen Contributors

- Sandy Bandli. Riparian trees inventory.
- Ann Berg. Aesthetic beauty inventory.
- Larry Berg. Prioritizing Grindstone Lake shorelines.
- Barb and Lyn Britton. Visible structures inventory.
- Steve Buss. Prioritizing Grindstone Lake shorelines.
- Al and Cooper Campbell. Emergent aquatic macrophyte inventory.
- Dina Deno. Aesthetic beauty inventory.
- Stan Deno. Emergent aquatic macrophyte inventory.

• Lew and Nancy Landt.	Coarse woody habitat inventory.
• Laura and Marti Lewellen.	Riparian wetland and bottom structure inventories.
• Hal Meeker.	Riparian trees inventory.
• Chuck and Linn Newton.	Visible structures inventory.
• Kathy O'Cull.	Emergent aquatic macrophyte inventory.
• Bruce Paulson.	Pontoon boat.
• Linda Rogers.	Aesthetic beauty inventory.
• Mark and Susan Schmiel.	Visible structures inventory.
• Lee and Nancy Skelly.	Riparian trees inventory.
• Dag Solberg.	Visible structures and course woody habitat inventories.
• Mary Trousdale.	Riparian wetland and bottom structure inventories.
• Bob Trousdale.	Riparian wetland inventory.

Project Cooperators

- Brian Devries, Sawyer County Land Records Department. Brian provided technical geographic information system (GIS) data that proved valuable in understanding the resource.
- Kristi Maki, Sawyer County Land and Water Conservation. Kristi provided valuable expertise in identifying emergent aquatic macrophytes and aquatic invasive species.
- Kathy Moe, United States Forest Service. Kathy provided valuable information about Grindstone Lake's riparian woody vegetation and veteran trees.
- Alex Smith, Wisconsin Department of Natural Resources. Alex provided significant insight to the WDNR's critical habitat assessment process. Alex also helped citizens inventory riparian wetlands and littoral zone lake bottom structure.
- Dan Tyrolt, LCO Conservation Liaison and Water Quality. Dan provided testimony to the importance of various shoreline characteristics for prioritizing shorelines for conservation and identifying critical habitats.

Project Education and Assistance

- Douglas Miskowiak, GIS Educator and Project Manager. GIS Center – University of Wisconsin-Stevens Point.
- Jon Galloy, Lead GIS Technician and Intern. GIS Center – University of Wisconsin-Stevens Point.
- Mike Broton, GIS Technician and Intern. GIS Center – University of Wisconsin-Stevens Point.
- Corinna Neeb, GIS Technician and Intern. GIS Center – University of Wisconsin-Stevens Point.

Executive Summary

Analyses conducted for the Grindstone Lake Watershed and inventories of the Grindstone Lake littoral and riparian areas reveal spatial patterns important to Grindstone Lake's water quality, ecological health, and aesthetic integrity. The chapters of this report provide detailed information about inventories, the methodologies used, and findings. The information below summarizes the primary findings for Grindstone Lake.

General Lake and Watershed Statistics

- Grindstone Lake encompasses 3,193 acres.
- Grindstone Lake contains 2 islands.
- Grindstone Lake has 12.46 miles of shoreline of which 11.73 miles are along the mainland and 0.726 miles, or almost six percent, are island frontage.
- The Grindstone Lake Watershed encompasses 11,699 acres.
- The watershed holds 3,261 acres of surface waters.
- Grindstone Creek and Grindstone Lake are designated by the WDNR as Outstanding Water Resources. Waters flow from Grindstone Lake into Lake Lac Courte Oreilles, also designated as an Outstanding Water Resource.

Ownership Findings

- The Lac Courte Oreilles Band of the Ojibwe owns 0.26 miles of shoreline, as measured by perimeter of shoreline.
- Private landholdings on the lake total 10.43 miles, as measured by perimeter of shoreline.
- Public land holdings (i.e. Town of Bass Lake and State of Wisconsin) on the lake total 1.65 miles of shoreline, as measured by perimeter of shoreline.

Development Findings

- With the tree canopy in full leaf-on condition, 631 man-made structures or objects were documented that were visible from the littoral zone of Grindstone Lake. The inventory was conducted on September 29, 2010 and notably, some landowners had previously removed their docks or piers.

Emergent Aquatic Vegetation Findings

- Only 1.39 miles or 11 percent of shoreline held emergent aquatic macrophytes within the littoral zone.
- Emergent aquatic macrophytes were found primarily in two areas—behind the lake's two islands and near the lake's outlet to Lake Lac Courte Oreilles.
- Purple loosestrife, an aquatic invasive plant, were found on Grindstone Lake. One specimen was located behind the islands. Five specimens were found east of the cranberry bog in public land survey section 25.

Citizen inventories revealed that purple loosestrife, an aquatic invasive species, is present on Grindstone Lake.

Coarse Woody Habitat

- Coarse woody habitat has a propensity for regression on Grindstone Lake. Limited tree falls were documented. Western most shores and in particular those shores behind the islands had the most significant, if still limited, coarse woody habitat.

Riparian Trees and Veteran Trees

- Riparian vegetation is proceeding toward a climax condition as defined by the pre-settlement vegetation surveys documented by surveyors in the mid-1800's.
- Tamarack bogs, inhabiting shorelines within sections 23 and 26, are ecologically significant landscapes that provide valuable habitats for various flora and fauna.
- Eighty-seven trees were identified as veteran tree specimens, being of remarkable size for their species. Veteran white pines dominated the total numbers of veteran trees.
- Locations of veteran trees are well distributed along Grindstone Lake shorelines.
- Significant stands of white cedar trees are present on Grindstone Lake, especially near the shores of the cranberry bog.

Bottom Structure (near shore)

- Over five miles of shorelines are of a suitable bottom structure for walleye reproduction or small mouth habitat; consisting of fine gravels, coarse gravels, rubble/cobble, or small boulders.

Aesthetic Conditions

- Almost 3.5 miles of shoreline exist in a naturally scenic condition, where no visible man-made structures are visible and no disturbance to the riparian vegetation is discernible.

Critical Habitat Assessment

- Using WDNR criteria for critical habitat assessment, not including measurements for submerged aquatic macrophytes, Grindstone Lake harbors 7.18 miles of critical habitat, as measured by shoreline perimeter.
- The Critical Habitat Designation Program includes formal designations of sensitive areas, public rights features, and resource protection areas. These elements provide regulatory and management advice to the State of Wisconsin, local units of government, and others who are interested in protecting critical habitats and public rights features.

Priority Shorelines Assessment

- Based upon further assessment by the Grindstone Lake Association to identify priority shorelines—those that contain a number of ecologically and aesthetically significant characteristics, Grindstone Lake has:
  - 0.21 miles of shoreline that harbor five ecological and aesthetic indicators.
  - 0.27 miles of shoreline that harbor four ecological and aesthetic indicators.
  - 0.65 miles of shoreline that harbor three ecological and aesthetic indicators.
  - 1.60 miles of shoreline that harbor two ecological and aesthetic indicators.
  - 5.25 miles of shoreline that harbor one ecological or aesthetic indicator.

Chapter 1. Project Goals and Objectives

The Grindstone Lake Association continues its efforts to protect the characteristics of the shoreline that make Grindstone Lake an ecologically significant and aesthetically desirable landscape. The Grindstone Lake aquatic management plan, crafted in 2006, recommended that an analysis be conducted to survey sensitive areas (i.e. critical habitats and public rights features) on Grindstone Lake. The survey, to be conducted by the WDNR, evaluates key habitat regions that are important for fish, wildlife, and other organisms. Additionally, the survey identifies key plant habitats that help to preserve water quality and natural scenic beauty. The following project goals are designed to assist the WDNR in future efforts to survey sensitive areas by providing a foundation of geographic information.

Goal 1. Develop a watershed and lake information system to be used for natural resources and lake protection decision-making, planning and management.

Goal 2. Develop a watershed and lake conservation strategy that sets protection priorities for critical, threatened, aesthetic, or ecologically important habitats.

Goal 3. Build awareness among lake associations, land trusts, other conservation organizations, professionals, and the WDNR of the methods citizens can use to determine critical habitats.

Goal 4. Develop a plan to protect the critical habitat of Grindstone Lake.

Goal 5. Produce data that will significantly reduce resources needed by the WDNR when they conduct their critical habitat analysis, preliminarily scheduled for 2011.

The remaining chapters in this report document and detail efforts to accomplish these project goals.

Figure 1.1

This artistic rendering of an actual photograph from the Grindstone Lake inventories depicts a significant reason for why we plan for the protection of resources on Grindstone Lake.

Here a young boy searches for frogs along shorelines lined with coarse woody habitat and emergent aquatic macrophytes – favorite hiding spots for invertebrates, reptiles, amphibians, and other critters.

Chapter 2. Overview of Methods, Activities, Products, and Deliverables.

Chapter two provides an overview of the activities and products delivered to satisfy the Grindstone Lake Association Lake Management and Planning Grant.

Analyze the Grindstone Lake Watershed.

The Grindstone Lake Watershed was systematically analyzed to identify significant spatial patterns that contribute or detract from the ecological and aesthetic quality of Grindstone Lake. The following accomplishments accompany the analysis of the Grindstone Lake Watershed.

Watershed Delineation

The UW-Stevens Point, GIS Center delineated the watershed boundary for Grindstone Lake. The watershed defines the geographic region where water flows. The watershed model used in previous lake studies was unsuitable for spatial watershed inventories and analysis. The previous watershed model was unaccompanied by metadata to discern source data, spatial accuracy standards, attribute accuracy standards, credits, or process methods. A new model was developed using the United States Geological Survey 30-meter digital elevation model and ArcGIS 9.3.1. More information about the watershed model is found in chapter four.

Watershed Analyses

Eight watershed analyses were conducted. The following items were analyzed. More information about each analysis is found in chapter four. More information about the data used to conduct the analyses are found in Appendix A.

1. Water resources.
2. Environmental corridors.
3. Pre-settlement vegetation.
4. Land cover, 2001.
5. Publicly managed lands.
6. Impervious surfaces.
7. Tree canopy density.
8. Glacial geology.

Description of Data Collected

Data for the watershed analyses were compiled from existing federal and state sources. The following data were extracted to the Grindstone Lake Watershed.

- Minor civil divisions, 2000. U.S. Department of Commerce.
- County boundaries. Wisconsin Department of Natural Resources.
- Public Land Survey System. Wisconsin Department of Natural Resources.
- Lakes, ponds, and flowages, 2006. Wisconsin Department of Natural Resources.
- Rivers, streams, and shorelines, 2006. Wisconsin Department of Natural Resources.
- Islands and uplands, 2006. Wisconsin Department of Natural Resources.
- Outstanding and exceptional water resources, 2007. Wisconsin Department of Natural Resources and Douglas Miskowiak, Center for Land Use Education.

- Dam locations, 2006. Wisconsin Department of Natural Resources.
- Native American lands, 2000. Wisconsin Department of Natural Resources.
- Federal lands. Wisconsin Department of Natural Resources.
- National forests, Wisconsin Department of Natural Resources.
- WDNR managed lands, 2002. Wisconsin Department of Natural Resources.
- County forests, 2005. Wisconsin Department of Natural Resources.
- Forest Crop Program, 2005. Wisconsin Department of Natural Resources.
- Managed Forest Program, 2005. Wisconsin Department of Natural Resources.
- Original vegetation. Wisconsin Department of Natural Resources.
- Digital elevation 30 meter. Wisconsin Department of Natural Resources.
- Hillshade. Douglas Miskowiak, Center for Land Use Education.
- Steep slopes. Douglas Miskowiak, Center for Land Use Education.
- Land cover, 2001. Multi-Resolution Land Characteristics Consortium.
- Impervious surface, 2001. Multi-Resolution Land Characteristics Consortium.
- Tree cover, 2001. Multi-Resolution Land Characteristics Consortium.
- Glacial deposits, 1976. Wisconsin Geological and Natural History Survey.

Inventory Shoreline Indicators and Characteristics

Grindstone Lake shorelines have been systematically inventoried for various indicators of ecological health and aesthetic integrity. Each inventory documents various shoreline characteristics. Both mainland and island shorelines were measured and delineated using Sawyer County's six-inch, black and white orthophotography acquired in 2006. Shoreline delineated from 2006 orthophotography indicates a larger shoreline perimeter (12.34 miles) than WDNR, 1:24,000 hydrography data (11.45 miles)—a seven percent increase. The shoreline database derived from 2006 orthophotography serves as the framework to compile and maintain the Grindstone Lake inventory of shoreline characteristics. Each map uses the 2008 National Agricultural Inventory Program (NAIP) orthophotography as a basemap for overlaying data and creating maps—NAIP orthophotography documents land covers with a leaf-on condition and provides a more appealing backdrop for map-making.

The UW-Stevens Point GIS Center, with help from resource experts from various fields, developed a protocol for conducting physical inventories of shorelines. This protocol was initially developed during the Moose Lake Legacy Initiative inventories conducted in 2007. Volunteers from Grindstone Lake conducted the inventories based on tested protocols using hardcopy maps, indelible marking pens, and log books. Shoreline inventories were entered into the shoreline database by GIS Center technicians using ArcGIS 9.3.1. The inventories provide a rich database in which to conduct lake planning and management. Inventories include:

- Shoreline ownership.
- Shoreline bottom structure.
- Riparian wetlands.
- Emergent aquatic macrophytes.
- Coarse woody habitat.
- Visible structures.
- Riparian trees.
- Veteran tree specimens.
- Shoreline aesthetic condition.
- Wildlife observations

Critical Habitat and Priority Shorelines Assessment

Participants from the Grindstone Lake Association utilized information collected from the watershed analyses and the shoreline inventories to:

1. Identify shorelines that meet the WDNR's definition of Critical Habitat Areas. Critical Habitat Areas, also known as Sensitive Areas and Public Rights Features, are identified if they meet one of the following descriptions defined by the WDNR.

- Biologically diverse submerged aquatic plants (a submerged plant inventory was not conducted on Grindstone Lake).
- Submerged aquatic vegetation important to fish and wildlife (a submerged plant inventory was not conducted on Grindstone Lake).
- Emergent and floating leaf vegetation.
- Rush beds.
- Wild rice.
- Extensive riparian wetlands.
- Woody habitat.
- Spawning substrate.
- Water quality.
- Natural scenic beauty.

Critical habitat criteria and results are described in detail in chapter six.

2. Prioritize shorelines to identify those that are worthy of conservation or management. Collected information was also used to target high-priority shorelines for management and conservation. Using suitability-modeling techniques and ArcGIS additive-overlay analysis, participants were actively engaged in defining criteria that rank shoreline characteristics. The process resulted in identifying high-priority mainland and island shorelines worthy of conservation, and critical shorelines in need of management.

Priority shorelines criteria and results are described in detail in chapter six.

Figure 2.1

Citizen inventories have identified many of the features that make Grindstone Lake a an ecological and aesthetic gem.

At this location a great blue heron rests upon a tree fall near a patch of floating leaf aquatic macrophytes.

Locations like these provide critical habitats for wildlife and natural scenic beauty for the human inhabitants of Grindstone Lake.

Chapter 3. Project Dissemination

This chapter provides a brief description of the venues and methods used to disseminate information and data from the Grindstone Lake Association Lake Planning and Management Grant.

Wisconsin Lakes Annual Conference Exhibit Booth, 2011.

The UW-Stevens Point GIS Center exhibited a booth displaying inventories and assessments from the Grindstone Lake Association Lake Planning and Management Grant. Participants from lake associations across Wisconsin and elsewhere visited the GIS Center booth to learn more about the Grindstone Lake project, methodologies and results.

Northwest Lakes Forum Annual Conference Exhibit Booth. 2011.

The UW-Stevens Point GIS Center exhibited a booth displaying inventories and assessments from the Grindstone Lake Association Lake Planning and Management Grant. Participants from lake associations across Northwest Wisconsin and elsewhere visited the GIS Center booth to learn more about the Grindstone Lake project, methodologies and results. Additionally, the Grindstone Lake GIS server that included project data was demonstrated: http://gissrv2.uwsp.edu/giscenter/GLK1/.

Northwest Lakes Forum Annual Conference Presentation. 2011.

Douglas Miskowiak from the UW-Stevens Point GIS Center and Ben Niemann and Bill Czeskleba from Moose Lake presented work conducted on both Moose and Grindstone Lakes to participants of the Northwest Lakes Forum. Project goals, methods, and results were shared with audience members. Approximately thirty audience members were present for the presentation.

Grindstone Lake Association Annual Meeting, 2011.

Douglas Miskowiak from the UW-Stevens Point GIS Center presented the goals, methods, and results at the Grindstone Lake Association Annual Meeting held on July 2, 2011 and the Town of Bass Lake municipal building. Large format maps were displayed in the municipal building for participants to browse. Maps were left with the association to make accessible for association members. Approximately thirty participants were present for the presentation and the banquet that followed.

Grindstone Lake Association Lake Planning and Management Grant Final Report.

The Grindstone Lake Association Lake Planning and Management Grant Final Report compiles project goals, methods, results, participants, and other resources into a single document. The report is available in hardcopy (per request) and available in a digital format (adobe pdf). The report resides on the Grindstone Lake Association's website via google documents: https://sites.google.com/a/grindstonelake.org/grindstone-lake-association/the-lake. The plan document also resides on the GIS Center website: http://www.uwsp.edu/GIS.

Grindstone Lake Map Book, 2010.

Each map created as a result of the Grindstone Lake Association Lake Planning and Management Grant is compiled into a single map book that geographically shares the projects main findings. The map book is available in hardcopy (per request) and available in a digital format (adobe pdf). The maps from the map book reside on the Grindstone Lake Association's website via google documents: https://sites.google.com/a/grindstonelake.org/grindstone-lake-association/the-lake. The plan document also resides on the GIS Center website: http://www.uwsp.edu/GIS.

Grindstone Lake Management and Planning 2010-Flexviewer Web Tool

The UW-Stevens Point GIS Center developed a web mapping tool using Esri's flexviewer technology. The viewer allows users to view and query GIS data collected at the watershed and lake level, turn on and off data layers, view geographically referenced photographs, review lake and watershed statistics, and export maps into a JPG format. The site is currently hosted by the UW-Stevens Point GIS Center at http://gissrv2.uwsp.edu/giscenter/GLK1/.

Figure 3.1

At the Grindstone Lake Association's Annual Meeting members browse some of the maps created as a result of the planning project.

Afterward, they enjoy a meal with friends and family.

Chapter 4. Grindstone Lake Watershed Analysis

Grindstone Lake's ecological resources and aesthetic character are connected to, shared by, affect, and are affected by a larger landscape. A watershed is a geographic area that is drained by a stream or river and is separated from other watersheds by topographic ridgelines. The area within a watershed's boundary illustrates the connectivity among landscapes, even over great distances.

Grindstone Lake is contained within the small basin of the Grindstone Lake (GL) Watershed. The GL watershed is part of a much larger drainage system. Water from the GL watershed flows from Grindstone Lake into Lake Lac Courte Oreilles and then into the Couderay River before it flows into the Chippewa River system and ultimately out to the Mississippi River. The GL watershed is a small part of the Couderay River watershed, the Upper Chippewa River basin, and the much larger Mississippi River basin.

Watershed Delineation

The Grindstone Lake Association preferred to conduct a watershed scale analysis for the waters that flow more immediately to Grindstone Lake—the lake's immediate watershed. Data did not exist in a suitable format to conduct the analysis. Jon Galloy from the UW-Stevens Point GIS Center created the watershed database (See Figure 4.1). Source data included the 30-meter digital elevation model (DEM) created by the United States Geologic Survey and acquired through the WDNR and surface waters from the WDNR 1:24,000 hydrography VI database to serve as the hydrologic network in which waters from the watershed flow through. ArcGIS 9.3.1 and the ArcHydro model was employed to construct the watershed model from source data. A drainage point was selected near the outlet of Grindstone Lake into Little Grindstone Lake.

Figure 4.1

The Grindstone Lake Watershed, depicted in tan, is part of the larger Couderay River Watershed, depicted in light blue. Water originating in the Grindstone Lake Watershed flows into Grindstone Lake before flowing through the drainage point (red asterisk) and then into Lake Lac Courte Oreilles and then the Couderay River system.

The remainder of chapter four describes individual analyses conducted for the GL watershed and how the patterns that emerge from the analyses potentially affect Grindstone Lake. Eight individual analyses were conducted. They include:

1. Water resources
2. Environmental corridors
3. Pre-settlement vegetation
4. Land cover
5. Publicly managed lands
6. Impervious surfaces
7. Tree canopy density
8. Glacial geology

4.1 Water Resources

The water resources analysis, illustrated in Map 4.1, displays various hydrologic features within the GL watershed. Features include surface waters, the watershed boundary, outstanding and exceptional water resources, and active/inactive dam locations.

Analysis Summary

Geographic analyses have revealed the following information about water resources within the watershed.

- ***Watershed size:*** The watershed is comparatively small at only 11,699 acres in size. In comparison, a Public Land Survey township is approximately 23,040 acres.
- ***Multi-jurisdictional:*** Only Sawyer County has county-level jurisdiction within the GL watershed, however, both the towns of Bass Lake and Hayward also have jurisdiction within the watershed. Water and land use policies approved in Sawyer County and these towns hold potential to affect the water resources of Grindstone Lake.
- ***Surface water:*** According to the WDNR 1:24,000 hydrology open-water database, there are 3,261 acres of surface waters within the watershed. Grindstone Lake is 3,193 acres, in comparison. It is important to note that the database does not include acreages of smaller river and stream segments. Small rivers and stream segments are delineated as lines (length only) in the WDNR database.
- ***Shorelines:*** Bank and stream attributes of the WDNR 1:24,000 hydrology database reveal 24 miles of shorelines within the watershed.
- ***Outstanding Water Resources:*** Grindstone Lake and the Grindstone Creek are designated by the Department of Natural Resources as Outstanding Water Resources. Grindstone Lake then flows into Lake Lac Courte Oreilles, also designated with outstanding status. In all of Wisconsin, only 357 water-bodies retain this status.
- ***Dams:*** According to the WDNR database, zero dams exist in the watershed.

Significance to Grindstone Lake

The destiny of water resources in the watershed and the water quality of Grindstone Lake are largely local. Water and land use decisions made by Sawyer County and the towns of Bass Lake and Hayward affect Grindstone Lake and those downstream from Grindstone Lake. Those that own or use property within the watershed are ultimately in control of the quality of water and land resources within the watershed. Water quantity in the watershed is affected by climate and weather patterns and by outflows and usage of groundwater and surface water. Water quantity or flow of water in this watershed is not designated by flows through man-made dams.

Data Sources

Grindstone Lake Watershed. Developed by Jon Galloy, UW-Stevens Point GIS Center. Source data from the United States Geologic Survey 10-meter digital elevation models. ArcGIS 9.3.1 and ArcHydro version X tools were used to conduct the analysis. The flow point was delineated by Jon Galloy at the outlet of Grindstone Lake into Little Grindstone Lake.

Surface Waters. This data layer is a polygon shapefile delineating lakes, ponds, and flowages. Data is from the Wisconsin Department of Natural Resources 1:24,000 hydrology database version VI, 2007. This data includes information about hydrology features represented on the US Geological Survey's 1:24,000-scale topographic map series.

Shorelines. Shoreline statistics are derived by measuring the line segments from the WDNR 1:24,000 hydrology database. Only line segments attributed as single-line streams, banks, or shorelines were measured.

Outstanding Water Resources. This data is from a line shapefile delineating Outstanding and Exceptional Resource Waters (NR102) a Natural Resource Designation codified in law. Data is from the Wisconsin Department of Natural Resource Water Division based on various sources. Development of this data mainly occurred in 1994-1995 with edits in 1996 and 1999 after a final review. Additions reflecting 2007 OERW status appended to data by Douglas Miskowiak, Center for Land Use Education, with data from the Wisconsin Department of Natural Resources Water Division.

Dams. This data layer is from a point shapefile identifying the locations for large and small dams, including abandoned or removed dams. Data is from the Wisconsin Department of Natural Resources, Bureau of Watershed Management. The original geographic reference for dams was Public Land Survey System (PLSS) township, range, section, and quarter-quarter section. The GIS data layer was originally created from a download of this locational data from the Dam Safety Program's database in 2002. Each point was then visited individually and moved to a more accurate location using the 1:24,000 Hydrography layer. Some dam points were not moved from the original PLSS location if there was no matching water feature on the 24,000 hydro layer.

4.2 Environmental Corridors

Environmental corridors are linear areas that connect sensitive landscape features, including surface waters, wetlands, and steep topography (greater than 12.5 percent). This linear pattern contains upwards of 90 percent of the natural and cultural features that people value (Lewis, 1996). If protected, environmental corridors preserve the ecological quality and the natural aesthetic character of the landscape (see Map 4.2).

Analysis Summary

Surface water: The National Land Cover database from 2001 reveals 3,261 acres of surface waters. Conversely, the WDNR hydrology database reveals 3,344 acres of surface water in the watershed. Map 4.2 displays surface waters from the National Land Cover database.

Wetlands: The National Land Cover database from 2001 documents 627 acres of herbaceous wetlands and 167 acres of woody wetlands. In total, there are 794 acres of wetlands in the watershed.

Steep topography: Based on the Wisconsin Department of Natural Resources 30-meter digital-elevation model, 267 acres of land are equal to or steeper than 12.5 percent slope.

Significance to Grindstone Lake

In the smaller geographic context of the GL watershed, the Environmental Corridor concept establishes a linear passageway beneficial for ecosystem energy flows and wildlife. At a larger geographic context at the Couderay River watershed level, the Environmental Corridor concept holds potential to connect the Chippewa Flowage, designated by the WDNR as a Legacy Landscape, with the Namekagon River, a branch of the St. Croix National Scenic Riverway near Hayward, Wisconsin.

The features of environmental corridors (i.e. surface water, wetlands, steep topography) are also the most sensitive or vulnerable. Surface waters are influenced by and provide a conduit to carry contaminants such as phosphorus, other dissolved solids, thermal loads, and heavy metals. Wetlands are significant ecological features as they capture and filter contaminants and slow down the flow of water. Wetlands greatly reduce the potential for flooding from rain events. Because areas of steep topography are prone to erosion, efforts to effectively manage these areas in particular hold the greatest potential to sustain high water quality, promote ecological diversity, and enhance natural aesthetic character.

Data Sources

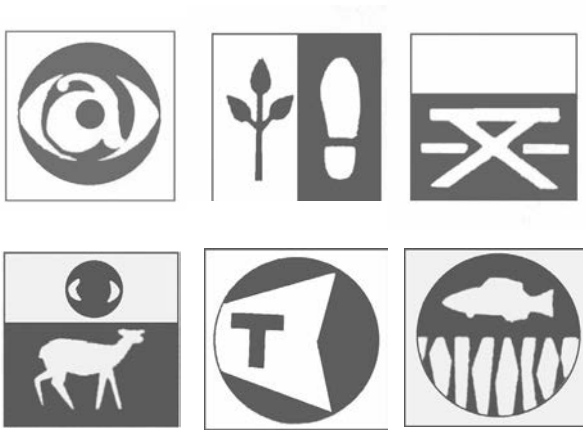
Surface Waters and Wetlands. Surface waters and wetlands from an ESRI GRID delineating land cover types using 30-meter square cells. Data is from the National Land Cover Database 2001 and produced through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) Consortium.

Steep Topography. Data was derived using the 30-meter digital elevation model from the WDNR and the ArcGIS 9.2 spatial analyst, surface analysis, slope tool. The result was an ESRI GRID data layer. The slope GRID was reclassified to only delineate slopes greater or equal to 12.5 percent. The reclassified GRID was converted to a polygon shapefile. Douglas Miskowiak, Land Use/GIS Specialist from the University of Wisconsin – Stevens Point, conducted the analysis, August, 2007.

Figures 4.2.1 - 4.2.6

At right are six of the 220 "icons" that Phil Lewis used to identify the individual environmental features that people stated they valued. Upwards of 90 percent of these features are found within or near surface waters, wetlands, or steep-slopes–environmental corridors.

Starting at the top left and ending at the bottom left, icons include: aesthetic viewing opportunities, nature trails, picnicing, fishing, trout fishing, and wildlife observations.



4.3 Pre-settlement Vegetation

In the mid-1800's when Wisconsin was first surveyed, surveyors documented not only the Public Land Survey System, but also captured notes about the vegetative cover. This work has established a baseline of pre-settlement vegetative conditions throughout Wisconsin (Kassulki, 2009) (See Map 4.3).

Analysis Summary

- White pine and red pine dominated the watershed and covered 7,135 acres or almost 61 percent of the watershed.
- Sugar maple, yellow birch, white pine, red pine covered 699 acres or almost six percent of the watershed.
- Jack pine, scrub, barrens, and oak forest consumed 463 acres or four percent of the watershed.
- Aspen, white birch, and pine covered 323 acres or almost three percent of the watershed.

Significance to Grindstone Lake

In comparison to the Riparian Tree inventory conducted for the Grindstone Lake riparian area, data show that Grindstone Lake is transitioning towards a climax or pre-settlement condition. Currently, Grindstone Lake is dominated by white and red pine. The 2010 inventory also shows areas of aspen, approximately where they might be expected according the pre-settlement surveys.

Tamarack wetlands are also present on Grindstone Lake, but these areas do not appear on the pre-settlement vegetation map. The coarseness of the original survey, conducted at the section corners, does not indicate the presence of tamaracks or white cedar. However, based upon the conditions at these sites, it is believed that tamarack and white cedar were also present at these locations prior to European settlement.

Data Sources

Pre-Settlement Vegetation. This data layer is a polygon shapefile derived from a 1:500,000-scale map showing the original, pre-settlement vegetation cover in Wisconsin. The original vegetation cover data was digitized from a 1976 map created from land survey notes written in the mid-1800s when Wisconsin was first surveyed. Line work representing lakes and other hydrographic areas in other data sets were subsequently merged with the original vegetation cover data set to more closely match the source map. Data originated by the University of Wisconsin – Madison, published by the Wisconsin Department of Natural Resource, 1990.

Figure 4.3.1

The original plat map for a portion of T40N R8W in Wisconsin, including Grindstone Lake. Original survey notes included a record of woody vegetation at each public land survey section corner. The pre-settlement vegetation map for Wisconsin is based upon these surveyor notes. The notes and maps show below were created by Edgar Sears, Theodore Conkey, and Jim Daugherty. The original survey here was completed in September 1855. Image courtesy of the Board of Commissioners of Public Lands. Acquired from http://digicoll.library.wisc.edu/SurveyNotes/SurveyNotesHome.html.

4.4 Land Cover

A land cover inventory documents the physical materials at the surface of the earth, such as grass, snow, deciduous trees, or water. Conversely, a land use inventory records how the land is utilized by humans. For example, while a land cover inventory might document 'deciduous trees,' a land use inventory documents uses, such as 'forestry,' 'recreational,' or even 'residential.'

This land cover inventory uses data from the National Land Cover Database from 2001 using remote-sensing methodologies. Although this inventory was conducted with 30-meter resolution, it is still a coarse method to discern land cover since developed uses might be hidden under forest canopies and are likely underrepresented (See Map 4.4). Orthophotography and field surveys do a better job of indicating land cover, but are more costly to conduct. Using data from the National Land Cover Database, although coarse, provides the means to compare places across the United States using a consistent source of data.

1998 Land Cover Analysis. Notably, the Grindstone Lake planning process conducted in 2006 identifies land covers based upon orthophotography captured in 1998. A comparison between this data set and the 2001 national land cover data set can reveal differences in data capture methods.

2010 Orthophotography. Wisconsin, including Sawyer County, captured new color orthophotography in 2010 at 1-foot resolution. This data source provides the means to update the land cover inventory conducted in 1998 to 2010 to determine changes in land cover.

Sawyer County Parcels. The GL Watershed largely has parcels completed by the Sawyer County Land Records Department. With tax assessment records attached to the parcel, this data set provides an accurate representation of land use, rather than land cover. Typically as land use changes or as land transactions occur, the parcel data is updated to reflect changes. This is yet another data resource available to the Grindstone Lake Association for conducting land use and land use change analyses.

Analysis Summary

- Cultivated crops = 467 acres
- Deciduous forest = 4,195 acres
- Developed – high intensity = 1 acre
- Developed – medium intensity = 15 acres
- Developed – low intensity = 158 acres
- Developed – open space = 304 acres
- Emergent herbaceous wetlands = 166 acres
- Evergreen forest = 1,673 acres
- Grassland/herbaceous = 64 acres
- Mixed forest = 23 acres
- Pasture/hay = 744 acres
- Shrub/scrub = 3 acres
- Woody wetlands = 626 acres

Significance to Grindstone Lake

This data set provides a snapshot in time of land cover from 2001. It can be used generally to compare land cover change, though is difficult and generally inappropriate to use for land use analysis. Focusing on Grindstone Lake specifically, we see that this data set does not record the known low-intensity development along the shoreline. Notably, this data set incorrectly denotes the cranberry bog as 'Pasture/Hay.' Focusing on the northern most portion of the watershed, large amounts of cultivated crops and pasture/hay are indicated. The golf course and adjacent developments are not indicated.

This data set, although generally useful for comparing rural places nationwide, does a poor job of correctly indicating developed land covers and uses. It is recommended that the new 2010 orthophotography be analyzed and interpreted to conduct a more accurate interpretation of land covers in the GL watershed.

Data Sources

Land Cover. Surface waters and wetlands from an ESRI GRID delineating land cover types using 30-meter square cells. Data is from the National Land Cover Database 2001 and produced through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) Consortium.

Figure 4.4.1

This tamarack bog, an ecologically valuable landscape, is displayed as woody wetlands on the land cover map from 2001. This landscape has likely existed in a similar condition since the pre-settlement surveys of the middle 1800's.

4.5 Publicly Managed Lands

The analysis of publicly managed lands illustrates and quantifies the ownership patterns of land within the watershed (See Map 4.5). This information provides context for potential land management and land use change. Land management and use strategies are often well defined for publicly owned lands. A specific and consistent management strategy for private lands, however, requires a more systematic examination of existing land use regulations.

Ownership statistics are derived from the Sawyer County tax parcel database from 2005 and 2008. Ownership attributes are incomplete—471 acres within the watershed are from parcels with insufficient ownership information.

Lac Courte Oreilles: The largest single land owner within the watershed is the Lac Courte Oreilles band of Ojibwe. Their mission statement relates specifically to the management of land resources and their cultural heritage. It states:

> *"We, the Anishinabeg, the people of Odahwah Zaaga'iganing, the Lac Courte Oreilles Tribe, will sustain our heritage, preserving our past, strengthening our present, and embracing our future."*
>
> *"We will defend our inherent sovereign rights and safefuard Mother Earth. We will provide for the educational, health, social welfare, and economic stability of the present and future generations."* (LCO, 2009).

Wisconsin Department of Natural Resources: The State of Wisconsin and the WDNR own and manage over 400 acres of land within the watershed. Lands include two islands on Grindstone Lake, public access to Grindstone Lake, and the Grindstone Creek Fishery Area. More information about these properties can be found on the WDNR website at http://www.dnr.state.wi.us/org/land/facilities/dnr_lands_mapping.html.

Sawyer County: Sawyer County and the Sawyer County Forestry Department own and maintain 77 acres within the watershed. County owned forested lands have a multi-use strategy of forestry management, natural resources conservation, recreation, and wildlife management. Sawyer County's 15 Year Forest Comprehensive Land Use Plan provides more detail about how forestry lands are managed.

Analysis Summary

- Private land = 3,948 acres
- Lac Courte Oreilles Band = 2,947 acres
- Federal Trust for Lac Courte Oreilles = 1,392 acre
- WDNR Managed Lands = 412 acres
- Town Government = 65 acres
- Sawyer County = 57 acres
- Sawyer County Forest = 20 acres
- St. Croix Band = 20 acres
- State of Wisconsin = 7 acres
- Utilities = 2 acres
- Ownership Data Unavailable = 471 acres

4.6 Impervious Surfaces

Impervious surfaces are surfaces that are impenetrable or impede the flow of water from percolating into the earth to recharge groundwater. Rooftops, roads, parking lots and other surfaces covered by concrete, asphalt, and other hard surfaces are typical impervious surfaces. Compacted soils and even manicured lawns impede the filtration of water into the soil, especially on steep topography.

Impervious surfaces become especially problematic during large rain events that generate rapid water runoff. Impervious surfaces speed the flow of water that leads to flooding, thermal loading of cold water streams, non-point pollution, soil erosion, and groundwater diminution, among other problems.

Analysis Summary

The GL watershed, consisting mainly of forest cover, is highly permeable to water. Data from the National Land Cover Database reveal that 93 percent of the watershed is pervious to water and only 7 percent of the landscape is impervious or only partially pervious to water (See Map 4.6). It should be noted that this data, based on remote sensing, likely underestimates the amounts of impervious surfaces in the watershed. Tree canopies hide impervious surfaces from satellite sensors.

To get a more accurate estimate of impervious surfaces for the watershed, an impervious surface analysis should be based on orthophotography with leaf-off conditions and field inspections. Leaf-off orthophotography enables photo-interpreters to better see the surfaces below the tree canopy. Orthophotography acquired in 2010 is available at 1-foot resolution, color, and in a leaf-off condition. This is an appropriate database in which to conduct further research.

Significance to Grindstone Lake

It is not surprising that Grindstone Lake possesses high quality surface waters. Rainfall that is allowed to seep through forest soils is filtered from many contaminants. Water then travels underground where it either becomes groundwater or is shared with surface waters.

This analysis, however, underestimates the significance of the riparian area to water bodies. Impervious surfaces hidden under the tree canopy (i.e. driveways, lawns, rooftops) are not accounted for. The proximity of these impervious surfaces to water bodies in riparian areas can more quickly contribute to the problems associated with water runoff. This analysis also doesn't recognize the golf course or its associated developments and their contribution to impervious surfaces. To accurately determine impervious surfaces for the GL watershed and their potential for degrading the water resource, a more detailed analysis is required using orthophotography.

Data Sources

Impervious surfaces. This data layer is from an ESRI GRID delineating percent surface imperviousness (1-100%) using 30 meter square cells. The National Land Cover Database 2001 was produced through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) Consortium.

4.7 Tree Canopy Density

Tree-canopy density measures the fullness of the forest tree canopy. The data do not measure the fullness of individual crowns; rather, they are measurements of the forest canopy at 30-meter resolution. The data provide an estimate and are useful for such things as, but are not limited to:

- Characterization of forest conditions.
- Estimating the fuel load for wildfire.
- Estimating timber harvest.
- Locating suitable habitats for wildlife.

Analysis Summary

Data reveal that the GL watershed is predominantly inhabited by a dense forest canopy and less dense forest canopy (See Map 4.7). Approximately 4,169 acres of the watershed or over 35 percent has a canopy thicker than 88 percent. Locations of surface waters, especially lakes, are evident from these data as are farm fields and pastures. Locations of smaller streams and roads are covered by forest canopy and are difficult to detect on this map.

Significance to Grindstone Lake

Grindstone Lake, like its watershed, is also largely inhabited by a forest canopy. This has various implications for wildlife that use forests, timber harvests, and for wildfire control along the interface between urban and wild areas.

Data Sources

Tree Canopy Density. This data layer is from an ESRI GRID delineating percent tree cover (1-100%) using 30 meter square cells. The National Land Cover Database 2001 was produced through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) Consortium.

4.8 Glacial Geology

Glaciers have sculpted much of Wisconsin, affecting not only the topography, but soils and water resources. The glacial geology analysis describes the glacial features present within the GL watershed that affect many other vegetative and topographic patterns (See Map 4.8).

Analysis Summary

The following glacial features are present within the watershed. Definitions are from Ritter (2009).

Pitted Outwash Plain. An area characterized by many depressions, including shallow pits, kettles, kettle lakes, and potholes.

End Moraine. A ridge of till found where the glacier stopped its progression.

Significance to Grindstone Lake

Deposits near Grindstone Lake include pitted outwash plain and end moraine. Landscape features today exist largely from the effects of the glaciers on the landscape thousands of years ago. Further analysis comparing glacial geology patterns to Grindstone Lake soils and hydrology is necessary for further assessment.

Data Sources

Glacial Geology. This data layer is scanned from a hardcopy version of the Glacial Deposits of Wisconsin: Sand and Gravel Deposits Potential created by the Land Resources Analysis Program, Wisconsin Geological and Natural History Survey, University of Wisconsin-Extension, and State Planning Office, Department of Administration. 1976. Jon Galloy of the UW-Stevens Point, GIS Center digitized the database into a new feature class using ArcGIS 9.3.1.

Chapter 5. Grindstone Lake Shoreline Inventory

What characteristics exist on the shores of Grindstone Lake that make it ecologically significant and aesthetically beautiful? Citizen contributors on Grindstone Lake have systematically documented the various ecological and aesthetic indicators that make Grindstone Lake a special place to live and recreate.

This chapter describes the methods and results of ten shoreline inventories conducted by citizen contributors. These inventories establish a baseline of information important to distinguish healthy fish and wildlife habitats and places of exceptional natural scenic beauty. Future planning and management efforts on the lake can utilize these inventories to measure how these indices of ecological health and aesthetic beauty have changed over time.

Citizen contributors have inventoried the following items detailed in this chapter:

1. Shoreline ownership
2. Shoreline bottom structure
3. Riparian wetlands
4. Emergent aquatic macrophytes
5. Coarse woody habitat
6. Visible structures
7. Riparian trees
8. Veteran tree specimens
9. Aesthetic shoreline condition
10. Wildlife observations

Grindstone Lake Shoreline Measurements

Shoreline data for Grindstone Lake's mainland and island shorelines were digitized from rectified 2006, six-inch, black and white, leaf-off condition, orthophotography from the Sawyer County Land Records Department. Shorelines were interpreted and digitized by Jon Galloy, GIS technician from the UW-Stevens Point GIS Center. Shorelines were created as a line feature in the ArcGIS feature class format. The following topology rules were established to determine the topological and spatial integrity of the data set:

- Must not have dangles.
- Must not self-intersect.
- Must be single-part.
- Must not self-overlap.

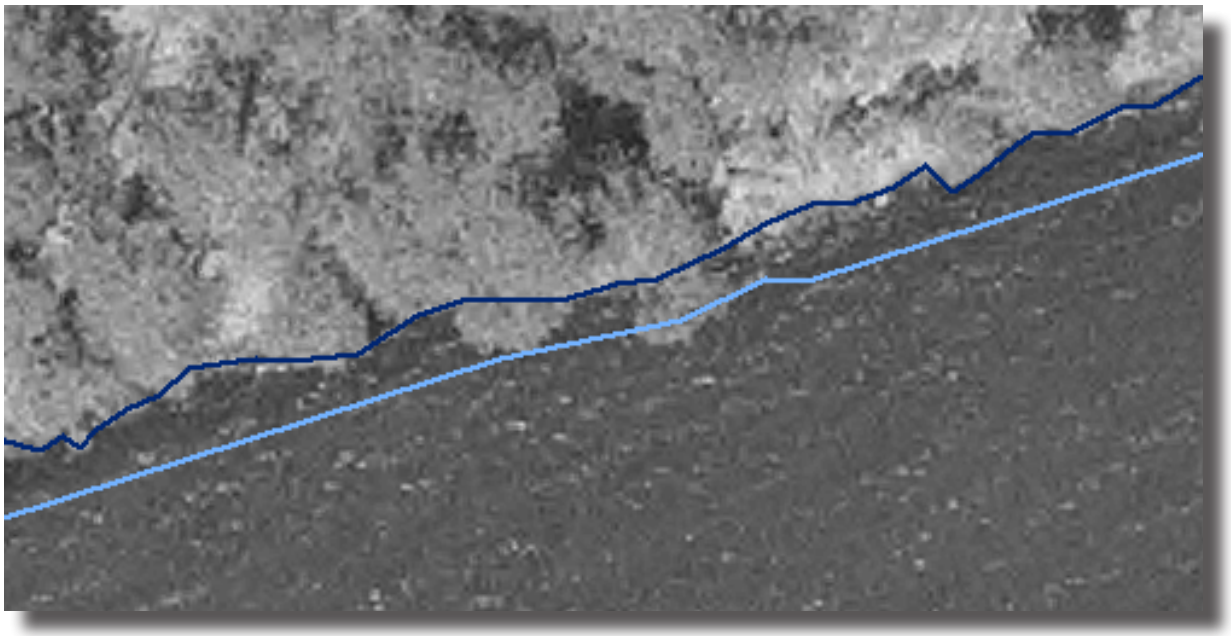
This digital interpretation of the Grindstone Lake shoreline identifies 12.46 miles of total shoreline with 0.726 miles of island shoreline frontage. In comparison, the WDNR hydrology data set created from various 1:24,000 source data recognizes only 11.44 miles. The Sawyer County parcel data set recognizes 11.46 miles of shoreline. These differences exist based upon data schema (data creation strategy) and the accuracy and resolution of source data. With six-inch orthophotography, shoreline undulations or the spatial variations in the shoreline can more accurately be mapped, adding to the perimeter of shoreline identified (See Figure 5.1).

Figure 5.0.1. Spatial variation of shoreline interpreted from different source data.

This figure displays 6-inch black and white orthophotography for Grindstone Lake from Sawyer County. The light blue line is the interpretation of the shoreline using 1:24,000 source data from the WDNR. The dark blue line is the interpretation of the shoreline using the underlying 6-inch orthophotography.

With more accurate source data shoreline can be interpreted more accurately and show the geographic variations or undulations that account for higher measurements of shoreline.

All shoreline inventories were encoded to the shoreline database created from the six-inch orthophotography source data from Sawyer County.



Figures 5.0.2 and 5.0.3.

A team of citizens worked together to document shoreline characteristics. For each stretch of shoreline one or more citizens would document the characteristic and record it in a log book with an identification number. A second team of citizens would record the same stretch of shoreline on a hardcopy map and tag it with the corresponding identification number.

5.1 Shoreline Ownership

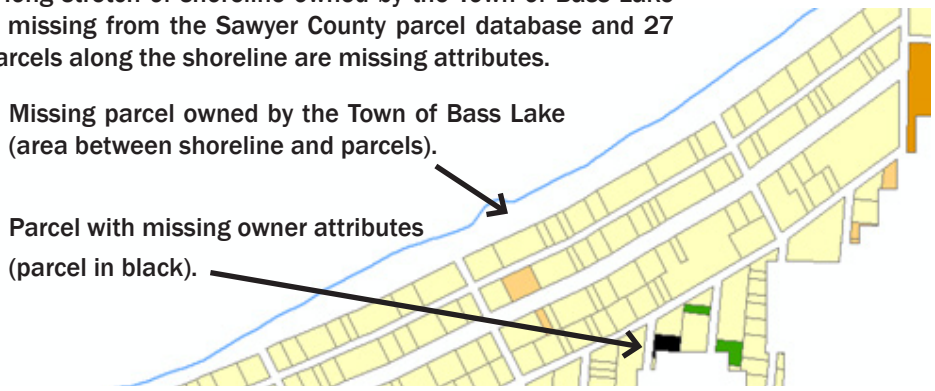
A common and shared strategy to manage land and resources effectively is not possible unless ownership of the land and resources is well documented. On Grindstone Lake, the Sawyer County Land Records Department has a modernized parcel database that documents land ownership, although there are some notable inaccuracies and missing data. For this analysis, researchers at the UW-Stevens Point conducted additional research to repair data inconsistencies.

Inventory Methods

Shoreline ownership data started with source data from the 2005 and 2008 parcel data sets developed and maintained by the Sawyer County Land Records Department. Parcel data from 2005 covers the western portions of Grindstone Lake while data from 2008 covers the remaining eastern portions of the lake. There are several inaccuracies in the data set that require noting.

- ***Town of Bass Lake, PLSS Sections 19 and 30.*** The Sawyer County Parcel Database does not acknowledge parcels owned by the Town of Bass Lake along the Grindstone Lake shoreline within sections 19 and 30. Inland private landholdings are identified incorrectly as existing along the shoreline (See Figure 5.1.1). Citizens from the Grindstone Lake Association confirmed that this stretch of shoreline is missing a significant parcel of publicly owned land (Grindstone Lake Association, 2011).

Figure 5.1.1.
A long stretch of shoreline owned by the Town of Bass Lake is missing from the Sawyer County parcel database and 27 parcels along the shoreline are missing attributes.



- Twenty-seven parcels along the shoreline do not have attributes that indicate ownership information or other information about the parcel. Parcels without ownership information include (identified by Sawyer County PARCEL_ID):

1. 002940255215
2. 002940255208
3. 002245000000
4. 002227000000
5. 002940235404
6. 002940235406
7. 002940235103
8. 002940245208
9. 002940245201
10. 002940245207
11. 002940144405
12. 002151001600
13. 002940135103
14. Remaining parcels did not have a PARCEL_ID

To determine shoreline ownership, Jon Galloy from the UW-Stevens Point GIS Center individually researched parcels with missing ownership information.

To consistently measure and compare ownership patterns along Grindstone Lake with other shoreline inventories, ownership discerned from parcel data was transposed to the shoreline database developed by the UW-Stevens Point GIS Center from Sawyer County's six-inch orthophotography.

Results

Grindstone Lake has 12.46 miles of shoreline and two islands. Mainland shorelines total 11.73 miles and island shorelines total 0.73 miles (see Map 5.1 and Table 5.1.1).

Table 5.1.1. Mainland and Island Ownership

Shoreline Ownership	Miles of Mainland Shoreline	Miles of Island Shoreline	Miles of Total Shoreline
Private	10.50	0	10.50
Lac Courte Oreilles Band	0.26	0	0.26
State of Wisconsin	0.06	0.73	0.79
Town of Bass Lake	0.91	0	0.91
Total	11.73	0.73	12.46

5.2 Shoreline Bottom Structure

Geology naturally determines what materials exist on lake bottoms and shorelines. Sands and gravels are typically found in areas that are exposed to wave action. Mucks are usually in shallow, sheltered bays. Receding glaciers left the cobbles and boulders still seen on the bottoms of lakes (WDNR, 2004a).

The bottom materials, also called bottom structure or bottom substrate are useful habitat for fish and other aquatic life. Walleyes, an important game fish, for example spawn on wind-swept gravel shorelines. Wind and corresponding wave-action help to keep gravels clean of sandy and mucky deposits and help to oxygenate eggs (Smith, 2010). Small mouth bass prefer patrolling substrates that consist of cobble and small boulders in search for crayfish and other forage. Gravels, cobbles, and small boulders are bottom substrates that the WDNR considers in its critical habitat assessment. Mucky bottoms support the insects and invertebrates that ultimately provide food for fish and other wildlife. Sand is the least ecologically productive bottom substrate (WDNR, 2004a).

Inventory Methods

The inventory of shoreline bottom structure (SBS) documents the lake bottom substrate materials present in the littoral zone of Grindstone Lake. The clear waters of Grindstone Lake allowed bottom structure inventories to occur using simple visual observations from aboard a boat.

Volunteer contributors from Grindstone Lake were trained by Alex Smith, Critical Habitat Coordinator for the WDNR northern region. Mr. Smith educated contributors on the benefits of various substrates to wildlife and also provided a guide for determining the differences among gravels, cobbles, and boulders by size. No physical measurements of bottom substrate were conducted—substrate structure and size was estimated from boat.

- Fine gravels – marble sized, smaller than a golf ball
- Coarse gravels – golf ball sized, smaller than a tennis ball
- Rubble/Cobble – larger than a tennis ball, smaller than a basketball
- Small boulders – larger than a basketball, smaller than a beach ball
- Large boulders – larger than a beach ball

Contributors used large-format, hardcopy maps and indelible marking pens to document locations of SBS. A line, representing the shoreline, was drawn on the maps. Perpendicular lines denote the beginning and ending points of a line segment. Between the perpendicular lines, an attribute was entered recording the substrate characteristic. A unique PIN number was given to each individual segment of shoreline. The PIN on the map corresponds to the PIN in the SBS inventory logbook. In instances where various substrates exist in the same geographic area, only the most dominant substrate was documented based upon visual appearance. In some instances, bottom structure changes in proximity to the shoreline—bottom structure attributes indicate those in closest proximity to the shoreline.

Results

Table 5.2.1 showcases the miles of shoreline by category of bottom structure. Map 5.2 illustrates the spatial characteristics of bottom structure on Grindstone Lake. Bottom structure near the smaller island was not inventoried.

Table 5.2.1. Shoreline Bottom Structure

Bottom Structure Type	Miles of Total Shoreline
Detritus/Muck	10.50
Silt	0.07
Sand	6.32
Fine Gravel	0.33
Coarse Gravel	1.35
Rubble/Cobble	3.60
Small Boulder	0.09
Area not inventoried	0.24
Total	12.46

Significance

The windswept shores of Grindstone Lake provide ample habitat for walleye reproduction in the gravels and cobbles, insects and invertebrates that provide food for fish in the muck substrate, and small mouth bass to browse for food in the small boulders and cobble. So long as gravels and small boulders remain free of sediments due to erosion and runoff, and landowners don't physically alter their near shoreline areas (e.g. replacing gravels, rubble/cobble with sand), Grindstone Lake has bottom substrates that provide ample habitat with the potential to support healthy fish populations.

Figure 5.2.1.

This photograph displays shoreline bottom consisting predominantly of rubble/cobble mixed with some gravels. This substrate is suitable for small-mouth bass in browsing for food and walleye spawning.

Shoreline erosion, however, can fill these substrates with sediments and eliminate their benefits to the fishery.

5.3 Riparian Wetlands

Wisconsin State Statute (23.32) define a wetland as "an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic (water-loving) vegetation, and which has soils indicative of wet conditions." Wetlands provide incredibly productive ecosystems, but in addition provide many other ecosystem services (WDNR, 2011). Benefits include, but are not limited to:

- Nearly 40 percent of Wisconsin's bird species use wetlands for food, nesting and cover.
- Nearly one third of Wisconsin's endangered and threatened species rely on wetlands.
- Wetlands reduce flood potential by as much as 60 percent.
- An acre of wetlands can store up to 1.5 million gallons of floodwater.
- Wetlands filter pollutants from surface waters.
- Some wetlands recharge groundwater supplies with filtered water.
- Wetlands act as buffers to the shoreline and protect against erosion from wave action.
- The roots of wetland plants help to keep soils in place and out of the water where they can fill gravels with sediments that inhibit walleye reproduction, for example.

Inventory Methods

The inventory of riparian wetlands documents locations of wetlands that are adjacent to Grindstone Lake. Volunteer citizen contributors were accompanied by Alex Smith, Critical Habitat Coordinator for the Wisconsin northern region to conduct the inventory of riparian wetlands. Previous analyses and local knowledge about the locations of wetlands were used as a means to begin the analysis. Riparian wetlands were verified by Alex Smith from aboard a boat in the near shoreline area—approximately five to ten meters from shore.

Contributors used large-format, hardcopy maps and indelible marking pens to document the locations of riparian wetlands. A line, representing the shoreline, was drawn on the maps. Perpendicular lines denote the beginning and ending point of the line segment identifying a riparian wetland. Each perpendicular line was attributed with the type of wetland found and a PIN number. The PIN relates the shoreline segment with the corresponding attributes recorded in the logbook.

Results

Table 5.3.1 reveals the miles of shoreline where riparian wetlands are present. Map 5.3 indicates the locations where riparian wetlands were identified.

Table 5.3.1. Riparian Wetlands

Riparian Wetland by Type	Miles of Total Shoreline
Cattail Marsh	0.12
Tamarack Bog	0.23
Cranberry Bog	0.27
Scrub/Shrub Wetland	0.50
Total	1.12

Significance

Most notable to the ecological health and aesthetic beauty of Grindstone Lake are the tamarack bog and the scrub/shrub wetlands. These landscapes provide habitats for many species of both flora and fauna and are good habitats where native, endangered, and threatened species are likely found. The tamarack bog is an ecological gem created by the retreat of the glaciers. Coniferous bogs of black spruce and tamarack are often present with sphagnum moss as the dominant ground layer and sedges, orchids, and pitcher plants. This landscape with its special acidic soil conditions and perennial wetness has likely remained as a bog environment since the retreat of the last glaciers.

Figure 5.3.1.

Scrub/shrub wetlands, depicted here, provide valuable ecosystem services that benefit both wildlife and humans.

Wetlands help keep the waters of Grindstone Lake clean of sediments and other pollutants.

Figure 5.3.2.

The tamarack bog on Grindstone Lake, located near the lake's two islands, is a relatively rare landscape type that provides benefits for wildlife and a unique aesthetic experience.

5.4 Emergent Aquatic Macrophytes

Aquatic macrophytes are plants that live completely or partially in the water and are large enough to be seen with the naked eye. Aquatic macrophytes can be submersed (have most of their leaves underwater), emergent (plants that have leaves that extend above the water's surface), or floating (plants can be free floating or floating, but rooted to the bottom) (Borman, 1997).

Aquatic macrophytes provide building materials, food, and protection for fish, birds, amphibians, and reptiles. Aquatic macrophytes provide important fish spawning and nursery areas, as well as cover for many species of fish. Emergent aquatic plants are used by birds, reptiles, amphibians and even small mammals for cover and habitat. Lack of vegetation reduces available habitats and can decrease the biodiversity of the lake ecosystem. Emergent aquatic macrophytes help to lessen the effects of wave action on erosion and help to filter contaminates before they enter the water body.

Inventory Methods

The inventory on Grindstone Lake includes only emergent aquatic macrophytes found within the littoral zone of Grindstone Lake. Only emergent aquatic macrophytes that were visible to the naked eye from boat were inventoried. Volunteer contributors stopped near shorelines to document visible emergent aquatic macrophytes.

Kristi Maki from the Sawyer County Land and Water Conservation Department assisted and trained citizens in inventory methods and plant identification. Ms. Maki explained how to identify various plants and shared some general rules about identification. Lilies for example, are found is mucky, calmer waters. Bulrushes conversely are found more often in gravelly lake substrates. Additionally, Ms. Maki explained the differences between identifying sedges and rushes--"sedges have edges" while "rushes are round," referring to the shape of the plants' stems (Maki, 2010).

Type of emergent aquatic macrophyte was attributed to the shoreline geodatabase. The database records dominant species present, and other less-prominent species. The inventory was conducted by drawing a line parallel to the shoreline. Small lines perpendicular to the shoreline indicated the beginning and ending points of a particular portion of the inventory, each of which was represented by a line segment. Each line segment is attributed with a PIN, which was also recorded in the aquatic macrophyte log book, along with names of macrophytes present at that line segment.

Figure 5.4.1.

Kristi Maki from the Sawyer County Land and Water Conservation Department helps citizens learn how to identify different species of emergent and floating leaf aquatic macrophytes.

Macophytes are leaves that can be seen without assistance from a magnifying device.

Results

The inventory documents aquatic macrophytes for the mainland and the two island shorelines of Grindstone Lake. Citizen volunteers identified over eight types of dominant emergent aquatic macrophytes (See Map 5.4) and a total of 14 species of emergent aquatic macrophytes. Tables 5.4.1 – 5.4.4 document observations.

The following plants were identified by citizen volunteers, but no samples were obtained for laboratory verification.

1.	Cattails (unknown variety)	Typha
2.	Pickerelweed	Pontederia cordata
3.	Purple loosestrife	Lythrum salicaria
4.	Sedge	Carex utricutata
5.	Soft-stem bulrush	Schoenoplectus tabernaemontani
6.	Yellow water lily	Nuphar lutea
7.	White water lily	Nymphaea ordorata
8.	Water willow	Justicia americana
9.	Small narrow-leaf arrowhead	Sagittaria
10.	Smartweed	Polygonum
11.	Water shield	Brasenia schreberi
12.	Duckweed	Lemna minor
13.	Bur-reed	Sparganium erectum
14.	Floating-leaf pondweed	Potamogeton natans

Table 5.4.1. Dominant aquatic macrophytes inventoried on mainland shorelines

Emergent Aquatic Macrophyte	Miles of Total Shoreline	Percent of Total Shoreline
No Macrophyte Present	10.66	90.88
White Water Lily	0.49	4.18
Sedge	0.23	1.97
Soft-stem Bulrush	0.11	0.94
Mixed Species	0.11	0.93
Cattails	0.06	0.50
Yellow Water Lily	0.05	0.40
Pickerelweed	0.02	0.15
Unidentified Emergent	0.01	0.10
Purple Loosestrife	6 plants	N/A
Total	11.73	100

Table 5.4.2. Dominant aquatic macrophytes inventoried on island shorelines

Emergent Aquatic Macrophyte	Miles of Total Shoreline	Percent of Total Shoreline
No Macrophyte Present	0.42	57.22
Water Willow	0.12	16.44
Pickerelweed	0.06	8.41
White Water Lily	0.05	6.49
Sedge	0.05	6.33
Soft-stem Bulrush	0.04	5.48
Total	0.73	100

Table 5.4.3. All aquatic macrophytes inventoried on mainland shorelines

Emergent Aquatic Macrophyte	Miles of Total Shoreline	Percent of Total Observations
No Macrophyte Present	10.66	65.32
White Water Lily	0.90	5.54
Pickerelweed	0.90	5.50
Water Willow	0.75	4.57
Sedge	0.73	4.50
Cattails	0.60	3.66
Yellow Water Lily	0.54	3.37
Soft-stem Bulrush	0.44	2.70
Narrow-leaf Arrowhead	0.25	1.53
Smartweed	0.23	1.38
Mixed Species	0.11	0.67
Water Shield	0.10	0.62
Duckweed	0.09	0.52
Unidentified Emergent	0.01	0.07
Purple Loosestrife	6 plants	N/A
Total	N/A	100

Table 5.4.4. All aquatic macrophytes inventoried on island shorelines

Emergent Aquatic Macrophyte	Miles of Total Shoreline	Percent of Total Observations
No Macrophyte Present	0.42	19.70
Water Willow	0.31	14.53
Pickerelweed	0.31	14.53
Sedge	0.31	14.53
White Water Lily	0.22	10.18
Yellow Water Lily	0.22	10.18
Cattails	0.15	6.84
Floating-leaf Pondweed	0.12	5.52
Bur-reed	0.05	2.23
Soft-stem Bulrush	0.04	1.70
Total	N/A	100

Figure 5.4.2.

This bed of rushes helps to control shoreline erosion by calming wave action and collecting sediments.

Figure 5.4.3.

A great blue heron takes advantage of the floating leaf aquatic macrophytes in search of its next meal.

Floating leaf macrophytes also are beneficial to minimize shoreline erosion from wave action.

Significance

Islands

The location of islands in relationship to their nearest mainland shorelines is a positive harbor for emergent aquatic macrophytes on Grindstone Lake. The largest populations of emergent aquatic macrophytes are located predominantly in this location—Grindstone Lake's southwestern shores, near the islands. This location provides conditions beneficial for harboring emergent aquatic plant growth that the remainder of Grindstone Lake, except the outlet to Lake Lac Courte Oreilles, does not adequately provide.

Purple Loosestrife (Lythrum salicaria)

Six individual specimens of purple loosestrife were inventoried on Grindstone Lake in 2010. Each plant was fully flowered during observation. Purple loosestrife is a perennial herb that grows three to seven feet tall and has a dense bushy growth of one to fifty stems. The plant has showy flowers that range in color from magenta to purple.

By law, purple loosestrife is a nuisance species in Wisconsin. Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. The plant spreads mainly by seed and can produce hundreds of thousands of seeds per year. Seed survival is 60-70 percent. Ultimately, the veracity of purple loosestrife can overrun habitats, shorelines, and wetlands (WDNR, 2004b).

The Grindstone Lake Association should remain vigilant in its search and removal of purple loosestrife. Individual plants should be pulled or cut prior to seeds dropping from plants. Care should be taken not to release seeds during the cutting or pulling process—bagging plants is recommended. Captured plants and seeds should be disposed in a capped landfill or dried and then burned. The most effective method to eliminate adult plants is through chemical control (WDNR, 2004b).

Cattails

The broad and narrow-leaf cattails and their resultant hybrids are often confused with each other and both varieties have tremendous capacity to grow, spread, and become invasive. The broad and narrow-leaf cattails are known to cross-pollinate and hybridize into an equally fertile and invasive Typha x glauca (Spickerman, 2008). Though both species are native to Wisconsin, neither are native to the Grindstone Lake area 100 years ago (Spickerman, 2008). Both species are invasive and can take over shallow areas and other established plants in shallow areas. The broad-leaf cattail grows in moist soil in up to a meter of water. The narrow-leaf cattail grows in disturbed sites with brackish water up to 0.5 meters (Borman, 1997).

Although a suitable habitat for birds and mammals, cattail patches are too dense to be of much use to fish for spawning or protection. Cattails, if crowding out other aquatic macrophytes in shallow areas, could be further detrimental to fish that rely on these macrophytes for cover, food, and spawning. Cattails are also useful for reducing the effects of wave action on shoreline erosion.

Figure 5.4.4.

Jon Galloy gets a closer look at an emergent aquatic before citizens document the type of aquatic macrophyte in the inventory.

Here citizens were trying to distinguish between sedges and rushes. Rushes are round while sedges have edges.

Figure 5.4.5.

Kristi Maki searches for submerged aquatic macrophytes by dragging a rake along the bottom of Grindstone Lake.

Submergent aquatic macrophytes were not inventoried in this lake plan.

5.5. Coarse Woody Habitat

The inventory of Coarse Woody Habitat (CWH) documents tree falls, stumps, and logs in the littoral zone of Grindstone Lake. CWH is important to lake riparian and littoral ecosystems; it creates and provides habitat complexity and species diversity. CWH also contributes to carbon and nutrient flows to aquatic ecosystems (Harmon et al. 1986). Christensen et al. (1986) found a positive correlation between CWH and forested riparian areas, and a negative correlation between CWH and shoreline development.

Inventory Methods

The inventory of CWH documents observations of tree falls, stumps, and logs found within the littoral zone of Grindstone Lake. Only CWH visible from aboard a boat in the near shoreline area was inventoried. The clear waters of Grindstone Lake enabled the inventory of CWH that was completely submerged. The inventory conducted on Grindstone Lake uses procedures modified from the University of Wisconsin Limnology Department (http://lter.limnology.wisc.edu/spatial/source/cwd_web.htm).

Volunteer contributors from Grindstone Lake were trained by Douglas Miskowiak, GIS Project Manager from the UW–Stevens Point GIS Center. The inventory of CWH was classified into the following categories:

1. Continuous (CWH found repeatedly and continually in the littoral zone)
2. Scattered (CWH found consistently, but with less frequency)
3. Isolated (solitary or individual locations of CWH)
4. Absent (no CWH was visible above the water's surface)

Contributors used large-format, hardcopy maps and indelible marking pens to document the locations of CWH. A line, representing the shoreline, was drawn on the maps. Perpendicular lines denote the beginning point and ending point of the line segment. Between the perpendicular lines, an attribute was entered, recording a unique PIN number. The PIN on the map corresponds to the PIN in the CWH inventory log book. Contributors denoted the CWH category for each line segment in the log book.

Results

Tables 5.5.1 and 5.5.2 present the miles of shoreline by CWH category gathered from data collected by citizen contributors. Map 5.5 depicts the spatial distribution of CWH on Grindstone Lake.

Table 5.5.1. Mainland Littoral Coarse Woody Habitat

CWH Category	Miles of Total Shoreline	Percent of Total Shoreline
Continuous	0.14	1.19
Scattered	0.25	2.13
Isolated	0.33	2.81
Absent	11.01	93.86
Total	11.73	100

Table 5.5.2. Island Littoral Coarse Woody Habitat

CWH Category	Miles of Total Shoreline	Percent of Total Shoreline
Continuous	0.02	2.74
Scattered	0.01	1.37
Isolated	0.01	1.37
Absent	0.69	94.52
Total	0.73	100

Significance

On land, trees have an important and effective role in the environment. Living for hundreds of years, trees provide shelter for wildlife and in riparian areas supply shade and protection for fish and aquatic organisms. Natural decay and decomposition, usually due to wind, initiates the second life of a tree in the littoral zone. In the water, the tree as coarse woody habitat supplies numerous organisms, including fish, with habitat. As it decays further, it returns precious nutrients back into the lake.

Individual tree falls provide habitat for fish and other aquatic organisms. However, a more intricate littoral zone, with an assortment of numerous fallen trees, is more useful. Numerous species of fish use stumps and fallen logs to protect their young and build their nests near or under. The young of many species disperse throughout branches for protection; northern pike and muskellunge use the same branches to ambush prey, while walleye use CWH for daytime refuge. Small mouth bass build their nests adjacent to or under CWH to reduce the perimeter in need of their protection. (Bozek, 2001).

Trees that grow in riparian areas mature and fall into the water. Seedlings and saplings replace fallen trees, grow and then repeat the cycle. This process is called the recruitment cycle. Factors such as fire and forestry suppress or interrupt the cycle, but do not stop it entirely. Seedlings and saplings continue to grow near riparian areas. The most substantial threat to the recruitment cycle is from shoreline developers that modify the riparian area by removing vegetation and continuing to maintain this unnatural state by continually removing young trees and understory (Bozek, 2001). Without younger tree growth, future growth of CWH is impossible.

CWH is most ample on smaller lakes with undeveloped shorelines. Christensen et al. (1996) found that in lakes with no shoreline development, the shorelines averaged 555 logs/km. Developed lakes with undeveloped shorelines averaged 379 logs/km, while developed shorelines averaged 57 logs/km. Impacts of increasing development along shorelines are causing dramatic long-term consequences to lakes and their littoral zones.

Figure 5.5.1.

This recent tree fall (2010) is now coarse woody habitat that provides shelter for young fish and ambush cover for predator fish.

Left intact, this tree fall will provide habitat and nutrients back to the lake for many years. Wind and ice action on Grindstone Lake, however, limit opportunties for CWH.

5.6. Visible Shoreline Development

This inventory documents observations of development (man-made structures) in the near shoreline area, visible from the littoral zone. Shoreline development is a useful indicator for examining fish spawning habitats, riparian wildlife habitats, and aesthetics.

Inventory Methods

The inventory of shoreline development includes man-made structures visible from the littoral zone of Grindstone Lake. The tree canopy was at full leaf-on condition during the inventory conducted September 29, 2010. Notably, some landowners had already removed their boat docks or piers prior to the inventory. The inventory used on Grindstone Lake was modified from the inventory conducted by the University of Wisconsin Limnology Department as part of the National Science Foundation-sponsored Research Opportunities for Undergraduates program, 1996.

The inventory on Grindstone Lake denotes man-made objects both in the littoral and riparian areas of Grindstone Lake. Student technicians from the GIS Center, Jon Galloy and Mike Brostad, trained in inventory procedures, conducted the inventory. Man-made structures and objects visible from the littoral zone were documented both on hardcopy maps and in the shoreline development log book. Locations of man-made structures and objects were denoted on hardcopy maps with a dot and a personal identification number (PIN). The PIN is also denoted in the shoreline development log book along with notes describing the object.

Results

Six-hundred thirty-one man-made structure or objects that are visible from the littoral zone of Grindstone Lake were documented (See Maps 5.6a - d). These include:

- 91 accessory buildings (garages, sheds, gazebos)
- 6 boat launches/landings
- 224 decks, docks, or piers on the water
- 307 residences (houses, cabins, mobile homes, condominiums)
- 3 miscellaneous items

Significance

Muskellunge

In regard to muskellunge, lakes characterized as self-sustaining exhibit shorelines with fewer alterations. Lakes that required stocking had extensively developed shorelines (Rust et al., 2002). The study also indicated that development along the shoreline is a more important indicator of fishery health than development within a lake's watershed. According to Rust et al., self-sustaining muskellunge lakes had a significant percentage of undeveloped shorelines (80 percent) as compared to lakes that required stocking (59 percent undeveloped shoreline). Studies conducted by Trautman (1981) and Dombeck et al. (1984) also indicate that human development affects muskellunge reproduction and overall numbers success.

Riparian Areas

Riparian areas serve as an interface between terrestrial and aquatic ecosystems and, if healthy, are home to a wealth of wildlife diversity. Riparian areas supply food, cover, and water, serve as migration routes, and offer connectors between habitats for wildlife. Riparian areas also remove excess nutrients and sediments from water runoff before they enter surface waters. Riparian vegetation is important in slowing down, cooling, and removing excess nutrients from surface water runoff. Riparian areas however are also coveted for their aesthetic beauty, bounty for hunting and fishing, and other recreational opportunities, making them vulnerable to severe alteration (Montgomery, 1996).

Development and human modification can have adverse effects on wildlife and aesthetics in riparian areas. Development can lead to edge and isolation effects that disturb the stability of ecosystems. Edge effects decrease the area of core habitats. Some species, such as whitetail deer, thrive along habitat edges, but detrimental effects include (NRCS, 2004a)(URPL & DNR, 2002):

- Loss of native vegetation
- Greater frequency and severity of wildfire
- Greater predation by native and exotic predators
- Higher probability of nest predation
- Greater windfall potential
- Greater intensity of browsing and grazing
- Greater disturbance that favors growth of exotic invasive species.

As habitat continues to become fragmented, the connectivity of the habitat corridor decreases and it becomes more difficult for species to disperse and migrate between habitat patches. Maintaining habitat connections is important for maintaining the long-term survival of fish and other wildlife. Riparian areas provide some of the most valuable habitat connections (NRCS, 2004a).

Aesthetics

Grindstone Lake is endowed with Northwood's character and natural scenic beauty. What exactly are the characteristics that define Northwood's atmosphere and draw people to live and play here? Can these characteristics be measured, and how does landscape change affect these characteristics?

Considerable research asserts that the characteristics that make a place beautiful can be measured. Agreement and predictability of test results have shown that people typically agree about what is considered beautiful. Research also shows that natural-appearing characteristics appeal most and that the public tends to have a common perception of what constitutes natural scenic beauty (Galliano and Loeffler, 2002. Litton and Tetlow, 1978. Lee, 1976. McGuire, 1979. Newby, 1971. Noe, 1988. Zube, 1976).

Gallianno and Loeffler (2002) identify elements of landscape character that can be measured. These elements include: land form, vegetation, aquatic forms, cultural features, and landscape themes that indicate how people perceive landscapes. Landscapes that are perceived as visually whole, meaning that the landscape consistently exhibits the characteristics of a landscape theme, such as Northwood's character, have scenic integrity.

Visible development and modifications to the littoral and riparian areas have potential to dramatically alter the naturally scenic Northwood's character of Grindstone Lake. Such modifications are shown to significantly alter the aesthetic experience and ultimately affect property values. In 2001, scenic beauty and relaxation was the number one reason tourists cited for spending $11.4 billion in Wisconsin (Simon, 2005). In Minnesota, survey results revealed that over 85 percent of waterfront property owners and lake users cited development as the primary factor altering the aesthetic experience of the lake. Other factors included installation of docks and boat lifts and removal of riparian vegetation (Simon, 2005). These man-made intrusions may also affect water quality—another aesthetic contributor. Related to property values, good water quality can add as much as $200 of value per foot of shoreline.

Related to property values, good water quality can add as much as $200 of value per foot of shoreline.

Although Grindstone Lake shorelines largely exist in a developed condition there are actions that landowners can take to protect the ecology and aesthetics of their waterfront investment (Markham, 2005). The UW-Stevens Point Center for Land Use Education recommends the following actions:

1. Choose zero-phosphorus fertilizer
2. Properly dispose of household hazardous wastes.
3. Minimize erosion.
4. Inspect and maintain a septic system regularly.
5. Reduce hard surfaces like rooftops and driveways.
6. Plant trees and shrubs or protect already wooded areas.
7. Direct downspouts onto surfaces that can soak rainwater.
8. Install a rain barrel.
9. Build a rain garden.
10. Protect or restore the riparian shoreline buffer.

More information about implementing these steps can be found at http://clean-water.uwex.edu/pubs/pdf/waterfront.pdf.

Figure 5.6.1.

An example of development visible from the water that has a tremendous negative aesthetic and ecological affect.

Removal of riparian vegetation compromises water quality and the fishery on Grindstone Lake by allowing additional sediments and other pollutants into the system.

Aesthetically, this structure inhibits the publics' right to enjoy the natural scenic beauty of navigable waters as protected by the Wisconsin Constitution and the Wisconsin Public Trust Doctrine.

Figure 5.6.2.

An example of development that does a good job of protecting the riparian vegetation.

Natural riparian vegetation slows sediments and pollutants from reaching the water.

Natural vegetation also protects the publics' right to the natural scenic beauty of Wisconsin's Public Trust Waters.

5.7. Riparian Trees

During pre-settlement times, when surveyors initially laid-out Wisconsin's Public Land Survey System (PLSS), Grindstone Lake consisted mainly of white and red pine and on its southern drier shores; jack pine, scrub, barrens, and oak forest. The inventory of riparian trees documents dominant and subordinate tree species present along the shores of Grindstone Lake in 2010 (See Map 5.7).

Inventory Methods

Riparian trees were inventoried based on procedures described by Spickerman (USFS, 2008). Douglas Miskowiak from the University of Wisconsin-Stevens Point and Kathy Moe from the USFS provided citizen volunteers with training. Citizen contributors conducted the inventory of the riparian area by boat from the near shoreline (5 to 10 meters) area of Grindstone Lake. Predominant and subordinate riparian tree species, discernible from the near shoreline area, were inventoried.

Riparian trees are inventoried by dividing the shoreline into homogenous units, determined by visual examination of riparian tree species of the same type and relative frequency. Indelible marking pens were used to discern homogenous units on large-format, hardcopy maps. Homogenous units were represented with parallel lines drawn to the shoreline. Small perpendicular lines separated homogeneous units. A PIN was assigned to each unit on the map as well as in a log book. The log book included the attributes of each homogeneous unit. For each homogeneous unit the dominant tree present was inventoried as well as other tree species present within the homogenous unit. Map 5.7 documents only the dominant tree specie present within the homogenous unit, but the GIS database documents dominate and subordinate species.

Results

Citizens identified the following tree species in the riparian area along Grindstone Lake. Tables 5.7.1 - 5.7.4 document the riparian trees along island and mainland shorelines.

- Aspen
- Birch (unidentified type)
- Black ash
- Black spruce
- Maple (unidentified type)
- Oak (unidentified type)
- Red oak
- Red pine
- Spruce (unidentified type)
- Tamarack
- White spruce
- White cedar
- White pine

Table 5.7.1. Dominant riparian trees on mainland shorelines

Riparian Tree	Miles of Total Shoreline	Percent of Mainland Shoreline
White Pine	4.45	37.94
Red Pine	3.18	27.11
Oak (type unidentified)	1.90	16.20
Red Oak	0.84	7.16
Tamarack	0.45	3.84
Mixed Dominance	0.36	3.07
White Cedar	0.35	2.98
Paper Birch	0.20	1.71
Total	11.73	100

Table 5.7.2. Dominant riparian trees on island shorelines

Riparian Tree	Miles of Total Shoreline	Percent of Island Shoreline
Red Oak	0.24	32.88
Paper Birch	0.22	30.14
Red Pine	0.15	20.55
Aspen	0.12	16.44
Total	0.73	100

Table 5.7.3. Total riparian tree observations on mainland shorelines

Riparian Tree	Miles of Total Shoreline	Percent of Mainland Shoreline
White Pine	10.01	85.34
Paper Birch	8.60	73.32
Red Pine	8.14	69.39
Oak (type unidentified)	5.88	50.13
Red Oak	3.83	32.65
White Cedar	1.65	14.07
Spruce (type unidentified)	1.48	12.62
Tamarack	1.03	8.78
Aspen	0.81	6.90
Black Spruce	0.20	1.70
White Spruce	0.15	1.28
Black Ash	0.10	0.85
Total	N/A	N/A

Table 5.7.4. Total riparian tree observations on island shorelines

Riparian Tree	Miles of Total Shoreline	Percent of Island Shoreline
Paper Birch	0.56	76.12
Red Oak	0.38	52.05
Red Pine	0.37	50.68
White Pine	0.36	49.32
Oak (type unidentified)	0.24	32.88
White Spruce	0.23	31.51
Aspen	0.23	31.51
Maple	0.15	20.55
White Cedar	0.08	10.96
Total	N/A	N/A

Significance

In comparison to pre-settlement vegetation data, the inventory of riparian trees suggests that trees on Grindstone Lake are proceeding toward an original climax condition. Shorelines currently are predominated by red pine and white pine and have largely shaded out white birch. Red and white pine, based upon the pre-settlement inventory are anticipated to predominate as the climax trees on Grindstone Lake.

A tamarack stand also exists on Grindstone Lake's western shores near the islands. This small stand exists in its climax state and likely has changed very little since pre-settlement times. Although the pre-settlement vegetation map is too coarse to locate the stand, the soil and wetness conditions of the area predispose its climax condition as a tamarack bog.

Figure 5.7.1.

A stretch of shoreline dominated by red pine. Red pine and white pine dominate the shores of Grindstone Lake. They will likely remain as the climax species as data from the pre-settlement vegetation surveys suggest.

5.8 Veteran Tree Specimens

Veteran trees are defined as trees that are of interest biologically, aesthetically, or culturally due to their age, size, or condition relative to the specie (Newton, 2007). Biologically, veteran trees provide 'micro-habitats' for wildlife and even microorganisms. Aesthetically, veteran trees provide unique and valued landscape experiences to those who view them. All else held equal, landscapes with veteran trees provide a more valued aesthetic experience. Culturally, veteran trees link humans to a different era in human time—some trees date back to European colonization and before.

Inventory Methods

An inventory of veteran trees is not based on a single type of tree characteristic and is unique to the specie inventoried. For example, a veteran white birch—a specimen that lives to 80 years, is different from hemlock, which lives on upward to 700 years.

Inventory procedures were initially developed on Moose Lake in Sawyer County and field-tested by Douglas Miskowiak, University of Wisconsin–Stevens Point and Ben Niemann, Professor Emeritus of Landscape Architecture and Urban and Regional Planning. Kathy Moe from the USFS helped field test procedures for Grindstone Lake and helped citizens learn how to identify various types of veteran trees from the littoral zone. The inventory of riparian veteran tree specimens was conducted by citizen contributors in boats along the near shoreline (5 to 10 meters) area of Grindstone Lake. Individual specimens were compared to other trees of the same species along Grindstone Lake. Several specimens were examined and physically measured to gauge examination techniques. Upon close inspection, veteran white pine, for example, were found to be 24 inches or larger at breast height.

Veteran tree specimens were recorded by drawing the location of each specimen on large-format, hardcopy maps using indelible marking pens. The type of specimen was also recorded on the hardcopy maps as well as in a log book, identified by a PIN.

Results

The inventory documents 87 veteran tree specimens of six different species (see Table 5.8.1 and Map 5.8.

Table 5.8.1. Veteran tree observations

Veteran Tree	Number of Specimens
White Pine	47
Red Pine	46
Red Oak	15
White Cedar	4
Oak (type unidentified)	4
Aspen	1
Total	87

5.9 Shoreline Aesthetic Condition

Inventory Methods

Aesthetic shoreline condition was inventoried based on the degree of a shoreline's natural state, unmodified by man-made contributions. Shorelines are classified into four categories:

1. Natural
2. Slightly modified
3. Moderately modified
4. Highly modified

Natural shorelines exist in a natural condition and are visibly without human modification in the riparian area. Slightly modified shorelines show some signs of human modification that might include a partially visible house, presence of a dock, or slight removal of riparian vegetation. Moderately modified shorelines show more prominent signs of human modification: a house is more prominently visible, more riparian vegetation is disturbed. Highly modified shorelines show significant signs of human modification, including intensive removal of riparian trees and vegetation and/or prominently visible development.

Shorelines were inventoried by boat in the near shoreline (5 to 10 meters) area. Aesthetic shoreline condition (natural, slightly modified, moderately modified, highly modified) was attributed to mainland and island shorelines of Grindstone Lake on large-format, hardcopy maps using indelible pens. Individual line segments with a unique attribute were divided using small lines drawn perpendicular to the shoreline. Attributes were affixed directly to hardcopy maps.

Results

The following table describe the results of the Aesthetic Shoreline Condition inventory. Map 5.9 compiles the spatial results of the inventory.

Significance

See section 5.6, Shoreline Development.

Table 5.9.1. Aesthetic Shoreline Condition

Aesthetic Shoreline Condition	Miles of Mainland Shoreline	Miles of Island Shoreline
Natural	2.76	0.73
Slightly Modified	2.84	0
Moderately Modified	2.21	0
Highly Modified	3.93	0

5.10 Wildlife Observations

This section documents wildlife observations made by residents of Grindstone Lake in Sawyer County, Wisconsin. Various fauna were observed during the summer of 2010. These include the following:

- Bear
- Goose
- Fox
- Chipmunk
- Deer
- Raccoon
- Porcupine
- Mink; Muskrat
- Otter
- Turtle
- Bald Eagle
- Hawk
- Duck
- Loon
- Heron
- Fisher
- Woodpecker
- Grouse; Ruffed Grouse
- Red-Winged Blackbird
- Merganser
- Beaver
- Cormorant
- Eastern Phoebe

Inventory Methods

Hardcopy maps were created illustrating Grindstone Lake shorelines and two islands. Each map included instructions about:

- How to denote observation locations.
- How to record further information about the observation.
- How to get information back to the consultant.

Volunteers given hardcopy maps were instructed to record observations throughout the summer. Volunteers could record any type of wildlife observation; they were not expected to differentiate among multiple observations of the same specimen. This strategy allowed investigators to identify spatial patterns, variation, and diversity of species.

Results

Hardcopy maps were distributed for volunteers to record observations. Four maps were returned complete with observations and notes. Two maps indicated the approximate locations of wildlife on Grindstone Lake. Two maps tied wildlife observations to the location of the human observer. In total, 131 individually recorded observations were inventoried (See Map 5.10). The first observation recorded was on May 15, 2010. The final observation was recorded on October 6, 2010.

Figure 5.10.1.

A bald-eagle takes inventory of citizen researchers. Several citizens inventoried wildlife observations during the summer months of 2010.

Chapter 6. Critical Habitat and Priority Shorelines Assessments

The Grindstone Lake Association is working with the WDNR to acquire a critical habitat assessment for Grindstone Lake. Additionally, the association desired to prioritize its shorelines to help inform their own potential conservation efforts on Grindstone Lake. Identifying critical habitats identifies the landscape features that are protected on behalf of the citizens of Wisconsin and the citizens of the United States of America in the Wisconsin Public Trust Doctrine. In Wisconsin, lakes and rivers are public resources, owned in common by all Wisconsin citizens. The Wisconsin Public Trust Doctrine is defined within Wisconsin's state constitution. The Wisconsin Public Trust Doctrine protects the rights of Wisconsin's citizens to navigate, boat, fish, hunt, ice skate, and swim on navigable waters. It also protects the publics' right to enjoy the natural scenic beauty and enjoy the water's quality and quantity.

6.1 Critical Habitat Assessment

Critical Habitat Designation is a WDNR program that includes formal designations of sensitive areas according to Ch. NR 107, public rights features according to Ch. NR 1.06, and resource protection areas (uplands within the shoreland zone). The designation process identifies "Public Rights Features" defined in Ch. NR 1.06. Public Rights Features include:

- Fish and wildlife habitat, including specific sites necessary for breeding, nesting, nursery and feeding;
- Physical features of lakes and streams that ensure protection of water quality;
- Reaches of bank, shore or bed that are predominantly natural in appearance (not man−made or artificial) or that screen man−made or artificial features;
- Navigation thoroughfares or areas traditionally used for navigation during recreational boating, angling, hunting or enjoyment of natural scenic beauty; and
- Sensitive areas are one subset of Public Rights Features which are defined in Ch. NR 107 as: areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or life-stage requirements, or offering water quality or erosion control benefits to the body of water.

Participants reviewed the shoreline indicators inventoried by citizens from Grindstone Lake for consideration as critical habitat and as public rights features, as defined by the WDNR. Douglas Miskowiak, GIS Education Specialist from the University of Wisconsin-Stevens Point, GIS Center facilitated the meeting. The meeting was attended by participants from the Grindstone Lake Association, Sawyer County, WDNR, LCO, and UW-Stevens Point GIS Center (See Table 6.1.1).

Table 6.1.1. List of participants

Larry Berg, Grindstone Lake Association
Steven Buss, President, Grindstone Lake Association
Bruce Paulson, Vice President, Grindstone Lake Association
Alex Smith, Critical Habitat Coordinator, WDNR
Kristi Maki, Aquatic Invasive Species Coordinator, Sawyer County
Dan Tyrolt, Conservation Technician, Lac Courte Oreilles
Douglas Miskowiak, GIS Education Specialist and meeting facilitator, UW-Stevens Point GIS Center
Jon Galloy, GIS Technician, UW-Stevens Point GIS Center

Critical Habitat Criteria

The following criteria were used to identify critical habitats using definitions provided by the WDNR.

Locations of emergent aquatic macrophytes.

All locations of emergent aquatic macrophytes were identified as critical habitats using WDNR criteria. Emergent and floating leaf vegetation help prevent shoreline erosion by stabilizing shoreline sediments and buffer wave action. Floating leaves provide shade and shelter for fish, reptiles, and invertebrates. Seeds of emergent and floating leaf plants are eaten by waterfowl. Muskrats and beaver also eat the rhizomes.

Locations of Coarse Woody Habitat (Continuous or Scattered Condition)

Locations of shorelines where coarse woody habitat exists in a continuous or scattered condition were identified as critical habitat. CWH is critical for all kinds of aquatic and terrestrial life. Water insects such as mayflies graze on the algae that grow on decomposing wood. Fish find food, shelter, or nesting habitat among fallen trees. Above water, ducks and turtles loaf and sun themselves on the trunks. Muskrats use the trees as feeding platforms.

Bottom Structure (Fine Gravel, Coarse Gravel, Rubble/Cobble, and Small Boulders)

Shorelines consisting of fine gravel, coarse gravel, rubble/cobble, or small boulders were identified as critical habitat and public rights features. Walleyes use clean gravels along wind swept shores for spawning. Aquatic insects, crayfish, rock bass, and small mouth bass also hide and forage among the gravels and small boulders.

Riparian Wetlands

Shorelines where riparian wetlands are present (i.e. tamarack bog and scrub/shrub wetland) were identified as critical habitat and public rights features. The cranberry bog and areas of cattails were not included in the designation. The cranberry bog is a man-made feature on Grindstone Lake and cattails are considered invasive to the region. Extensive riparian wetlands are spawning grounds for northern pike, nurseries for fish and ducklings, critical habitat for shorebirds and songbirds and lifelong habitat for some

frogs and turtles. Wetlands also provide essential habitat for smaller aquatic organisms in the food web, including crustaceans, mollusks, insects, and plankton. Wetland vegetation provides food and cover for waterfowl, muskrats, and other wildlife. Wetlands also help keep lakes and rivers clean by filtering sediments and excess nutrients. Wetlands slow down the flow of water and act like natural sponges to reduce flooding, stabilize stream flow and lake levels, and provide recharge for groundwater.

Natural Scenic Beauty

Areas inventoried that existed in a natural scenic condition (i.e. no visible structure present and no discernible removal of riparian vegetation) that existed in significant lengths (i.e. five longest shorelines with a natural scenic appearance) were identified as critical habitats and public rights features using WDNR criteria. Reaches of bank, shore or bed that are predominantly natural in appearance (not man−made or artificial) or that screen man−made or artificial features. Reaches include those with stands of vegetation that include intermixed trees, shrubs and grasses; stands of mature pines or other conifer species; bog fringe; bluffs rising from the water's edge; beds of emergent plants such as wild rice, wild celery, reeds, arrowhead.

Results

The locations of each public rights feature or critical habitat features were identified in the GIS. Shorelines that possessed any one of the five public rights features criteria were given critical habitat status. Locations that did not possess any of the five public rights criteria were not designated. In total, 7.18 miles or 58.2 percent of Grindstone Lake mainland and island shorelines received critical habitat status. Notably, 100 percent of island shorelines achieved critical habitat status (See Map 6.1).

7.18 miles or 58.2 percent of Grindstone Lake mainland and island shorelines received critical habitat status.

6.2 Priority Shorelines Assessment

In addition to the critical habitat assessment defined with criteria from the WDNR the Grindstone Lake Association desires to further prioritize shorelines to inform other conservation and protection efforts.

Priority Shorelines Criteria

The following criteria were used to construct priority shorelines. Additive overlay methods were used to identify shorelines that met zero to several of the following criteria.

Locations of emergent aquatic macrophytes.

All locations of emergent aquatic macrophytes were identified to contribute to the priority shores assessment.

Locations of Coarse Woody Habitat (Continuous or Scattered Condition)

Locations of shorelines where coarse woody habitat exists in a continuous or scattered condition were identified to contribute to the priority shores assessment.

Bottom Structure (Fine Gravel, Coarse Gravel, Rubble/Cobble, and Small Boulders)

Shorelines consisting of fine gravel, coarse gravel, rubble/cobble, or small boulders were identified to contribute to the priority shores assessment.

Riparian Wetlands

Shorelines where riparian wetlands are present (i.e. tamarack bog and scrub/shrub wetland) were identified to contribute to the priority shores assessment.

Natural Scenic Beauty

Areas inventoried that existed in a natural scenic condition (i.e. no visible structure present and no discernible removal of riparian vegetation) that existed in significant lengths (i.e. five longest shorelines with a natural scenic appearance) were identified to contribute to the priority shores assessment.

Presence of White Cedar and Tamarack

Any shoreline inhabited by white cedar and tamarack riparian trees was identified to contribute to the priority shores assessment. White cedar and tamarack are relatively rare and unique in the present day Northwoods. White tail deer browse heavily on young white cedar trees. Many wetlands including tamarack bogs have been drained and filled in Wisconsin since pre-settlement times.

Results

Additive overlay techniques were employed to determine the number of priority features present along stretches of Grindstone Lake's shorelines (See Table 6.2.1 and Map 6.2).

Table 6.2.1. Priority shorelines

Priority Shorelines Ranking	Miles of Shoreline	Percent of Shoreline
5 priority features present	0.21	1.7
4 priority features present	0.27	2.2
3 priority features present	0.65	5.3
2 priority features present	1.60	12.9
1 priority feature present	5.25	42.5
0 priority features present	4.36	35.4

Figure 6.2.1.

The western shores of Grindstone Lake, behind the islands, harbor the largest concentrations of various priority features. This photo shows several of them, including: riparian wetlands, aquatic macrophytes, tamarack, coarse woody habitat, and in a naturally scenic condition.

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Appendix A. Watershed and Lake Information System

General Information

Projection

All data are projected using the NAD 1983 HARN Wisconsin CRS Sawyer County (US Feet) projection.

Geographic Extent

The geographic extent for watershed maps and analyses includes the Grindstone Lake watershed.

The geographic extent for Grindstone Lake inventories include the island and mainland shorelines of Grindstone Lake based upon digitizng from Sawyer County six-inch orthophotography acquired in 2006 as interpretted by Jon Galloy from the UW-Stevens Point GIS Center.

Grindstone Lake Inventories

Data: GrindstoneLake.gdb (file geodatabase)

Description: File geodatabase containing feature classes and attribute tables of data collected for the Grindstone Lake inventories of 2010.

Feature Class: GL_Shoreline_6in

Description: Line feature class that identifies mainland and island shorelines of Grindstone Lake and their attributes.

Attributes:

Aesthetic	Natural aesthetic condition of shoreline.
• "Natural shoreline"	Shoreline exists in a natural condition, visibly without human modification
• "Slightly modified"	Shoreline exists in a condition in which structures are slightly visible and/or riparian vegetation is slightly modified.
• "Moderately modified"	Shoreline exists in a condition in which structures are moderately hidden and/or riparian vegetation is moderately modified.
• "Highly modified"	Shoreline exists in a condition in which structures are prominently visible and/or riparian vegetation is severely altered.
Field_Notes_Aesthetic	Field notes related to aesthetic inventory.
Mac_ID	Aquatic macrophyte inventory domain codes
Dom_Mac_Type	Dominant emergent aquatic macrophyte inventoried
Mac_Type1	Type of subordinate emergent aquatic macrophyte
Mac_Type2	Type of subordinate emergent aquatic macrophyte
Mac_Type3	Type of subordinate emergent aquatic macrophyte
Mac_Type4	Type of subordinate emergent aquatic macrophyte
Mac_Type5	Type of subordinate emergent aquatic macrophyte
Mac_Type6	Type of subordinate emergent aquatic macrophyte
Tree_Type_Id	Riparian tree inventory domain codes
Dom_Tree_Type1	Dominant riparian tree
Dom_Tree_Type2	Dominant riparian tree
Dom_Tree_Type3	Dominant riparian tree

Tree_SubType1	Type of subordinate riparian tree
Tree_SubType1	Type of subordinate riparian tree
Tree_SubType2	Type of subordinate riparian tree
Tree_SubType3	Type of subordinate riparian tree
Tree_SubType4	Type of subordinate riparian tree
Tree_Type_Fieldnotes	Field notes related to riparian tree inventory
Vet_Tree_Id	Veteran tree domain codes
Vet_Tree_Type	Veteran tree type
Vet_Tree_Fieldnotes	Field notes related to veteran tree inventory
Shoreline_Type	Island or mainland shoreline
Rip_Wtland_Id	Riparian wetland domain codes
Rip_Wtlnd_Type	Type of riparian wetland
Rip_Wtlnd_Type2	Type of riparian wetland
Btm_Str_Id	Bottom structure domain codes
Btm_Str_Type1	Type of bottom structure
• "detritus/muck"	partially decayed organic material
• "silt"	material derived from soil or rock, smaller than sand
• "sand"	finely divided rock or mineral particles
• "fine gravel"	marble sized rocks smaller than a ping pong ball
• "coarse gravel"	ping pong ball sized rocks smaller than a tennis ball
• "rubble/cobble"	larger than a tennis ball yet smaller than basketball
• "small boulder"	larger than a basketball yet smaller than beach ball
• "unobserved"	littoral zone not observed during bottom structure inventory
Btm_Str_Fieldnotes	Field notes related to bottom structure inventory
CWoody_Id	Coarse Woody Habitat domain codes
CWoody_Type	Frequency of coarse woody habitat present
• "Continuous"	CWH found continuously along shoreline
• "Scattered"	CWH found scattered periodically along shoreline
• "Isolated"	Individual tree falls/stumps found isolated from other CWH
• "Absent"	Coarse woody habitat absent from the shoreline
CWoody_FieldNotes	Field notes related to coarse woody habitat inventory
CH_Woody	Coarse woody habitat present in continuous or scattered condition - yes/no
CH_AqMac	Emergent aquatic macrophytes present - yes/no.
CH_Btm_Str	Bottom structure equal to fine gravel, coarse gravel, rubble/cobble or small boulder - yes/no
CH_RipWtlnd	Wetland type equal to scrub/shrub or tamarack bog - yes/no
CH_AES	Shoreline exists in a natural condition - yes/no
CH_Sum	Sum of critical habitat features present
Own_Type	Type of shoreline ownership
Own_Type_Id	Ownership domain codes
CH_AES_L	Aesthetic shores in continuous lengths greater than 395 feet
CH	Meets critical habitat criteria - yes/no
Priority_Shore	Additive sum of priority criteria
PR_VetTree	Veteran tree present/absent.
PR_ERA	Tamarack or white cedar present/absent
Miles	Length of shoreline in miles
Shape_Length	Length of shoreline in feet

Feature Class: Purple_Loosestrife

Description: Point feature class that identifies the locations of purple loosestrife plants on Grindstone Lake in 2010.

Attributes: Spatial attributes only

Feature Class: Vis_Structures

Description: Point feature class that identifies the locations of various structures visible from the littoral zone of Grindstone Lake, September 2010.

Attributes:

VS_ID	Visible structure domain codes
VS_Type	Type of structure visible
VS_Desc	Field notes related to the inventory of visible structures

Feature Class: Wildlife_Observations

Description: Point feature class that identifies the locations of various wildlife observed on or near Grindstone Lake during the summer of 2010.

Attributes:

WLO_ID	Wildlife domain codes
Wildlife_Type	Type of wildlife observed

Jurisdictional/Locational Boundaries

County Boundaries

Data: adjacent_counties.shp and sawyer_co.shp

Description: Polygon shapefiles delineating Sawyer County and counties adjacent to Sawyer County. Data is from the Wisconsin Department of Natural Resources, derived from 1:24,000-scale sources.

More Information: http://dnr.wi.gov/maps/gis/documents/county_boundaries.pdf

Public Land Survey System Section Boundaries

Data: PLSS_Sections.shp

Description: This data set is a polygon shapefile representing Public Land Survey System (PLSS) sections. The data are a subset of the Wisconsin DNR's 'Landnet' database, automated from 1:24,000-scale sources. Approximately 73% of section corner coordinates have been provided by Chequamegon National Forest, Nicolet National Forest, Northern States Power Company, United States Geological Survey, and Wisconsin Power and Light Company. WDNR has digitized standard PLSS corners from USGS 7.5' maps where no data were provided by cooperators. Data in a few areas were obtained from resurvey maps, plat maps or digital county data.

More Information: http://dnr.wi.gov/maps/gis/documents/plss_sections.pdf

Water Resources

Lakes, Ponds and Flowages

Data: hydrshai.shp (Version VI)

Description: The Wisconsin Department of Natural Resources (DNR) developed this statewide Hydrography geographic data layer from 1:24,000-scale sources. The 1:24K Hydrography database includes information about surface water features represented on the US Geological Survey's 1:24,000-scale topographic map series such as perennial and intermittent streams, lakes, and so on. A large portion of the DNR's Waterbody Identification Codes (WBICs) have been incorporated into the 24K Hydro layer, along with surface water names from the USGS Geographic Names Information System (GNIS) database. Wetlands delineations are NOT included in the 24K Hydro data layer.

Following the initial release of the 24K Hydrography database in October of 2000, a series of data updates and enhancements have culminated in Version 6 of the 24K Hydro layer, which was completed in June 2007. Version 6 includes data enhancements and corrections.

More Information: http://www.dnr.state.wi.us/maps/gis/datahydro.html.

Rivers, Streams and Shorelines

Data: hydarc.shp

Description: This shapefile includes all line features (arcs) in the 1:24,000-scale Hydrography data model (Version 6). The arcs are attributed to easily define themes based on cartographic or modeling needs. Arc attributes include feature names and Water Body ID Codes (WBICs).

The Wisconsin Department of Natural Resources (DNR) developed this statewide Hydrography geographic data layer from 1:24,000-scale sources. The 1:24K Hydrography database includes information about surface water features represented on the US Geological Survey's 1:24,000-scale topographic map series such as perennial and intermittent streams, lakes, and so on. A large portion of the DNR's Waterbody Identification Codes (WBICs) have been incorporated into the 24K Hydro layer, along with surface water names from the USGS Geographic Names Information System (GNIS) database. Wetlands delineations are NOT included in the 24K Hydro data layer.

Following the initial release of the 24K Hydrography database in October of 2000, a series of data updates and enhancements have culminated in Version 6 of the 24K Hydro layer, which was completed in June 2007. Version 6 includes data enhancements and corrections.

More Information: http://www.dnr.state.wi.us/maps/gis/datahydro.html

Outstanding and Exceptional Water Resources

Data: oew_2007.shp

Description: This data layer is a line shapefile delineating Outstanding and Exceptional Resource Waters (NR 102) a Natural Resources Designation codified in law. Data is from the Wisconsin Department of Natural Resources Water Division based on various sources. If the water body showed up at 100K the arc was copied from 100K Digital Line Graphs. If it didn't show up at that scale, it was digitized from 24K sources, or taken from air photo interpretation. Development of this data mainly occurred in 1994 – 1995 with edits in 1996 and 1999 after a final review. Additions

reflecting 2007 OEWR status appended to data by Douglas Miskowiak, Center for Land Use Education, with data from the Wisconsin Department of Natural Resources Water Division.

Wisconsin's Outstanding and Exceptional Resources Waters Program is designed to maintain the water quality in Wisconsin's cleanest waters. An outstanding resource water is defined as a lake or stream having excellent water quality, high recreational and aesthetic value, high quality fishing and is free from point source or non-point source pollution. An exceptional resource water is defined as a stream exhibiting the same high quality resource values as outstanding waters, but may be impacted by point source pollution or have the potential for future discharge from a small sewer community.

More Information: http://dnr.wi.gov/org/water/wm/wqs/orwerw/

Islands and Uplands

Data: hydrupld.shp

Description: This shapefile includes all upland and island polygons in the 1:24,000-scale Hydrography data model (Version 6). These polygons have descriptive attributes. Some islands may have names, but in most cases they are unnamed. No Water Body ID Codes (WBICs) exist for islands.

The Wisconsin Department of Natural Resources (DNR) developed this statewide Hydrography geographic data layer from 1:24,000-scale sources. The 1:24K Hydrography database includes information about surface water features represented on the US Geological Survey's 1:24,000-scale topographic map series such as perennial and intermittent streams, lakes, and so on. A large portion of the DNR's Waterbody Identification Codes (WBICs) have been incorporated into the 24K Hydro layer, along with surface water names from the USGS Geographic Names Information System (GNIS) database. Wetlands delineations are NOT included in the 24K Hydro data layer.

Following the initial release of the 24K Hydrography database in October of 2000, a series of data updates and enhancements have culminated in Version 6 of the 24K Hydro layer, which was completed in June 2007. Version 6 includes data enhancements and corrections.

More Information: http://www.dnr.state.wi.us/maps/gis/datahydro.html

Dam Locations

Data: dams_2006.shp

Description: This data layer is a point shapefile identifying the locations for large and small dams, including abandoned or removed dams. Data is from the Wisconsin Department of Natural Resources, Bureau of Watershed Management. The original geographic reference The original geographic reference for dams was Public Land Survey System (PLSS) township, range, section, and quarter-quarter section. The GIS data layer was originally created from a download of this locational data from the Dam Safety Program's database in 2002. Each point was then visited individually and moved to a more accurate location using the 1:24,000 Hydrography layer. Some dam points were not moved from the original PLSS location if there was no matching water feature on the 24,000 hydro layer.

More Information: Frank Dallam, Water Management Engineer frank.dallam@wisconsin.gov or (715) 635-4064

Watershed

Data: NewWatershed.shp

Description: This data layer is a polygon shapefile delineating the Grindstone Lake Watershed. Watershed delineations generally indicate areas that drain into a common river system or lake. This layer was created using the Arc Hydro tool, the 30 meter Digital Elevation Model GRID acquired from the WDNR and the surface waters polyline feature class from the WDNR 1:24,000 Hydrography VI database, 2010 as inputs. Both inputs were clipped to the Sawyer County extent and projected in the Sawyer County Coordinate System (US Feet).

More Information: Jon Galloy, GIS Technician (715) 346-4788

Land Ownership/Management

Data: parcels.shp and parcels40_8.shp

Description: This data layer is a polygon shapefile delineating property ownership. Data is from the Sawyer County Land Information Office. The parcels.shp delineates property ownership from 2005 while parcels40_8.shp delineates property ownership for 2008. These shapefiles were merged using the ArcGIS 9.3 Merge tool to create a single shapefile that covered the area of interest. Data from Sawyer County is missing significant ownership attributes and some spatial features (i.e. parcels).

More Information: Sawyer County Land Information Office.

Natural Resources

Original Vegetation

Data: orig_veg.shp

Description: This data layer is a polygon shapefile derived from 1:500,000-scale map showing the original, pre-settlement vegetation cover in Wisconsin. The original vegetation cover data was digitized from a 1976 map created from land survey notes written in the mid – 1800s when Wisconsin was first surveyed. Line work representing lakes and other hydrographical areas in other data sets were subsequently merged with the original vegetation cover data set to more closely match the source map. This digital version of the original vegetation cover map can be used to identify regional changes in land cover since the time when the state was first surveyed. This data is not intended for landscape-scale analysis.

Elevation

Data: dem30m

Description: This data layer is an ESRI GRID delineating elevation. Data is from the Wisconsin Department of Natural Resources 30 meter Digital Elevation Model. The DEMs were obtained from USGS as 1:24,000 quad or quarter-quad tiles.

More Information: http://dnr.wi.gov/maps/gis/documents/digital_elevation_model.pdf or contact John Laedlein, John.Laedlein@dnr.state.wi.us

Steep Slopes

Data: slopes12_5_project.shp and slopes12_5_GLWtshd_Calculate3.shp

Description: These data layers are polygon shapefiles delineating areas of steep topography. Data was derived using the 30 meter digital elevation model from the WDNR and the ArcGIS 9.3 spatial analyst, surface analyst, slope tool. The result was a ESRI GRID data layer. The slope GRID was reclassified to only delineate slopes greater or equal to 12.5 percent. The reclassified GRID was then converted to a polygon shapefile. Wisconsin Transverse Mercator projection was used to conduct the analysis.

Resulting shapefiles were re-projected using Sawyer County coordinates. Mike Broton of the UW –Stevens Point GIS Center conducted the analysis, summer 2011.

Land Cover

Data: landcover (grid)

Description: This data layer is and ESRI GRID delineating land cover types using 30 meter square cells. Data is from the National Land Cover Database 2001 and produced through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) Consortium. The MRLC Consortium is a partnership of federal agencies (www.mrlc.gov), consisting of the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA), the U.S. Forest Service (USFS), the National Park Service (NPS), the U.S. Fish and Wildlife Service (FWS), the Bureau of Land Management (BLM) and the USDA Natural Resources Conservation Service (NRCS).

More Information: http://www.mrlc.gov/mrlc2k_nlcd.asp

Impervious

Data: impervious (grid)

Description: This data layer is an ESRI GRID delineating percent surface imperviousness (1 – 100%) using 30 meter square cells. The National Land Cover Database 2001 was produced through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) Consortium. The MRLC Consortium is a partnership of federal agencies (www.mrlc.gov), consisting of the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA), the U.S. Forest Service (USFS), the National Park Service (NPS), the U.S. Fish and Wildlife Service (FWS), the Bureau of Land Management (BLM) and the USDA Natural Resources Conservation Service (NRCS).

More Information: http://www.mrlc.gov/mrlc2k_nlcd.asp

Tree Cover

Data: treecover (grid)

Description: This data layer is an ESRI GRID delineating percent tree cover (1 – 100%) using 30 meter square meter cells. The National Land Cover Database 2001 was produced through a

cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) Consortium. The MRLC Consortium is a partnership of federal agencies (www.mrlc.gov), consisting of the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA), the U.S. Forest Service (USFS), the National Park Service (NPS), the U.S. Fish and Wildlife Service (FWS), the Bureau of Land Management (BLM) and the USDA Natural Resources Conservation Service (NRCS).

More Information: http://www.mrlc.gov/mrlc2k_nlcd.asp

Glacial Deposits

Data: glacial_deposit.tiff (image)

Description: This data layer is a tiff image that delineates the boundaries of glacial deposits. Hard copy source is the Glacial Deposits of Wisconsin: Sand and Gravel Resource Potential. Land Resources Analysis Program. Wisconsin Geological and Natural History Survey, University of Wisconsin – Extension, and State Planning Office, Department of Administration, 1976. Compiled from various sources.

Transportation

Roads and Highways

Data: wislr_roads03.shp and wislr_hwy03.shp

Description: These data layers are line shapefiles delineating roads and highways. Data are from the Wisconsin Local Roads (WISLR) database received from the Wisconsin Department of Transportation (WisDot). The WISLR data represent roads in Wisconsin completed through the end of 2005. Some of the WISLR data has not been finalized and should be considered preliminary or pre-production.

More Information: http://dnr.wi.gov/maps/gis/documents/WisDOT_local_roads.pdf

Reference

Orthophotography

Data: county'08_NAIP.sid

Description: These data layers are compressed images in .sid format showing ortho-rectified images of the landscape with leaf on condition. Data are from the United States Department of Agriculture National Agriculture Imagery Program, 2008. The intended display scale is 1:12,000. Ground resolution is 1-meter pixels. Accuracy of data is + or – 15 meters. Rectification source is USGS National Elevation Dataset.

More Information: http://www.fsa.usda.gov/FSA/apfoapp?area=home&subject=prog&topic=nai